

Proceedings of the International Conference on Innovation - driven Knowledge Economies and Transformation in the Global South



Vol V - Entrepreneurship, employability and gender dimension in innovation and development

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Volume V Entrepreneurship, Employability and Gender Dimension in Innovation and Development

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Preface / A word of welcome and thanks

It is a matter of great pride that the 20th-anniversary Globelics International Conference is being held in Thiruvananthapuram. This conference deliberates on an issue of much contemporary relevance – Innovation-driven Knowledge Economies and Transformation in the Global South, which is at the centre stage of development strategy both at the national and that of the government of Kerala. In 2006, when inclusive development was a major issue of global concern, Globelics conference was held in Trivandrum and deliberated on Innovation Systems for International Competitiveness and Shared Prosperity.

This Conference intends to bring together scholars across disciplines from over 50 countries to pool together experiences and expertise to reflect on varied issues involved in the process of transforming developing economies into sustainable, resilient, and inclusive innovation-driven knowledge economies.

In the conference, to be inaugurated by Shri Pinarayi Vijayan, the Hon'ble Chief Minister of Kerala, scholars of eminence will join as keynote speakers and panelists in plenary sessions and special sessions. The conference, organized in nine parallel tracks, will also have book presentations, excursions, and cultural events. As part of the conference, about 20 leading scholars from Globelics will visit different universities and colleges in Kerala to deliver lectures and interact with faculty and students, which is facilitated by Kerala Higher Education Council and Kerala Economic Association.

We welcome with great appreciation the Honourable Chief Minister Shri Pinarayi Vijayan and all the dignitaries who joined us for the inaugural address and eminent scholars delivering keynotes and addressing in different plenary sessions, special sessions, and parallel sessions. While the invisible hand of our honourable Chief Minister is there in all the important initiatives of GIFT, this program has been ably guided and steered by our Chairperson Shri K N Balagopal, Hon'ble Finance Minister of Kerala.

This important event is the outcome of the collective effort of all those involved, especially the Co-organising institutions: RIS, New Delhi, who inter alia managed the political clearance from the Ministry of External Affairs, IIM Bangalore, K DISC and the Digital University of Kerala. Our partnering institutions, ICSSR, Kerala State Higher Education Council, Centre for Development Studies, Kerala Economic Association, and the Centre for Latin American Studies also have been helpful in organising this conference.

With much appreciation for all of you for being with us, we welcome you

K J Joseph

For the local organising Committee

About the 20th Anniversary Conference

The central theme of the 20th Anniversary Globelics International conference is Innovation-driven Knowledge Economies and Transformation in the Global South.

This conference intends to bring together scholars across disciplines from over 50 countries to pool together experiences and expertise to reflect on varied issues involved in the process of transforming developing economies into sustainable, resilient, and inclusive innovation-driven knowledge economies. Episodes of development in economic history highlight the successful experience of countries that have managed to harness Learning, Innovation and Competence-building Systems at the global, national, subnational and sectoral levels in order to transform their social and economic structures for achieving prosperity. In the current times, the constellation of innovations driven by rapid advances in digital technologies has given rise to a new technological revolution, commonly referred to as the fourth industrial revolution, or Industry 4.0, with profound impacts on all sectors of the economies and sections of societies. New and persisting developmental challenges have driven a renewed interest in different types of innovations that highlight their impact on society and the natural environment, such as inclusive innovation, responsible innovation, transformative innovation, grassroots innovation and Jugaad. At the core of all these approaches is how knowledge, both science-based and experience-based, is harnessed for addressing development challenges, the basic premise being “the knowledge divide is at the root of the development divide”

At the current juncture, wherein globalization is at the crossroads, the economies across the world, ravaged by the once-in-a-century pandemic and external shocks, consider strengthening the innovation system as a strategic approach towards building resilience. Evidently, there is an across-the-board drive among developing countries to transform their economies into innovation-driven knowledge economies. Such a transformation is often viewed as capable of building resilience by addressing many of the downsides

of globalization-induced high growth, like excessive exploitation of exhaustible resources and accentuated divides within and between countries. Such initiatives in India are manifested, among others, in Atal Innovation Mission (AIM), Digital India, Skill India, and Make in India and other concerted efforts to transform India into an innovation-driven knowledge economy. It is also in sync with the national agenda of harnessing Science, Technology, and Innovation (STI) to achieve sustainable development. The choice of the location of the conference is inspired by Kerala's strategy towards transforming the state into a knowledge economy, as explicitly stated in the budgets starting with 2020-2021 and the subsequent concerted efforts that followed. It is in this background that Globelics revisits India for the 20th Globelics International conference with the chosen central theme: 'Innovation-Driven Knowledge-Economies and Transformation in the Global South'.

The 20th Anniversary Globelics is also an occasion to celebrate the journey of Globelics from Brazil 2003 to India 2023 and its varied achievements. At the same time, it is also a forum for critically reflecting on our perspective and the approaches *inter alia* in terms of its achievements and limits. This is especially important at the current juncture wherein there is growing disenchantment with the development experience under globalisation on the one hand and the need on the other hand, for reimagining innovation systems in the COVID and Post COVID world towards building the much needed resilience in the South.

Globelics-India 2023 coincides with India's Presidency of G-20 that *inter alia* aims at influencing the development dynamics of Global South and it is an appropriate time for translating the insights of the conference with respect to strengthening Learning, Innovation and Competence-building Systems (LICS) into policy action. For the past two decades, we have observed an increasing influence of Global South in shaping the paradigms and trajectories of the global development agenda—sustainability, climate change, pandemic, and energy security issues—with India playing a key role; all being closely linked to the research domains of the Globelics.

World-leading scholars are set to give this year's keynote address on innovation and development. It is planned that the conference will be inaugurated by the Chief Minister of Kerala and there will be a special keynote on the conference theme along with a Globelics Lecture and Freeman Lecture. The conference will combine plenary sessions, presentations of research papers in parallel tracks, thematic panel sessions or special sessions, poster presentations, book presentation sessions, excursions, and cultural events.

Conference Tracks

While submissions on the central theme of the conference have been especially encouraged, submissions on all the issues conventionally deliberated in the Globelics international conferences are also included. Submissions have been organized around the following themes:

1. Science, technology, innovation: Theory and policy for a knowledge economy
2. Transformative innovation, responsible innovation and mission-oriented innovation
3. Knowledge-driven development of national, regional, local and sectoral innovation systems, including Agricultural innovation systems and rural development
4. Measurement of the knowledge economy: Indicators, data requirements, different approaches and methodologies
5. Skilling for the knowledge economy: Industry-academy interaction, Intellectual property rights, open innovation and development
6. Industry 4.0 and development: Digitalization and automatization, productivity and employment implications, gig economy and quality of employment
7. Economic and social upgrading for sustainable Catch-up: trade policies, FDI, value chains and innovation networks in a knowledge-driven economy
8. Innovation for inclusive development: Indigenous knowledge, Grassroot innovations, Jugaad, informal economy, micro and small enterprises
9. Entrepreneurship, employability and gender dimension in innovation and development
10. The green economy and financing innovation: Low carbon innovations, environmental technologies and renewable energy

Volume V
Entrepreneurship, Employability and Gender
Dimension in Innovation and Development

Contents

	Page No
Preface	V
About the 20th Anniversary Conference	VII
Conference Tracks	IX
1 Business model innovation, technological innovation and firm performance in digital start-ups Xuelin Chen, Dongmei Zhou, Mengqin Yuan, Ruoyu Lu	1
2 Influence of Entrepreneurial Characteristics and Incubation Facilities on Venture Creation among Technology Business incubators in Nigeria Caleb Adelowo ,Seun Adedeji	23
3 Venture capital policy in Argentina: an analysis of the Fondo Fiduciario Para el Desarrollo de Capital Emprendedor (FONDCE) Manuel Gonzalo, Santiago Lopez	42
4 An institutional logic perspective on the relationship between bribery and product innovation: Empirical evidence from MENA region Isabel Maria Bodas Freitas, Fakher Omezzine	65
5 A firm-level study of gender diversity of the board composition of Indian firms on innovation and performance Rituparna Kaushik,Danilo Spinola	91
6 Which Businesses Enroll in Innovation Training? Evidence from a Field Experiment Cintia Kulzer Sacilotto, Pascale Crama, Sharique Hasan Reddi Kotha, Vish Krishnan, Chon Phung Lim	115
7 High-altitudes wines and wine tourism: resources and capability building from the periphery of La Rioja, Argentina Brenda Yanez, Marilyn D Alessandro, Manuel Gonzalo	153

8	Experiences of emerging black woman farmers in the digital agricultural era Nonceba Ntoyanto-Tyatyantsi, Zamandlovu Sizile Makola, Babalwa Ceki	171
9	Positioning firms along the capabilities ladder Alex Coad, Nanditha Mathew, Emanuele Pugliese	193
10	ICT Adoption and Gender Productivity Gap in Sub-Saharan Africa DJIJO TIAKOU Audrey Jennie	231
11	Advanced Digital Technologies, Defeminization, and Informalization in India's Manufacturing Sandeep Kumar Kujur	271
12	Gender and transformative innovation within the 4IR in Africa: Exploring key attributes and characteristics of women innovators operating in maker spaces in Nairobi and Johannesburg Pamela Adhiambo Mreji	292
13	Southern transnational migrants and entrepreneurship in the Global South: Exploring the role of Indian migrants in South-South pharmaceutical production networks Yves-Marie Rault-Chodankar, Dinar Kale	308
14	Product Market Concentration with Ownership Characteristics: An Exploration into the Consolidation Activities of Business Groups Beena Saraswathy	331
15	Gender in innovation: the case of renewable energy resources in a rural setting Ann Njoki Kingiri	355
16	Economic Reintegration of Return Migrants in Kerala Lessons from Collective Entrepreneurship models Vinoj Abraham, Dona Maria John	371

17	Factors affecting development of University-Based Innovation Ecosystems in developing Countries: A Case from Iran Maryam Nozari, Reza Asadifard	391
18	What makes a metro city fall in love with a female entrepreneur? An Indian perspective Sabyasachi Tripathi	419
19	Do Wage Levels affect Self-Employment? Evidence from Indian Pseudo-Panel Data Basit Abdullah, Jagannadha Pawan Tamvada	447

Business model innovation, technological innovation and firm performance in digital start-ups

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Abstract

Digital start-ups are no longer confined to technological innovation, and gaining competitive advantage through business model innovation has become an important pursuit. Based on data from 760 enterprises in the CPSED II database, the impact of the efficiency and novelty dimensions of business model innovation on firm performance and the moderating role of technological innovation are discussed. It is found that the efficiency dimension of business model innovation has a positive impact on firm performance, while the novelty dimension shows a negative impact on firm performance. Meanwhile, technological innovation weakens the impact of business model innovation on firm performance. The findings of the study have implications for the development of business model innovation in digital start-ups and the promotion of the digital economy.

Index Terms—digital start-ups, business model innovation, technological innovation, firm performance

Introduction

With the popularity and depth of the digital economy, digital start-ups based on digital technologies such as the Internet, IT, cloud computing, big data, the Internet of Things and artificial intelligence have emerged. Not only creating a large number of new fields but also driving the disruption and transformation of traditional industries, digital start-ups have become the backbone of the digital development and upgrading of the economy and society (Bharadwaj et al., 2013; Nambisan, 2017). Significantly since 2020, the global downturn has been affected by the continuous impact of the new crown epidemic. Still, digital start-ups have remained on the frontline, guaranteeing the rapid resumption of work and production worldwide. Digital start-ups have shown resilience not only because of their technological innovation, but also because they continue to seek breakthroughs in their business models (Amit and Han, 2017;

Frankenberger et al., 2013; Saebi et al., 2017). Digital start-ups have become one of the leading players in business model innovation, with the platform model (e.g., e-commerce platforms), models being free for users and paid by third parties (e.g., search engines), and shared models (e.g., bicycle sharing) being widely used. Some digital start-ups have achieved leapfrog growth and development through business model innovation. For example, Amazon has become the world's largest retail website in terms of users in less than 15 years through its platform-based business model innovation. However, behind the glamour, many digital start-ups still have fallen into the mire of business model innovation and eventually retired regretfully. For instance, ofo, a Chinese bike-sharing company, used user deposits due to profitability difficulties

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This move touched the bottom line of the industry operations, leading to its eventual failure. As business models involve multiple players in the entire value network, the failure of innovations will cause incalculable losses to the company, and even affect the entire industry (Amit and Zott, 2001; Frankenberger et al., 2013). Therefore, gaining a competitive advantage through appropriate business model innovation to achieve improved performance is an essential pursuit for digital start-ups.

Digital start-ups are one type of entrepreneurial entity created and developed by digital technology (Guiones and Brem, 2017; Huang et al., 2017). In other words, digital start-ups would cease to exist without developing digital technologies such as the Internet and IT. For example, Amazon would probably not be able to function without digital technologies (Sussan and Acs, 2017). Unlike other firms, digital start-ups have a more pronounced service-oriented, digital orientation in business model innovation (Frank et al., 2019; Ibarra et al., 2018). Firstly, influenced by the demand-driven servitization orientation, digital start-ups invest more capital in meeting users' needs for maximum product enjoyment and minimum product risk. Meanwhile, they are faced with user acquisition and retention challenges. Both high investment and user issues amplify the negative impact of business model innovation (Visnjic et al., 2016). Secondly, influenced by the technology-driven digital orientation, digital start-ups need to find new business models that maximize the market value of new digital technologies. Compared to other technologies, digital technologies are more disruptive and malleable, creating more possibilities for business model innovation (Amit and Han, 2017). As a result, the role of business model innovation as a source of competitive advantage has become more prominent in digital start-ups seeking a business model technology fit. For example, the success of Apple illustrates that well thought out business model innovations (e.g., system ecology) may be more effective than technological or product

leadership. Influenced by digital orientation, technological innovation can affect the process of business model innovations for value creation and capture. However, the existing research on the relationship between business model innovation and firm performance has focused on the positive impact of business model innovation, ignoring the risks inherent in business model innovation. In the discussion of the fit between business model innovation and technological innovation, the focus is on business model innovation as a means of technology commercialization, ignoring that it is also a factor in value creation. As a result, it is difficult to fully answer how business model innovation and technological innovation in digital start-ups affect firm performance. Based on this, the direct impact of business model innovation on firm performance and the moderating role of technological innovation in it is explored through an empirical analysis of data from 760 firms in the CPSED II database.

1. Literature Review

1.1 Business model innovation and firm performance

Every firm has its business model (George and Bock, 2011). Although the concept of business model in the existing research varies widely, most of them are close to or in line with the definition of Teece (2010), who believes that business model is the structure and mechanism for enterprises to create, deliver and obtain value (Teece, 2010). Amit and Zott (2012) further proposed that business models are composed of three dimensions: content (what), structure (how) and governance (who) (Amit and Zott, 2012). The content dimension represents what is offered to the target customer, that is, the value proposition that a firm provides to customers (Chesbrough and Rosenbloom, 2002; Morris et al., 2005). The structure dimension represents how the value proposition is built and realized, involving specific transactional processes and the arrangement of interactions (Hedman and Kalling, 2003; Johnson et al., 2008). And the governance dimension represents how benefits are distributed within the value network, as well as incentives and constraints (Johnson et al., 2008; Teece, 2010). Based on the above understanding of business models, a large number of scholars have argued that business model innovation refers to a new way of creating, delivering and capturing value by changing one or more dimensions of the business model, i.e., proposing new content, creating new structures, implementing new governance, etc. (Amit and Zott, 2001; Chesbrough, 2010; Demil and Lecocq, 2010; Mitchell and Coles, 2003; Teece, 2010).

Studies have generally recognized that business model innovation is an important cause of differences in firm performance (Anwar, 2018; Aspara et al., 2013; Cucculelli and Bettinelli, 2015; Kim and Min, 2015). Firstly, the prevailing view is that business model innovation can bring a competitive advantage to firms through a 'cost-value' effect structure to improve firm performance

(Adner and Kapoor, 2010; Amit and Zott, 2015). On the one hand, the efficiency dimension of business model innovation reduces transaction costs by breaking the industry cost structure, thereby making the enterprise more efficient than its competitors and gaining a competitive advantage (Amit and Zott, 2001). Take Ryanair, for example. It adopted a cost leadership strategy to reduce the cost of interaction with stakeholders such as customers through the Internet platform (Chesbrough, 2010). On the other hand, the novel dimension of business model innovation focuses on competition in raising prices or volumes to increase revenues, gaining competitive advantage by connecting new transactional players and designing new transaction mechanisms to break industry value rules (Amit and Zott, 2001; Gambardella and McGahan, 2010). For example, Dell's introduction of the direct sales model into the personal computer industry changed traditional transaction structures through multi-channel interaction with users and supplier lock-in, leading to increased sales (Christensen et al., 2001). It is worth noting that the efficiency and novelty of business model innovation are not mutually exclusive, and they may exist simultaneously in the innovation process of firms (Zott and Amit, 2008). Secondly, some scholars mentioned that business model innovation might hurt firm performance due to expanded organizations and higher capital investment, which may cause the company to face higher product and financial risks. A negative 'cost-value' effect happens, where higher costs create lower value (Gambardella and McGahan, 2010; Saebi et al., 2017). However, at this stage, the assumption of beneficial outcomes of business model innovation is the motivation for most studies. Even if there are adverse effects, the conclusions lack empirical research.

1.2 *Business model innovation in digital start-ups*

Unlike mature firms, start-ups are less constrained by path dependency and corporate inertia in designing their business models (Trimi and Berbegal-Mirabent, 2012). Thus, start-ups have become a naturally favorable venue for business model innovation. As mentioned by Ireland et al. (2001), entrepreneurs often try to find new business operation methods that disrupt the existing rules of competition in their industries, thereby promoting the development of new business models (Ireland et al., 2001). In the digital economy, different from other start-ups, digital start-ups show obvious servitization and digital orientation in business model innovation (Frank et al., 2019; Ibarra et al., 2018).

First, servitization is a demand-driven business model innovation (Visnjic et al., 2016). Demand for services arises because users avoid bearing the cost of a product but want to gain value from it (Enkel and Gassmann, 2010; Tukker, 2015). To meet this demand, the business model innovation of many digital start-ups has shifted from product oriented to service oriented. For instance, bike-sharing companies transform bicycle sales into bicycle rentals, where the user enjoys the product value to the maximum, and the company bears a large amount of the product cost. Even product centric digital start-ups cannot avoid

building product service systems (PSS) (Kowalkowski et al., 2017). While this service oriented business model innovation can maximize user attraction and quickly create a network effect, it also has potential pitfalls. Firstly, it is a very "costly" business model innovation, as product cost is further passed on to the business, often requiring a large capital investment by the digital start-up. Secondly, the key to value creation and acquisition is a large number of users, and if there are not enough users or they are lost, the survival of digital start-ups will be difficult (Elia et al., 2020). Thus, under the influence of servitization, the business model innovation of digital start-ups is more likely to create lower value at a higher cost. Under that circumstance, the negative outcome of the 'cost-value' effect structure is magnified. Therefore, it is necessary to pay further attention to the negative impact of business model innovation in digital start-ups on firm performance.

Secondly, digitalization is a technology-driven business model innovation (Rachinger et al., 2018). Two different views have been studied regarding the relationship between technological and business model innovation. Some scholars suggested that business model innovation is separate from technological innovation. Business model innovation could occur without technological innovation (Baden-Fuller and Morgan, 2010; Teece, 2010), i.e., the 'just in time' model pioneered in Japan in 1980. More scholars argued that business model innovation and technological innovation are complementary and that business model innovation act as the way and means to realize the market potential of technology (Calia et al., 2007; Chesbrough, 2010; Johnson et al., 2008; Zott et al., 2011). However, while acknowledging the importance of aligning business model innovation with technological innovation, this view focuses too much on the commercialization of technology. It believes that business model innovation is only a supplement to technological innovation rather than the power of innovation and value creation (Chesbrough and Rosenbloom, 2002; Gambardella and McGahan, 2010; Leten et al., 2007). In fact, with the advent of the digital economy, the development of digital technologies such as information technology and the Internet has started to break down the boundaries of enterprises and industries, offering unlimited possibilities for business model innovation. Business model innovation in digital start-ups is no longer just an appendage of technological innovation but a vital source of competitive advantage. Based on the digital orientation, the extent to which business model innovation can be transformed into firm performance is affected by digital technology. For example, Google's development of a two-sided dynamic search engine in 2003 was a technological advancement and a business model leap forward resulting from the invention of the advertiser payment model (Rochet and Tirole, 2006). Therefore, it is of great importance to further explore the role of technological innovation in digital start-ups on value creation and value capture in business model innovation.

In summary, digital start-ups have obvious service-oriented and digital orientation in business model innovation. Which affects the traditional "cost-value" effect structure, amplifies negative results, and makes technological innovation more critical in the relationship between business model innovation and firm performance. However, existing research pays limited attention to the adverse effects of business model innovation, and ignores the impact of technological innovation on realizing the value of business model innovation. Based on the insufficiency of existing research, this paper attempts to answer the following two questions: (1) How do the efficiency dimension and novelty dimension of business model innovation of digital start-ups affect firm performance in digital start-ups? (2) How does technological innovation moderate the relationship between business model innovation and firm performance?

2. Research Hypothesis

Different business models result in differences in firm performance, and many firms strive to foster a positive correlation between the two. Unlike them, in the case of digital entrepreneurship business model innovation, the service orientation amplifies the negative impact of the "cost-value" effect structure. At the same time, the digital orientation highlights the importance of technological innovation in turning business model innovation into a competitive advantage.

2.1 Business model innovation and firm performance in digital start-ups

Studies have examined the impact of business model innovation on firm performance through the positive "cost-value" effect. Which suggests that business model innovation can improve firm performance by reducing costs, optimizing processes, introducing new products, entering new markets, and enhancing corporate reputation and image (Saebi et al., 2017).

The efficiency dimension of business model innovation pursues cost minimization. Based on transaction cost theory, the uncertainty, complexity and information asymmetry in the transaction process are reduced in value creation. This is mainly through the reduction of search, information, negotiation, decision-making, and monitoring costs, thus reducing transaction risks (Balboni et al., 2019). Furthermore, In value capture, firms attract more potential customers, partners, and suppliers through efficiency improvements in the value chain, which leads to higher value through cost advantages (Zott and Amit, 2007). For example, Wal-Mart has gained a competitive advantage by managing its supply chain through electronic information systems. In the case of digital start-ups, in value creation, they are hyper-connected and better at connecting members of one group to members of another, e.g., uber, Google, and Amazon, whose core competencies stem from the ability to reduce transaction costs through matching (Elia et al., 2020). In value capture, the bargaining power of digital start-ups is not only derived from cost advantages,

but they also achieve connectivity to both sides of the market by building platforms. As platform owners, they have the natural power to control the core resources of the platform and thus have easier access to value (Cutolo and Kenney, 2021). For example, e-commerce firms profit by connecting buyers and sellers to reduce transaction costs and gain revenue by controlling essential resources such as marketplace interfaces and user data. Based on this, hypothesis 1 is proposed.

H1: The efficiency dimension of business model innovation in digital start-ups has a positive impact on firm performance. The novel dimension of business model innovation pursues value maximization. Based on Schumpeter's theory of innovation, new economic communication methods in value creation are used to make profits by connecting parties that have not been connected in the past, connecting transaction parties in new ways, or designing new transaction mechanisms (Zott and Amit, 2007). Moreover, in value capture, a "lock-in effect" is formed on stakeholders through a novel business model so that they cannot easily switch to competitors so as to enhance their bargaining power and obtain value (Zott and Amit, 2007). For example, Fuji Xerox was the first to launch a pay-per-use model due to the high cost of printers, thus successfully locking in users (Chesbrough, 2010). As for digital start-ups, in value creation, they pursue an ecological development model that connects to new players more quickly, and has more diverse ways of connectivity (Amit and Han, 2017; Sussan and Acs, 2017). For example, to meet the travel needs of passengers, online car rental platforms provide vehicle rental services to users by acquiring vehicles ahead. In contrast, Uber connects drivers to passengers, and drivers provide driving services. However, achieving value capture in the new transaction structure is the challenge faced by the vast majority of digital start-ups (Cenamor, 2021). The key to capturing value in the new business model for digital start-ups is to 'lock in' users and investors. In order to lock in users, upfront user subsidy and later domain expansion is one of the expected growth paths for digital start-ups, a process that requires a high level of investment and is often difficult for the average start-up to afford unless external funding is obtained. In order to lock in investors, user traffic and growth potential must be sustained, and if users are lost or growth is weak, a break in the funding chain will exacerbate the loss of users. As a result, digital start-ups using novel business model innovations often struggle to break through the value capture dilemma. For example, Ruixing Coffee's model of selling coffee over the Internet failed to sustainably 'lock in' users and investors, and eventually failed to make ends meet. Based on this, hypothesis 2 is proposed.

H2: The novel dimension of business model innovation in digital start-ups has a negative impact on firm performance.

2.2 *The moderating role of technological innovation*

New technologies need to be commercialized eventually through business models, and bringing the same technology to market in different commercialization approaches will yield different economic returns (Chesbrough, 2010; Teece, 2010; Trimi and Berbegal-Mirabent, 2012). Thus, the impact of business model innovation on firm performance may vary under different technological innovativeness.

Generally speaking, the more innovative the technology, the more stringent the requirements for business model innovation. On the one hand, more innovative technologies tend to be disruptive and can expand existing value networks, thus bringing more opportunities for value creation and capture to more players. In other words, when technology innovation is high, the adoption of novel business model innovation often leads to better business performance. On the other hand, high technological innovation often requires higher R&D investment, which contradicts the efficiency-oriented business model innovation that emphasizes cost reduction to enhance efficiency. The struggle between high R&D investment and cost reduction may hurt firm performance. In digital start-ups, when technological innovation is high, adopting efficiency-oriented business model innovation may inhibit the potential of high technology to create value, while breaking through the challenges of value capture in novelty business model innovation. In the efficiency dimension of business model innovation, the key to value creation in digital start-ups is to connect all players to reduce transaction costs. When the technology is highly innovative, companies have already invested much money in R&D, and the value created by "cost-cutting" alone cannot compensate for the initial investment. It is challenging to realize the market potential of the new technology and miss the development opportunity. In the novel dimension of business models, the core of value capture for digital start-ups lies in the continuous lock-in of users and investors. When technology innovation is high, digital start-ups can provide more innovative products or services and meet users' needs for personalized value-added services. This reduces users' sensitivity to price, enhances user stickiness, and achieves user lock-in. In the first stage, users are attracted for free of charge, and users are transformed into traffic to achieve profitability. Secondly, the company extends the value chain or provides value-added services to complete the continuous locking of investors, which eventually forms a virtuous cycle of value acquisition. Thus, technological innovation in digital start-ups negatively modifies the relationship between business model innovation and firm performance. Based on this, hypotheses 3 and 4 are proposed in this paper.

H3: In digital start-ups, technological innovativeness weakens the positive relationship between the efficiency dimension of business model innovation and firm performance.

H4: In digital entrepreneurial firms, technological innovation weakens the negative relationship between the novelty dimension of business model innovation and firm performance.

The research model in this paper is shown in Figure 1

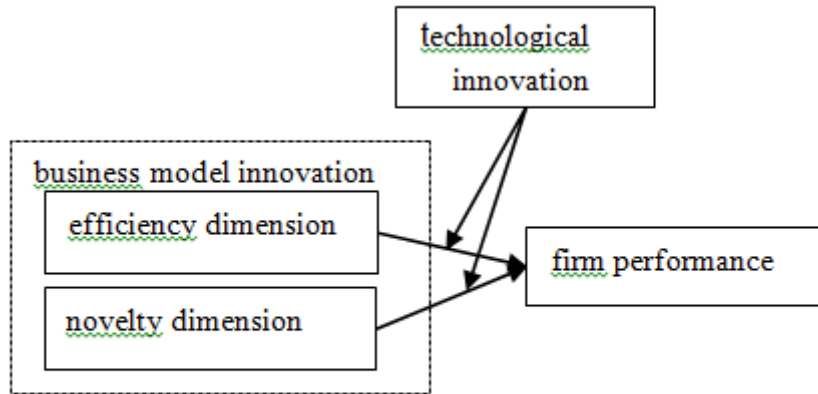


Figure 1. Research model

3. Research Methodology

3.1 Sample selection and data collection

The data in this paper were collected from the Chinese Panel Study of Entrepreneurial Development (CPSED II database) constructed by the Centre for Entrepreneurship Research of Nankai University. The database selected 969 NSE enterprises listed on the website of the National Small and Medium Enterprises Stock Transfer System (NSMTS) in the software and information technology (164) and internet-related industries (165) from January 1, 2013, to March 31, 2016, as the research objects. In the database, the enterprises' Public Transfer Instructions, Annual Reports, other important company announcements, and companies' website information were text-coded to construct a total of 1246 variables. Since this paper targets digital start-ups, entities in the software and information technology and Internet industries in the CPSED II database can meet the requirements of technology-based digital business. Thus the next step is to focus only further on start-ups.

The existing studies mainly use the year of establishment as a criterion for classifying entrepreneurial firms, but no consistent views have been formed. Some scholars believe that a firm established in less than six years is an entrepreneurial enterprise (Zahra et al., 2000), while others believe that the figure is eight years (McDougall et al., 1994). Also, some scholars extend it to 12 years (Chrisman et al., 1998; Kazanjian and Drazin, 1990). Since it is a long

process for a business model to grow from nothing and take shape stably, the innovation---business model innovation tends to last longer. Therefore, in this paper, we choose a larger threshold of years of start-ups and limit the establishment of digital start-ups to 12 years and below. The distribution of the sample characteristics is shown in Table 1, and 760 samples were obtained by excluding enterprises with missing year-end reports and those established for more than 12 years. Among the years of start-ups, most firms have been established for 4-12 years, and those established for 1-3 years accounted for only 9.6%. In the geographical distribution, enterprises are mainly concentrated in Beijing-Tianjin, Yangtze River Delta, Pearl River Delta and other regions. Only 16.5% of enterprises are in the northeast, central, and western regions. The distribution industry, mainly in software and information technology, accounts for 73.6% of enterprises.

Table 1 Distribution of Sample Characteristics

Samples	Category	Number of Samples	Percentage (%)
Established year	1-3	73	9.6
	4-6	252	33.2
	7-9	203	26.7
	10-12	232	30.5
Distribution area	Northeast China	19	2.5
	Beijing-Tianjin Wings Region	272	35.8
	Yangtze River Delta Region	224	29.5
	Pearl River Delta Region	120	15.8
	Western Region	56	7.4
	Central Region	69	9.1
Industry affiliation	Software and Information Technology Industry	559	73.6
	Internet-related industries	201	26.4
Total Number		760	100

3.2 *Measurement of variables*

(1) Dependent variable

Some studies use profitability (e.g., ROI, ROA) to measure firm performance. However, entrepreneurial firms often have yet to enter the large-scale profitability stage, and their earnings and book value are low. Profitability-based indicators are not suitable for high-growth, relatively young entrepreneurial firms (Zott and Amit, 2007), so this paper uses operating income per unit of assets to measure firm performance. Business performance is expressed by operating efficiency, which is defined as operating efficiency = revenue/total assets. The higher the operating income per unit of assets, the higher the firm's performance.

(2) Independent variables

This study refers to Zott and Amit's (2007) scale for measuring the novelty and efficiency dimensions of business model innovation, with 13 questions for each of the two dimensions (Zott and Amit, 2007). The scale has been widely used in business model innovation-related research and has high reliability and validity.

(3) Moderating Variables

Technological innovativeness refers to the degree of innovation of the technology embedded in the product or service. This paper draws on Samuelsson's (2004) scale to measure technological innovativeness (Samuelsson, 2004). It contains three questions: the uniqueness of the firm's products and services in the market, its prioritization of most of its capital in R&D activities, and its motivation to apply for patent, copyright or property rights protection. The scale has been widely used to measure innovation, and the reliability and validity of the test are high.

(4) Control variables

Firstly, to control the influence of previous years' development level, the previous year's total assets and business income are taken as control variables in this paper. Secondly, the number of years of start-up development and size are used as control variables, where the size is measured by taking the logarithm of the number of its employees. Finally, the intellectual property rights of the enterprises are controlled, and the number of patents, copyrights and trademarks are used for testing.

4. Analysis of Results

4.1 *Descriptive statistical analysis and correlation analysis*

The means, standard deviations, and correlation coefficients of the main research variables are shown in Table 2. Where the efficiency dimension is significantly positively correlated with firm performance. The novelty dimension is significantly negatively correlated with firm performance. Technological innovation is significantly negatively correlated with firm performance. With correlation coefficients of 0.05 ($p < 0.1$), -0.05 ($p < 0.1$), and -0.105 ($p < 0.01$), respectively. The above discussion shows that the research hypothesis is initially valid and needs to be further verified by regression analysis.

4.2 *Multiple regression analysis*

Table 3 shows the results of the linear regression analysis of the efficiency dimension and novelty dimension of the business model innovation of digital start-ups and the impact of other variables on firm performance. Model 1 is a regression model of the effect of control variables on the dependent variable. Model 2 is the main effect model of the effects of control, independent, and moderating variables on the dependent variable. Models 3, 4, and 5 are the moderating effect models after adding the interaction terms. As shown in Model 2 in Table 5, the efficiency dimension of business model innovation of digital entrepreneurship firms has a significant positive predictive effect on firm performance ($\beta = 0.082$, $P < 0.05$). Nevertheless, the novelty dimension of business model innovation has a significant negative predictive effect on firm performance ($\beta = -0.073$, $P < 0.10$). Thus, hypotheses 1 and 2 were tested. In model 3, technological innovativeness weakens the positive relationship between the efficiency dimension of business model innovation and firm performance ($\beta = -0.088$, $P < 0.05$). In model 4, technological innovation weakened the negative relationship between the novelty dimension of business model innovation and firm performance ($\beta = 0.074$, $p < 0.05$). In model 5, technological innovation weakens the positive relationship between the efficiency dimension of business model innovation and firm performance ($\beta = -0.129$, $p < 0.01$) and the negative relationship between the novelty dimension of business model innovation and firm performance ($\beta = 0.117$, $p < 0.01$). Therefore, hypotheses 3 and 4 were verified.

Table 2 Variable Means, Standard Deviations and Correlation Coefficients

Category	1	2	3	4	5	6	7	8	9	10	11
1. firm performance	1										
2. Total assets last year	0.087***	1									
3. Operating income last year	0.272***	0.825***	1								
4. Established Year	-0.044	0.252***	0.255***	1							
5. Enterprise Scale	0.127***	0.576***	0.578***	0.193***	1						
6. Copyright	-0.054*	0.400***	0.326***	0.248***	0.395***	1					
7. Patents	-0.047*	0.179***	0.138***	0.065**	0.011	0.087***	1				
8. Logo	-0.030	0.277***	0.229***	0.057*	0.277***	0.267***	0.043	1			
9. Efficiency Dimension	0.050*	0.056*	0.026	-0.156***	0.100***	-0.001	-0.069**	0.238***	1		
10. Novelty Dimension	-0.050*	0.126***	0.082**	-0.013	0.105***	0.110***	0.036	0.150***	0.429***	1	
11. Technological Innovation	-0.105***	0.161***	0.053*	0.128***	0.146***	0.382***	0.159***	0.202***	0.037*	0.266***	1
Mean Value	1.01	3.49	3.41	7.37	1.91	17.92	3.69	6.1	0.43	0.37	3.03
Standard Deviation	1.22	0.49	0.57	2.88	0.42	17.5	15.84	13.99	0.18	0.12	0.74

Note: * is $P < 0.10$, ** is $P < 0.05$, *** is $P < 0.01$, one-tailed test.

Table 3 Linear Regression Models

	Dependent variable: firm performance				
	Model 1	Model 2	Model 3	Model 4	Model 5
Total assets last year	-0.374***	-0.369***	-0.371***	-0.374***	-0.379***
Operating income last year	0.621***	0.619***	0.609***	0.629***	0.620***
Established Year	-0.090**	-0.079**	-0.083**	-0.078**	-0.082**
Enterprise Scale	0.049	0.045	0.046	0.044	0.045
Copyright	-0.086**	-0.073*	-0.069*	-0.074*	-0.069*
Patents	-0.051	-0.043	-0.047	-0.044	-0.052
Logo	-0.053	-0.063*	-0.045	-0.066*	-0.043
Efficiency Dimension		0.082**	0.060	0.076*	0.041
Novelty Dimension		-0.073*	-0.059	-0.068*	-0.045
Technological Innovation		-0.012	-0.009	-0.002	0.007
Efficiency Dimension*Technological Innovation			-0.088**		-0.129***
Novelty Dimension*Technological Innovation				0.074**	0.117***
R2	0.155	0.162	0.169	0.167	0.181
Adjusted R2	0.147	0.151	0.157	0.155	0.168
F	19.717***	14.749***	13.834***	13.663***	13.730***

Note: Standardised regression coefficients are presented in the table.* indicates P<0.10; ** indicates P<0.05; *** indicates P<0.0

In order to show more visually the moderating effect of technological innovativeness of digital start-ups on the relationship between business model innovation and firm performance, we draw the moderating effect diagram in Figure 2. This figure is a slope diagram showing the interaction between the efficiency dimension of business model innovation, the novelty dimension and technological innovativeness. In Figure 2a, technological innovativeness moderates the positive effect between the efficiency dimension of business model innovation and firm performance. Specifically, the positive effect of the efficiency dimension on firm performance is stronger for digital start-ups with low technological innovativeness. The positive effect of the efficiency dimension on firm performance is weaker or even negative for digital start-ups with high technological innovation. As shown in Figure 2b, technological innovation inhibits the negative relationship between the novelty dimension of business innovation and firm performance. Specifically, the negative effect of the business model novelty dimension on firm performance is stronger for digital start-ups with low technological innovation. For digital start-ups with

high technological innovation, the negative effect of the business model novelty dimension on firm performance is weaker and even shows a positive relationship

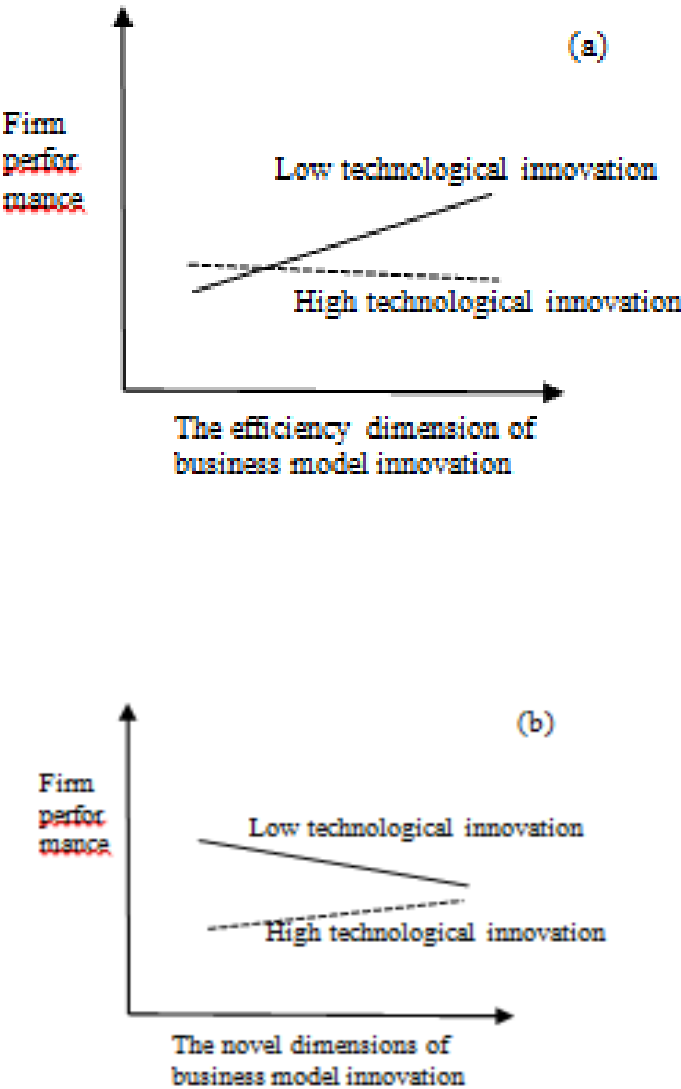


Figure 2 Slope diagram of the technical innovation interaction term

5 Conclusions and Discussion

5.1 Research findings and contributions

In this paper, the impact of the novel and efficiency dimensions of business model innovation on firm performance is explored, and the moderating role of

technological innovation is examined for digital start-ups. It is found that business model innovation is an important cause of performance differences among digital start-ups. The efficiency dimension positively impacts firm performance, while the novelty dimension hurts firm performance due to the value capture dilemma. However, in a high-technology innovation context, digital start-ups that adopt efficient business model innovation inhibit the potential of new technology value creation, which is detrimental to firm performance. On the contrary, if novel business model innovation is adopted, the firm performance is expected to improve due to the ability to break the value capture dilemma.

(1) Theoretical contributions

First, this paper unfolds the "black box" of adverse outcomes in the "cost-value" effect structure of business model innovation in digital start-ups. Studies have focused more on the positive impact of business model innovation on firm performance, ignoring the capital investment, product risk, and financial risk associated with business model innovation. However, the service orientation of digital start-ups amplifies the risks mentioned above in business model innovation. This paper finds that these innovation risks are mainly reflected in the novel dimension of business model innovation. The dilemma of continuously locking in users and investors leads to digital start-ups that may struggle to achieve value capture. Second, this paper explores the issue of fitting business model innovation with technological innovation based on the emphasis on the value of business model innovation itself in digital start-ups. It has been argued that business model innovation is only a means to achieve technology commercialization, ignoring that business model innovation is also a value-creating factor. In digital start-ups, digital orientation highlights the role of technological innovation in translating business model innovation into firm performance. This paper finds that when technological innovation reaches a certain level in digital start-ups, it will completely transform the impact of the novelty and efficiency dimensions of business model innovation on firm performance. That is, high technological innovation helps to continuously target users and investors in the novelty dimension and achieve value capture through a virtuous cycle. Conversely, suppose efficiency business model innovation is adopted. In that case, the possibility of value creation is limited by the inability to fill the upfront investment, which hinders the development of new technological potential. Finally, the dual importance of value creation and value capture in business model innovation for digital start-ups is emphasized from a value process perspective. The discussion on business model innovation has overemphasized value creation and neglected the issue of how to achieve it. Digital start-ups face the challenge of both value creation and value capture. This paper finds that in novel business model innovation, digital start-ups' key is achieving value capture. In efficiency-dimension business model innovation,

the key is to achieve value creation. Moreover, different technological innovation contexts affect the degree of operability of both.

(2) Practical Insights

First, it inspires digital start-ups to pay attention to the design of the profit model in business model innovation. A large number of digital start-ups try to break the industry structure through new business models. By investing large amounts of money in attracting users or participants, they try to achieve "winner-takes-all" through the network effect, which leads to over-emphasis on "traffic" at the expense of "profit." While digital start-ups need to create value through business model innovation, failure to capture value will fail to improve performance and may even have a negative effect. Therefore, how to provide value-added services, turn "traffic" into "money," and design a sustainable profit model is the foundation for long-term development. Secondly, it is essential to note that digital technology is only a tool and means of business model innovation and may not be a direct source of competitive advantage. In order to obtain the dividend of digital economy development, some digital start-ups create and promote new concepts based on digital technology but ignore the essence of business operation and development. Digital technology is only a tool for business model innovation, and the key to business growth is to reduce costs and increase value in business model innovation. Therefore, the development of digital start-ups should grasp the essence of the enterprise rather than floating on the "digital" surface. Finally, the need for business model innovation in digital start-ups to fit with technological innovation to facilitate performance improvement was confirmed. Digital technologies in digital start-ups help their business model innovation to some extent. However, in this innovation process, the market potential of the new technology needs to be exploited to the maximum extent possible, and stakeholders such as users and investors need to be consistently targeted to achieve performance improvement.

5.2 *Research shortcomings and outlook*

The main shortcomings of this paper are as follows: First, this paper classifies the business model innovation of digital start-ups into efficiency and novelty dimensions, which are supported by more mature scales but may need to be more comprehensive. For example, the "complementarity dimension," which emphasizes matching resources and goods, and the "lock-in dimension," which emphasizes retention of stakeholders (Amit and Zott, 2001), are not taken into account in it. There are also significant differences in the impact paths of the efficiency, novelty, complementarity, and lock-in dimensions of business model innovation on firm performance, which need further exploration in future studies. Second, the matching problem between technological and business model innovation is more complex. However, this paper only explores the effect of the degree of technological innovation on the relationship between business model innovation and firm performance. Future

research can further investigate the categories of technological innovation. For example, how incremental vs. breakthrough technological innovation, exploratory vs. exploitative technological innovation, etc., match business model innovation. Finally, the complete value process of an enterprise includes value creation, value delivery, and value acquisition. Unfortunately, this paper only focuses on two key aspects of value creation and value acquisition and needs to develop the content of value delivery. Future research can further discuss the different manifestations of business model innovation in value delivery and the impact on firm performance in digital entrepreneurial firms.

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Influence of Entrepreneurial Characteristics and Incubation Facilities on Venture Creation among Technology Business incubators in Nigeria

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Abstract

Technology business incubation contributes greatly to nurturing and growing young and innovative enterprises in both developed and developing countries. It should be noted that personal entrepreneurial characteristics (PECs) of the tenants also matter. Therefore, paying attention to tenants' PECs which moderate the influence of incubation facilities on venture creation is important for policy and practice. In this article, we explore the influence of tenants' PECs and the contribution of incubator facilities to successful venture creation among selected incubators. Data were collected from fifty-eight (58) tenants across six TBIs in South-West Nigeria through a validated questionnaire. The results show that tenants' PECs are generally high, except for demand for quality and information seeking that are considered as low. Further analysis revealed that PECs significantly moderate the influence of incubation facilities on venture creation. The implications of these findings are drawn and appropriate policy suggestions to improve incubators' performance are formulated.

Keywords: Incubators, Start-ups, SMEs, innovation, personal entrepreneurial characteristics, Nigeria

1. Introduction

One of the major problems in Africa, and Nigeria in particular is unemployment which is an offshoot of weak entrepreneurship and innovation ecosystems (Siyanbola, 2019; Adelowo, 2020; Akinwale et al., 2022). Recent data from the National Bureau of Statistics showed that the core infrastructure to bolster the development of small businesses in the country is weak (SMEDAN-NBS, 2019). For instance, major infrastructures such as electricity, road, good transport facilities, and other business facilities such as grants or loans, business space, and robust policies represent important areas where businesses empirically confirmed that they need assistance (SMEDAN-NBS, 2019). The challenges of unemployment and business mortality were further exacerbated by the economic impacts of the Covid-19 pandemic. Development planners, economists, researchers, and policymakers now seek alternative and lasting solutions to this perennial problem of unemployment and how to build back better after the pandemic. One clear and consistent strategy that has been identified is the need to create a dynamic and sustainable private sector system where businesses can thrive and create wealth for the masses (ERGP, 2017; ESP, 2020; NDP, 2021). For this to happen, there is a need to overhaul existing institutions, programmes, policies, and infrastructures set up to improve entrepreneurship ecosystems in the country, identify key gaps and constraints to their effectiveness and provide appropriate interventions. A typical example is the establishment of technology business incubation programme which began in 1993 by the Federal Government of Nigeria to promote start-ups, research commercialisation, access to innovation funds and grants, and improve innovation and entrepreneurship ecosystems in the country. These TBIs have been run in the country for nearly three decades now.

The proponents of technology business incubation programme (TBI) have argued that incubators are strategic economic instruments to nurture and grow small and medium-scale enterprises in both developed and developing countries (Lalkaka, 2002, 2009; Scillitoe and Chakrabarti 2010; Adelowo et al., 2012; Marlow and McAdam 2015; Mian et al., 2016; Adelowo, 2020; Hausberg and Korreck, 2020). TBIs provide a wide array of business support tools and services to assist budding entrepreneurs to develop and flourish. TBI promotes the formation of new firms, prevents start-up failures, promotes creativity, and supports a vibrant entrepreneurship sector (Bruneel et al., 2012; Jamil et al., 2016; Mansano and Pereira, 2016; Wang et al., 2020). Majorly, an incubation programme provides a conducive seedbed to tenant enterprises where they can adequately access business advice and training, marketing prospect, business management, and other related information aimed at enhancing successful ventures (Moraru and Rusei, 2012; Elmansor and Arthur, 2015). Pauwels et al.

(2016) classified the services supplied by incubators into five (5) main categories, including physical infrastructures, office support services, access to financial resources, process support, and network access. This classification is in alignment with the findings of Bruneel et al. (2012), who found infrastructure, business support, and network connectivity to be the value proposition of business incubators across all generations. It should be noted that there is no one-size-fits-all TBI, as most basic technical and managerial training, as well as business spaces are provided to support tenants' activities. This is because some tenants of the TBIs may require a specific kind or type of training, technology, and logistics for them to function efficiently. In such cases, some tenants do training buy-outs to support themselves (Adelowo, 2020). There is also an incubator variant called 'incubators without walls' or 'virtual incubators' which occurs when incubation services are extended to tenants in their various business locations. This is usually done where there is not enough space to accommodate tenants with viable business proposals, who meet the admission criteria. The major objectives are to equip tenant firms with adequate business capacity that can guarantee their survival during the incubation periods, usually between three to five years, and beyond (Adelowo et al., 2020). The question now is to what extent has the incubation facilities in Nigeria improved venture creation among the tenants?

In addition to available incubation facilities, which is a critical component of TBIs in developing countries, the personal entrepreneurial characteristics (PECs) of the tenants also matter to successful business development. PECs represent certain qualities that underpin the dispositional tendency of an entrepreneur to undertake business actions that lead to successful ventures (Adelowo et al., 2021). Although, at the proposal scrutiny and pre-incubation stages, some of the tenants' PECs might have been evaluated. However, these qualities have to be strengthened as tenants' businesses progress in the incubator. Several studies have reviewed PECs among small and mediums scale enterprises and found that innovativeness, risk-taking and orientation towards achievements are dominant forces (Schumpeter, 1934; Reyes et al., 2018; Adelowo et al., 2021). The core PECs indicators developed by Management System International that have become useful measures to monitor entrepreneurs' behaviours include opportunity seeking, risk-taking, information seeking, systematic planning and monitoring, persuasion and networking, commitment, persistence, demand for efficiency and quality, goal setting and self-confidence (Reyes et al., 2018). In an empirical study where these indicators were tested among potential entrepreneurs, the results showed that goal setting and opportunity recognition have greater likelihood of influencing entrepreneurial propensity (Adelowo et al., 2021). A recent study by Leckelt et al. (2022) also assessed personality traits of self-made and inherited millionaires around the globe and identified risk tolerance, emotional stability, openness, extraversion and consciousness as important traits. These studies point to the need to pay attention to certain traits and behaviours that

exemplify entrepreneurs and millionaires. Identifying the dominant PECs among entrepreneurs helps incubator managers, mentors and development planners to identify key areas to target when formulating policy for small business development. The second question raised in this article is to unpack specific PECs that moderate the influence of incubation facilities on venture creation among the tenants. For instance, as parts of the incubation programme, training and business advice offered to tenants have to address skills and knowledge gaps that are of direct relevance to the needs of tenants. The co-location advantage offered by the incubators also provides tenants with great opportunities to interact, share experiences and learn together for the betterment of their firms.

This article therefore explores the influence of incubation facilities and the personal entrepreneurial characteristics on venture creation among the tenants. This is with a view to identifying further plausible interventions or modifications necessary to improve venture creation and sustainability of tenants' firms.

2. Methodology

This section provides details of the study design, population and sample, data collection instruments and variables, and measurement, and concludes with the descriptions of data analytical tools.

2.1 Study Design

The study utilises a cross-sectional survey dataset collected from the tenants of six technology business incubators selected from six locations in South-West Nigeria. The six incubators are located Agege, Lagos State, Ado-Ekiti in Ekiti State, Abeokuta in Ogun State, Akure in Ondo state, Ile-Ife in Osun State, and Ibadan in Oyo state Nigeria. As presented in Table 1, out of the six main incubators that are present in the South-West, some of them have extensions. The extensions are created to provide opportunities for entrepreneurs in remote areas to benefit from the programme offered by the incubators in the areas. Therefore, the incubator in Abeokuta has two extensions, which were covered as parts of the incubator in Ogun state. Similarly, the incubator in Oyo state also has one extension in Ogbomoso, and was also covered as part of Ibadan incubation Centre (NBTI, 2022).

Having identified the incubators that are covered in this study, the next step toward data collection was to identify the total number of tenants operating in each incubation centre. Earlier studies have detailed the number of units available for entrepreneurs in selected incubators across the country (Adelowo, 2020). The incubator with the highest capacity in the country has thirty units, indicating that it can accommodate a maximum of thirty entrepreneurs/tenants. The spaces in the incubators are mostly occupied at every point in time because as one tenant graduates, the next tenant is already

in the queue, fully prepared to move in (Adelowo, 2020). In total, out of ninety-five spaces or units existing in the incubators, ninety of them have active tenants and all of them were selected to participate in the study. Of the total questionnaire administered to the tenants, fifty-eight of them were returned. All the retrieved copies of the questionnaire were found useful for analysis. Therefore, those that were well- completed were coded, entered, cleaned and analysed for this paper.

Table 1: Population and Sample Distribution of Tenants Across the Study Locations

State	Location	Year	Number of incubation units	Questionnaire administered	Questionnaire Retrieved
Lagos	Agege	1993	30	15	12
Ekiti	Ado-Ekiti	2012	15	15	9
Ogun	Abeokuta (2 Extensions)	2007	15	15	10
Ondo	Akure (2 Extensions)	2004	15	15	8
Osun	Ile-Ife	1993	15	15	9
Oyo	Ibadan	2006	15	15	10
Total			105	90	58

Source: Field Visit to the Locations

A single set of questionnaire was designed for this study to capture tenants' entrepreneurial characteristics, and usefulness of incubation facilities to the operations and survival of tenants' businesses. Finally, the degree to which tenants perceive their businesses to succeed as a result of supports received in the incubators were also captured.

The variables of interest in this study as highlighted above are measured using dichotomous and Likert rating scale questions, in addition to some demographic information about the tenants. The personal entrepreneurial characteristics (PECs) of tenants were measured using thirty items captured on a five- point Likert scale of between Never '0' and Always '4'. As noted earlier, these thirty items defined the ten main characteristics of successful entrepreneurs including goal setting, Information seeking, self- confidence, risk-taking, opportunity Recognition, demand for recognition, persistence, persuasion, networking, commitment, and systematic planning (Reyes et al., 2018). Three items define each indicator of PECs. The mean values were computed for each of them for Categorisation and were later used in the regression analyses conducted. These PECs items have been deployed in several empirical analyses of potential and active entrepreneurs in Nigerian universities (Adelowo et al., 2021). The contribution of incubation facilities to tenants' business was captured using fourteen items measured on a five-point

Likert rating scale of very low '1' to very high '5'. In this case, tenants were asked to rate how incubation facilities contribute to their venture creation (Adelowo et al., 2015; Adelowo, 2020). For the purpose of analysis, these items were grouped into four, and their mean values were computed and used in the regression analysis. The grouping includes physical infrastructure, funding, training and mentorship. Physical infrastructure here includes incubation unit and business centre, utilities and workshop unit, quality laboratory and display centre to showcase the products of the tenants. Funding here indicates the credit facility or seed fund and loan granted to the tenants of the incubators. Previous studies have shown that some tenants of the incubators have benefitted from the National Economic Reconstruction Fund (NERFund), Youth and Women in Innovation (YouWin) and other social schemes in the country. On the training facilities, the tenants were asked to rate its contribution to their business operations in the incubator. Finally, mentorship include all activities related to counsel, legal advice, management supports and services that are provided to the tenants.

For the dependent variable, venture creation among the tenants, two approaches were adopted to measure this important variable. First, the question of whether tenants are confident that their businesses would be successful after graduation was captured using the dichotomous variable of Yes '1' and No '0'. A follow-up open-ended question was also raised for the tenants to provide further information to support their claims. Secondly, another question was raised to map the extent to which incubation facilities contribute to tenant business survival after graduation. In this case, tenants were asked to rate it on a five-point Likert scale of between very low '1' and very high '5'. The question is 'to what extent do you think that your stay in the incubator will assisted your firm to survive after incubation?'

The data were analysed using descriptive and inferential analysis. Specifically, the computed mean of the independent variables, PECs, and the perception of incubation facilities were regressed on the computed mean of the dependent variable. The results are presented using tables and Charts in the subsequent section.

2.2 Ethical Consideration

The study complied with research ethics, as the respondents provided the information without any coercion or under undue pressure. The main purpose of the study was explained to the incubator managers and the tenants, with a clear assurance that the information will be processed and disseminated in aggregate form. Also, the tenants were encouraged to complete the instrument and they were at liberty to withdraw whenever they could not continue to provide the required information. Therefore, prior informed consent was sought and granted, before the survey could be completed.

3. Results and Discussion

This section presents the results of the data analysis, starting with the basic demographic information of the tenants to the main objectives of the study.

3.1 Demographic Characteristics of Tenants in the Incubators

The characteristics of the tenants in the incubators, as presented in Figure 1, showed that most of them are males (76%) while only a few are females (24%), reflecting the typical gender imbalance experienced in most of the sectors of the economy (SMEDAN-NBS, 2019). This imbalance could be probably due to limited number of female-led businesses apply to be admitted into the incubators or that their businesses are less likely to be selected for the programme. Interestingly, most of the tenants (50%) have a first degree as their highest academic qualification, as presented in Figure 2. About 22% of the owners of the tenant firms hold postgraduate degrees, especially master's degrees. The result implies that there are many highly educated individuals operating businesses in Nigerian incubators. Olofinyehun et al. (2008) have argued that one of the fundamental ways of raising high-growth oriented businesses in the country is not only to train educated young Nigerians but also to provide entrepreneurship infrastructure such as incubators, where business ideas could be nurtured. We have also observed interesting trends in the upsurge of entrepreneurial interest among students of higher education in Nigeria, particularly since the introduction of compulsory entrepreneurship education in 2006 (Adelowo et al., 2021).

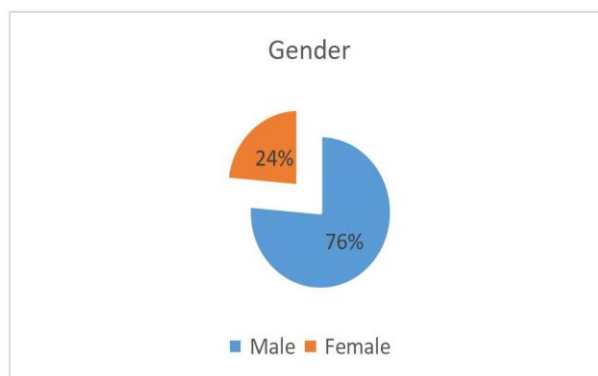


Figure 1: Gender Distribution of Tenants

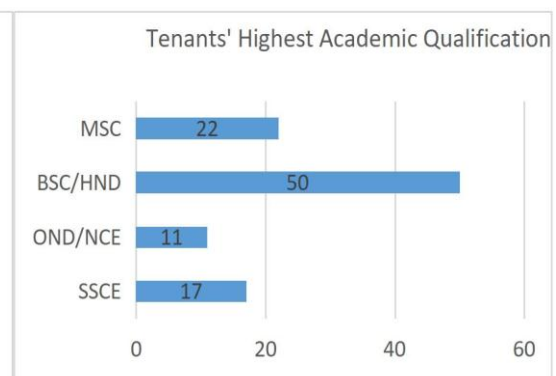


Figure 2: Highest Academic Qualification of Tenants

3.2 Background Information of the Business Operations in the Incubators

The Figure 3 speaks to the number of years the tenant firms have been operating before being admitted into the incubation facilities, and most of them have operated for less than two years (55.2%). Expectedly, this result is in line with the incubation programme design which is meant to help young enterprises overcome early-year challenges (Hacket and Dilt, 2014; Siyanbola et al., 2012; Adelowo, 2020). However, about 13.8% and 20.7% of the tenant enterprises in the incubators have operated for between 2 and 6 years, and above 6 years respectively. For these businesses to still pursue incubation admission may be a clear indication of a poor or weak entrepreneurial climate to grow enterprises in the country. In fact, this further justifies the need to establish more incubators across the country in order to expand the programme to serve more businesses. About 10% of the tenants did not respond to the question on when their businesses were founded.

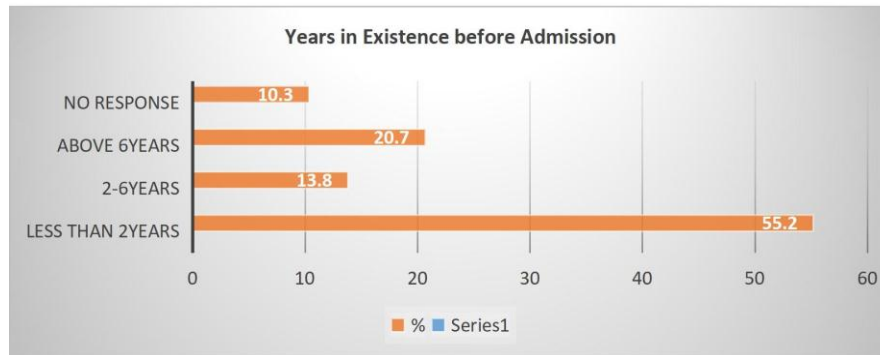


Figure 3: Tenants' Operation year before admission

In terms of the business operations of the incubation tenants, as indicated in Figure 4, most of them (55.6%) are into the production of food and beverages, followed by cosmetics and fashion products (20.4%), and manufacturing (20.4%). The finding is consistent with earlier studies on Nigerian technology business incubators being predominantly nurturing enterprises with food and beverages and manufacturing of agric-related products (Kajogbola, 1999; Shittu, 2004; Adelowo et al., 2015; Adelowo, 2020). Other tenants engage in equipment fabrication (1.9%), software development (1.9%) and repairs (1.7%). Specifically, some of the main products of the tenants listed were production of disposable paper cup, coconut oil, disinfectant, biofuel gel, herbal medicine, solar powered inverter, and hand sanitizers among others. Most of the products are targeted at addressing sustainable development goals and national aspirations.

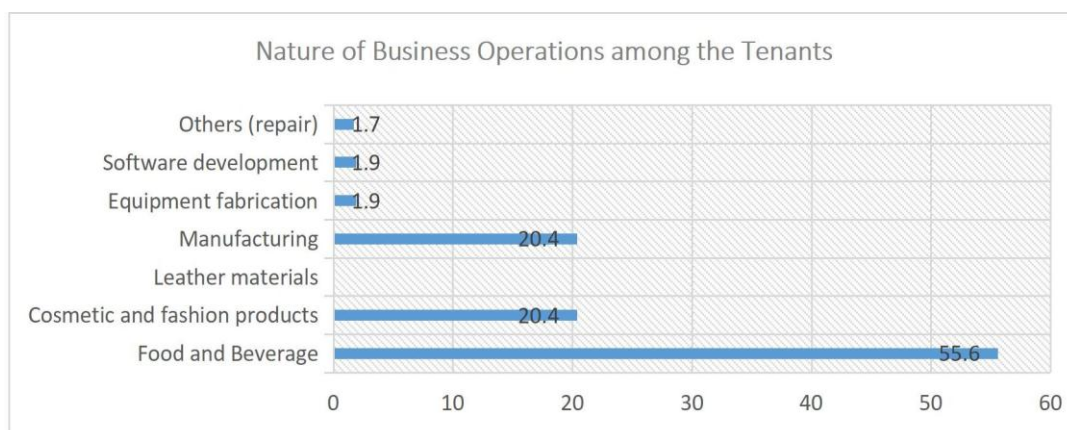


Figure 4: Nature of Tenants' Businesses in the Incubation Centres

During the peak of the Covid-19 pandemic in Nigeria, some of the incubation tenants were able to adapt their production process to produce key preventive non-medical materials such as hand sanitizers for use in hospitals and isolation centres across the country.

The funding access and sources are critical to the success of any incubator and the tenants. Most micro and small enterprises in Nigeria are faced with inadequate funding, particularly to expand their businesses and maintain adequate working capital (SMEDAN-NBS, 2019). In this study, the results as presented in Table 2 reveals that most of the tenants reported that they rely largely on personal savings (94.6%) and few of them on friends and family (39.2%). This suggests that there has not been a major improvement in the provision of adequate grants and innovation funds to the tenants. Earlier studies have shown that incubation tenants in Nigeria are poorly funded as most of them do not have access to government grants and innovation funds but rely mainly on personal savings and loans from friends (Adelowo, 2020). Some of these tenants also combine resources to form multipurpose cooperative societies to finance their operations in the incubator. For instance, our analysis shows that about 14.2% of the tenants reported that they source funds through cooperative societies. An interesting thing about cooperative societies for small business owners is that low interest is usually charged on loans. The loan is also dependent on how much assets each cooperator has in the society. The number of tenants who reported to have accessed funds from the Bank of Industry (BoI) is low (3.5%). This result is worrisome as the main essence of establishing the Bank is to support small businesses, of which innovative businesses in the incubators are central. To access the Bank loan, however, the business needs to come up with a robust and feasible proposal. In this case, providing adequate training to tenants on how to package their funding proposal to the Bank may be a plausible solution to access credit facilities from the Bank of Industry

Table 2: Funding Sources among the Tenants

Funding Sources	%
Personal Savings	94.6
Friends and Family	39.2
Micro-finance banks	5.3
Bank of Industry	3.5
Cooperative society	14.2
Inheritance	1.7
State Government	3.5
Innovation Fund	0
NEPC	0
SMEDAN	0
UNIDO	0
The World Bank	0
NGOs	0

3.3 Personal Entrepreneurial Characteristics of Tenants

The descriptive analysis of the personal entrepreneurial characteristics of tenants, as presented in Table 3, shows that most of the tenants have high opportunity-seeking potential (63.8%). Vibrant entrepreneurs are usually known for rigorous pursuits of opportunity as they seek to expand their business or add another line to their offerings or open up new markets (Adelowo et al., 2021; Akinwale et al., 2022). It is also observed that most of the tenants have high persistence (51.7%), risk-taking ability (58.6%), systematic planning (53.4%), persuasion and networking (55.2%), self-confidence (60.3%), goal setting (51.7%) and commitment to work (51.7%). However, most tenants' entrepreneurial characteristics ranked low on information seeking (53.4%) and demand for quality (53.4%). These indicators are important in planning interventions that are relevant to improving entrepreneurial orientation among the tenants. For instance, adequate training on quality assurance or total quality management might be helpful for those whose demand for quality is low while the introduction of various means by which tenants can access free business information could enhance their information-seeking potential. Overall, the results indicate that all the tenants of the incubators need to strengthen their personal entrepreneurial characteristics, although at different levels. Adeoti (2019) has suggested that improving individual entrepreneurial orientation is important to fostering small business development and innovation. Therefore, incubator managers with growth mindsets are required to structure their interventions, including training and access to resources in such a way that it will improve tenants' entrepreneurship potential.

Table 3: Entrepreneurial Characteristics of Tenants in the incubators

Variables	Mean score	Min	Max	Low (%)	High (%)
Opportunity Seeking	3.57	2.00	4.00	21 (36.2)	37 (63.8)
Persistence	3.33	1.33	4.00	28 (48.3)	30 (51.7)
Risk Taking	3.22	2.00	4.00	24 (41.4)	34 (58.6)
Information Seeking	3.25	2.33	4.00	31 (53.4)	27 (46.6)
Systematic Planning	3.43	2.33	4.00	27 (46.6)	31 (53.4)
Persuasion and Networking	3.24	2.00	4.00	26 (44.8)	32 (55.2)
Self Confidence	3.31	2.00	4.00	23 (39.7)	35 (60.3)
Goal Setting	3.62	3.00	4.00	28 (48.3)	30 (51.7)
Demand for Quality	3.49	2.00	4.00	31 (53.4)	27 (46.6)
Commitment to Work	3.45	2.00	4.00	28 (48.3)	30 (51.7)

3.4 Entrepreneurial Characteristics, Incubation Facilities, and Venture Creation

Three regression analyses were conducted and reported in this section. The first one estimated the influence of personal entrepreneurial characteristics on venture creation among the tenants. Secondly, we estimated the influence of incubation facilities on venture creation. Finally, a combined influence of PECs and incubation facilities on venture creation was also estimated to unpack how the two independent variables influence venture creation potential among the tenants. It also provides a holistic view of the relationship and its directionality.

The first level of analysis, as presented in Table 4, shows that information seeking ($\beta=0.92$, $p<0.01$), systematic planning ($\beta=1.32$, $p<0.01$), persuasion and networking ($\beta=1.302$, $p<0.01$), goal setting ($\beta=0.716$, $p<0.01$), and commitment to work ($\beta=0.6$, $p<0.05$) are key personal entrepreneurial characteristics of tenants that have a positive and significant influence on their venture creation potential. In general, the relationships among the dependent and independent variables are considered to be strong, that is 0.85 while the coefficient of determination is equally high for the model. This suggests that the independent variables explain as high as 67% of personal entrepreneurial characteristics which influence the venture creation ability of the tenants. From the analysis of variance, the model shows a significant difference among the variables, which suggests a significant fit for the model ($F=11.91$, $p<0.01$).

Table 4: Regression Analysis showing the influence of personal entrepreneurial characteristics on venture creation among the Tenants of the incubators

Independent variables	B	Std. Error	T	Sig.
Constant	.945	1.193	-	-
Opportunity-recognition	.191	.225	.847	.401
Persistence	.023	.174	.130	.897
Risk-taking	-.239	.206	-1.163	.251
Information-seeking	.920	.322	2.855	.006
Systematic planning	1.320	.307	4.296	.000
Persuasion and networking	1.302	.358	3.640	.001
Self-confidence	.219	.231	.950	.347
Goal-setting	.716	.286	2.504	.016
Demand for quality	.297	.231	1.289	.204
Commitment	.601	.291	2.060	.045
R	0.85			
R ²	0.72			
Adjusted R ²	0.665			
F	11.91*			

Dependent Variable: Venture Creation *p<0.01

Secondly, on the analysis of the influence of incubation facilities on venture creation among tenants, the results show that physical infrastructure ($\beta=0.961$, $p<0.01$) has a positive and significant relationship with venture creation. This result, as presented in the Table 5, further reinforces the role physical infrastructure play in the business operations of the tenants. This could be ascribed to free or subsidized space allocation for the tenants, provision of relatively reliable electricity and water, and other basic needs required to grow businesses. Similarly, funding and mentorship are also important variables that contribute positively to venture creation, although they are not significant. However, training shows negative but not significant influence on venture creation. All the independent variables explained about 45% of the incubation facilities-related factors that influence venture creation among the tenants. Although, it is surprising to see that training presents a negative contribution to venture creation, the results could suggest how unrelated some of the training activities are to tenants' ventures. It was observed in the previous studies that tenants themselves expend their insufficient resources on specific target

training, which have initial negative consequences on the business (Adelowo et al., 2015). The benefit of training to business ventures is usually not immediate

Table 5: Regression Analysis showing the influence of incubation facilities on venture creation among the Tenants of the incubators

Independent Variables	B	Std. Error	T	Sig.
Constant	.119	.606	.196	.845
Physical infrastructure	.961	.251	3.835	.000
Funding	.187	.125	1.498	.140
Training	-.147	.221	-.667	.508
Mentorship	.073	.166	.443	.660
R	0.67			
R ²	0.45			
Adjusted R ²	0.41			
F	10.07			

Dependent Variable: Venture Creation

*p<0.01

The third and last analysis which combines both PECs and incubation facilities provided richer information on how these two variables interact to influence venture creation among tenants in the incubators.

From Table 6 presented below, the results of the analysis revealed that the combined effects of PECs and incubation facilities changed the structure of the variables influencing venture creation among the tenants. The opportunity recognition ($\beta=0.802$, $p<0.01$) now become positively significant with substantial co-efficient, thereby improving the overall venture creation by a factor of 80.2%. The risk-taking ($\beta=-0.495$, $p<0.01$) shows a significant but negative relationship with venture creation among the tenants. This reflects the true nature of human attitudes toward risk, that is, the higher the risk, the higher the return, and only entrepreneurs have the tendency of taking calculated risks (Olofinyehun et al., 2018). Other PECs with a positive and significant relationship with venture creation potential among the tenants are persuasion and networking ($\beta=0.856$, $p<0.01$) and demand for quality ($\beta=0.527$, $p<0.01$). However, self-confidence ($\beta=-0.498$, $p<0.01$), goal-setting ($\beta=-0.401$, $p<0.01$), and commitment ($\beta=-0.765$, $p<0.01$) showed a negative and significant relationship with venture creation potential among the tenants in the incubators. Interestingly, physical infrastructure as a factor of incubation facility remained significant and with higher co-efficient than the previous results when incubation facilities alone were considered. Moreover, funding now become significant with a robust positive contribution to venture creation among the tenants. This suggests that the provision of funding facilities has to be done with due consideration to tenants' PECs to achieve the intended purpose of venture creation. Finally, training ($\beta=-0.594$, $p<0.01$) as a component of incubation facilities also shows a negative but significant relationship to

venture creation among the tenants. The basic observation from the results presented above is that PECs are important moderators of the influence of incubation facilities on the venture creation among the tenants of Nigerian incubators. The independent variables explained about 90% of the factors that influence venture creation potential in the incubators and the analysis of variance ($F=26.46$, $p<0.01$) shows a significant difference among the independent variables.

Table 6: Regression Analysis showing the joint influence of incubation facilities and PECs on Venture Creation among the Tenants of the incubators

Independent variables	B	Std. Error	T	Sig.
Constant	.477	1.139	.419	.678
Opportunity recognition	.802	.145	5.553	.000
Persistence	.159	.128	1.236	.224
Risk-taking	-.495	.168	-2.941	.005
Information-seeking	-.373	.205	-1.816	.077
Systematic planning	.385	.240	1.604	.117
Persuasion and networking	.856	.320	2.674	.011
Self-confidence	-.498	.214	-2.326	.025
Goal-setting	-.401	.208	-1.925	.061
Demand for quality	.527	.160	3.301	.002
Commitment	-.765	.247	-3.094	.004
Physical infrastructure	.991	.256	3.867	.000
Funding	.359	.112	3.209	.003
Training	-.594	.199	-2.978	.005
Mentorship	.006	.134	.044	.965
R	0.95			
R ²	0.91			
Adjusted R ²	0.87			
F	26.46*			

Dependent Variable: Venture Creation

* $p<0.01$

4. Conclusion and Policy Recommendations

This article sets out to examine how the personal entrepreneurial characteristics of tenant firms and the perception of incubation facilities have individually and jointly contributed to venture creation potential in the incubation centres across Nigeria. To date, anecdotal evidence suggests that the incubation programme improves start-up formation and survival, in addition to the improvement of entrepreneurship ecosystems (Mansano and Pereira, 2016; Mian et al, 2016; Adelowo, 2020). The programme had been launched in Nigeria since 1993, and

several incubators have been established and spread across thirty-six states of the Federation. The aim of the programme was to stem the tide of unemployment by providing facilities for young entrepreneurs to start and nurture their businesses for a number of years, mostly three to five years (Adelowo et al., 2012; Adelowo, 2020). The uniqueness of the incubation programme in Nigeria lies in the emphasis placed on innovation and technology commercialisation. The survival and continued operation of incubators are hinged on their ability to meet the expectations of the stakeholders and serve the purpose for which they were established. Major performance metrics of incubators include the number of businesses created, immediate (and potential) jobs created by the tenants, and increased government revenue resulting from taxes paid by the incubated enterprises. For incubators to deliver on their mandates, incubation managers and stakeholders have to pay adequate attention to the quality of tenants admitted into the programme, and the quality and relevance of facilities provided. The extent to which these two factors contribute to the venture creation potential of tenants has received limited attention in the literature. Using the core indicators of personal entrepreneurial characteristics advanced by Reyes et al. (2018), the study identifies ten major traits that underpin the dispositional tendency of entrepreneurs to undertake actions that lead to successful ventures. In addition, these indicators have earlier been adapted to map entrepreneurial characteristics of potential entrepreneurs in Nigerian universities (Adelowo et al., 2021). Given that there is no database to leverage for information on the tenants of the incubators in the country, the study designed and administered a set of validated questionnaire to the tenants. Appropriate ethical guidelines were followed to obtain the data. From the results obtained through the analyses, the entrepreneurial qualities of the tenants were considered to be generally high. This result is expected since these tenants are already entrepreneurs anyway. However, the low inclination toward demand for quality and information seeking requires attention, as the latter tends to significantly shape venture creation potential. Further analysis shows that most of the indicators of incubation facilities such as training and funding suddenly became very significant when they were pooled together with the entrepreneurial characteristics of the tenants. Therefore, the mere provision of incubation facilities for tenants is no longer sufficient for successful venture creation among the tenants. Implicitly, this suggests that incubator managers need to pay attention to the entrepreneurial characteristics of the tenants while designing funding schemes and training programmes for them. Although, mentorship in our analysis does not show a significant relationship with venture creation, but its positive contribution is noted. This also suggests that mentoring activities for the tenants could be intensified to improve their venture creation potential. Specific areas of mentorship for tenants could include how they can package their business proposals to access funding from the Bank of Industry and other innovation grants or funds as may be available in the ecosystems. In actual fact, the government needs to speedily implement

the national research and innovation fund, as articulated in the National Science, Technology and Innovation policy, to further promote and improve national entrepreneurship ecosystems. In addition, the challenge of poor funding, as reported by the tenants, could also be addressed with the speedy implementation of the national research and innovation fund. Other notable results such as the low participation of the females in the incubators could be improved through a deliberate and targeted programme that would encourage them to apply and be admitted into the programme.

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Venture capital policy in Argentina: an analysis of the Fondo Fiduciario Para el Desarrollo de Capital Emprendedor (FONDCE)

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Abstract

The debate about the role and impact of public venture capital policies remains highly focused on the Global North. Global South countries face additional challenges derived from their structural heterogeneity, the incomplete and unbalanced nature of their innovation and entrepreneurial systems, the lack of mature and deep financial systems, etc. In this context, this paper presents and introduces a first and novel analyses of the “Fondo Fiduciario Para el Desarrollo de Capital Emprendedor” (FONDCE) in the context of the evolution of the Argentinian venture capital industry. The FONDCE, initially structured as a “Fund of Funds”, represented a substantive leap in terms of resources for entrepreneurial financing in Argentina. This analysis constitutes a first fundamental input for entrepreneurial financing policy in Argentina, given the scale of the Fund, the novelty of the instrument, and the lack of previous analyses of this type. It is therefore also a key element in the study of financing innovation in the Global South.

1. Introduction

Given the need to cope with the accelerated technological change, most governments around the world are fostering innovation and entrepreneurial systems. Startups and innovative young firms are particularly relied upon to contribute to the introduction of new products and services, channel the entrepreneurial energies of the population and generate qualified jobs (Colombo et al, 2016). However, these firms face serious barriers to obtaining finance. Venture capital (VC) is particularly suitable for financing ‘...high-risk and potentially high-reward projects...’ (Gompers and Lerner, 2001, 145). Indeed, it is a highly specialized financial source for innovative startups, since,

in addition to the investment, VC funds' industry knowledge, experience and networks help newcomers to ride the uncertainties related to the earlier stages of ventures (Da Rin et al, 2006). Unlike debt financing, VC financing transfers part of the ownership risk to the investors, so they provide entrepreneurs with managerial as well as strategic support.

The expected positive returns of VC, coupled with the persistence of a financial gap in the private supply of VC to young innovative firms, lead states all over the world to introduce policies fostering the emergence and development of the VC industry, mimicking the US or Israeli experience. However, existing knowledge about the effectiveness of such policies is inconclusive, with certain critical views dominating (Da Rin et al, 2006; Mason and Harrison, 2003; Lerner, 2012). In fact, the US VC experience needed more than 50 years of experimentation and resources, and there are few public VC policy success stories globally (BVCA and NESTA, 2009; Lerner, 2010, 2012). At the same time, the debate about the role and impact of public VC policies remains highly focused on the Global North. Global South countries face additional challenges derived from their structural heterogeneity, the incomplete and unbalanced nature of their innovation and entrepreneurial systems, the lack of mature and deep financial systems, etc. (Kantis et al. 2020; Gonzalo and Cassiolato 2016; Gonzalo and Kantis, 2021).

This paper presents and introduces a first and novel analyses of the “Fondo Fiduciario Para el Desarrollo de Capital Emprendedor” (hereafter, FONDCE) in the context of the evolution of the Argentinian venture capital industry. The FONDCE, initially structured as a “Fund of Funds”, represented a substantive leap in terms of resources for entrepreneurial financing in Argentina. Therefore, this analysis constitutes a first fundamental input for entrepreneurial financing policy in Argentina, given the scale of the Fund, the novelty of the instrument, and the lack of previous analyses of this type. It is therefore also a key element in the study of financing innovation in the Global South.

In methodological terms, we use data provided by the Ministry of Productive Development of Argentina on the institutions that made investments or participated in the context of the Fund's programs, the number of deals made and amounts per deal, and the startups that received investments, etc. This data is published in a longer report published in Spanish (Gonzalo et al, 2022).

Next, we present a brief contextualization of the VC industry emergence and development around the world. Then, we present a brief evolution of the development of the VC industry in Argentina, analyzing the role of FONDCE. After this we make an assessment of the experience and present some final remarks.

2. Venture capital industry development beyond the US

VC industry as a particular form of business financing was born in the United States of America and remains idiosyncratically linked to American society. Among the milestones of its emergence is the founding of the American Research and Development Corporation (ARDC) by professors and institutional entrepreneurs linked to the Harvard Business School (HBS) and the Massachusetts Institute of Technology (MIT), as a fund aimed at investing in risk ventures following the competitive and geopolitical demands generated by the Second World War (Gompers and Lerner, 2001). ARDC recorded its first success story in 1957 when it invested USD 70,000 in Digital Equipment Corporation (DEC), which turned into USD 355 million when the company opened its share capital in 1968. In 1958, the US government gave its first institutional support to the VC industry with the passage of the Small Business Investment Act, which sought to boost entrepreneurial financing in technology sectors in the face of international competition with the USSR. Thus, VC funds could be leveraged with public resources at a ratio of 4:1 (for every dollar invested by the private sector, the US State put in four dollars).

Still tied to individual investors (with low participation of institutional investors), VC funds' investments grew sharply in the US during the 1970s and 1980s, mainly oriented towards investments in semiconductor, software and computer services companies based in Silicon Valley. The cases of Apple Computer, Cisco Systems, Genentech, Microsoft, Netscape, Sun Microsystems, between others, are widely known. During the 1990s, the industry received a strong boost through regulatory changes that allowed the entry of pension funds, complemented by the entry of institutional investors and corporate VC funds (Gompers and Lerner, 2001). While the dotcom crisis in the early 2000s hit the venture capital industry hard, today virtually every major technology corporation that started as a start-up in the US has received investment from a VC fund, from Facebook to Zoom. This shows how central this industry and form of financing has become.

Following the American success, different countries, including such dissimilar cases as the US, China, Korea and Russia, have tried to build a VC industry to finance new companies and emerging industries. For instance, in Israel, in the 1990s, the most successful international initiative to foster venture capital industry was launched: Yozma. It was based on the creation of a Fund of Funds (Yozma Funds), to which was added a Government Fund (Yozma Venture Fund) that would invest where there was public interest but no private investors (Gonzalo et al, 2022). It sought to attract and create venture capital funds that would invest in early-stage ventures through a partnership between Israeli investors and financial institutions and venture capital funds from abroad, mainly from the United States. The selected funds received a public investment of up to 40% with a cap of USD 8 million. But there was an important incentive: the funds would have the option, in the sixth year, to buy

back their share from the government at cost (plus a low interest rate) (Kantis, 2017). And if the outcome of the investment was negative, the first to take the loss was the state. With a public injection of USD 100 million into a group of 10 privately managed funds, foreign funds were attracted, reaching a total investment amount of USD 250 million (Avnimelech and Teubal, 2006).

In Korea, encouragement for the development of the venture capital industry has been growing since the early 2000s. Since the enactment of the Venture Investment Promotion Act in February 2020, the Korea Venture Investment Corporation (KVIC), as a private company financed with public resources, centralises the actions aimed at stimulating investments for the development and growth of Korean startups. The KVIC operates, on the one hand, as a Fund of Funds, with the Korea Fund of Funds, Angel Fund of Funds, Foreign VC Investment Fund, Job Creation Fund, Fund of Funds for Industrial Technology Commercialization, among others. On the other hand, KVIC has a co-investment scheme with other private funds (matching funds). In 2021, IT and biotechnology stood out as the two verticals with the highest investment volume (KVIC, 2022).

However, building a VC industry outside North America has not been neither an immediate nor a necessarily successful process (Lerner, 2009; Gonzalo et al, 2022; Gonzalo and Kantis, 2021). The characteristics of each country's banking and financial system, its national and regional innovation system, the development of entrepreneurial development policies, the type of productive and business structure, the economic and geopolitical complementarities and links with the US, the insertion of diasporas in Silicon Valley, are some of the factors that play an important role in the development of the VC industry (Saxenian and Sabel, 2008; Saxenian, 1999; Gonzalo and Kantis, 2021; Dossani and Kenney, 2001; Gonzalo et al, 2022).

Although the US remains the largest market, Asia has been the most dynamic region in the last decade, while there has been a marked growth in Latin America, and Europe has been the region that has grown the most during the pandemic (The Economist, 2021; KPMG, 2021). At the same time, VC funds (many of them linked to private equity or corporate funds) have increasingly internationalized, seeking projects and companies with growth potential in different latitudes.

In general terms, from the literature review of the international experiences, there are some key stylized facts related to the development and promotion of the VC industry:

- ✓ The role of the State and public policy is central to the development of the VC industry. However, the State does not always act in a direct and homogeneous manner. It is important to involve national and subnational levels and of public, private and third sector actors

(Mazzucato, 2013; Mazzucato and Semieniuk, 2017; Mazzucato and Penna, 2014; Gonzalo and Kantis, 2021; Gonzalo et al, 2022; Puri and Zarutskie, 2009; Rosiello et al, 2008, etc).

- ✓ The development of the VC industry requires the prior development of certain infrastructural conditions related to the development and consolidation of an national system of innovation and, particularly, an entrepreneurial ecosystem as the main source of projects and companies to be invested (Avnimelech and Teubal, 2006; Kantis, 2018, Gonzalo and Kantis, 2021; Gonzalo et al, 2022, etc.).
- ✓ The VC industry co-evolves with the development and growth of certain technologies and industries, mainly linked to the IT paradigm and biotechnology, which has been reinforced with the forced digitalization and the public health challenges caused by the pandemic (Avnimelech and Teubal, 2006; Rosiello et al, 2008; etc.).

Next, we explore the Argentinian case.

3. Venture capital emergence and development in Argentina: a brief overview

Overall, the development of VC industry in Argentina occurred over three periods with distinct characteristics. Throughout this section, an overview of the first two phases of development of the VC industry in Argentina will be presented. In the next section, we will introduce the latest phase in its development by focusing on the FONDCE.

Emergence of the venture capital industry: the 90s

The venture capital industry in Latin America mainly began in the 1990s, alongside processes that occurred in most countries in the region: trade and financial liberalization and reduced state intervention in the economy. In particular, in Argentina, this decade was characterized by two main factors. Firstly, the implementation of the Convertibility Plan in 1991 and secondly, the opening up to foreign capital through a new legal framework for Foreign Direct Investment (FDI). This opening up to FDI was marked by two factors that gave impetus to the development of the sector: the need for investment in medium-sized companies to improve competitiveness and the emergence of Venture Capital and Private Equity Funds to meet capital needs (Caballero et al., 2011).

By the late 1990s, the private equity market in Argentina (and VC in general) was considered one of the most dynamic in Latin America. Between 1996 and 1998, the country received almost 30% of the total funds in the region, being the second market behind Brazil. The opportunity to capitalize on the privatization of state-owned enterprises attracted many players, injecting capital into local companies with growth potential (Savino, 2015). The leveraged buyout (LBO) model began to advance, by which Argentina became the second largest recipient of private capital, with almost USD 2.9 billion invested between 1996

and 1998. Argentina was replicating the LBO model of the United States, initially attracting Bisa Group, EXXEL Group Associates and Bank of America, and then encouraging a second group of investors made up of Arcon Investments, Advent International, Banker Trusts, Blackstone, Chase Capital Partners, DLJ Merchant Banking, AIG Capital Partners, Bank Boston Capital, Bassini Playfair & Associates, among others (ARCAP, 2017; Savino, 2015).

From the public sector, in line with international experience, came the first push for the creation of innovative companies in Argentina. The Secretariat of Science and Technology heavily focused on the creation and strengthening of a network of technology-based incubators. Regarding particularly to VC, a milestone event had taken place in 1990, when the Law for the Promotion and Development of Technological Innovation (Law 23.877) was passed. The aim of this new regime was to strengthen the relationships between the productive private sector, universities, government agencies, and scientific-technological organizations. This law created the figure of Technology Linkage Units (TLU), non-state entities constituted for the identification, selection, and formulation of R&D projects, technology transfer, and technical assistance. The TLUs aimed to increase the participation of the private sector in financing science and technology activities. In addition, in 1995, Law 24,572 on invention patents and utility models was passed, regulating intellectual property rights.

During the 90s, there was a surge of technology companies and the dot-com revolution, with funds focusing on these sectors. Companies such as Star Media, Terrea Networks, and ElSitio went public, increasing expectations for continuous growth in the private equity and VC market, and creating opportunities for new business creation and investment. However, investment funds were mostly oriented towards large and medium-sized companies. By the year 2000, there were around 24 investment funds. However, the market was mostly composed of private equity funds dedicated to investing in non-listed companies in the capital market, with strong growth potential and in sectors with competitive advantages: food, beverages, IT or biotechnology.

The dot-com crisis of the beginning of the century had a strong impact on the Argentine industry and its economy as a whole. The fire-sale of shares caused the loss of value of many technological SMEs, simultaneously generating attractiveness for their purchase by large companies. In addition, in Argentina, the situation was particularly tenuous due to the domestic crisis of 2001. A large number of venture capital funds withdrew from the country, causing an almost total closure of private equity activity when a solid industry of venture capital funds oriented towards innovative companies had not yet been formed. The industry collapsed with no safety nets, as an active network of angel investors and/or non-institutionalized venture capital funds had not yet been formed.

In summary, during the 90s, an attractive context was created for the entry of foreign capital into the country, contributing to the gestation of the private VC

industry and private equity in general, reaching a peak in 2000 with the strengthening of dot-com firms. However, the explosion of the international technological bubble, combined with the macroeconomic crisis and national default, caused a virtual disappearance of venture capital when a solid industry of venture capital funds oriented towards innovative companies had not yet been formed. Furthermore, an active network of angel investors and/or non-institutionalized venture capital funds had also not yet been formed.

Institutional densification within a framework of macroeconomic growth: the 2000s

After the Argentinian 2001 crisis, a new administration emerged, which managed to steer the economy towards strong economic growth, including the design and articulation of strategic public policies aimed at consolidating the productive sector and generating employment. The devaluation of the Argentine peso, resulting from the exit from the convertibility law, generated exchange rate competitiveness in exporting companies and, coupled with the commodity price boom, created attractive investment opportunities at the national level. This created a propitious opportunity for the densification and consolidation of the venture capital in Argentina, which preceded the take-off seen in the past few years.

The support programs that took place in Argentina after the 2000 crisis recovery had a special focus on science and technology activities, applied not only to the creation of new technology-based companies but also to the consolidation of innovation in the existing productive network. This situation gained new impetus with the creation of a Ministry of Science and Technology and a coordinating agency for all initiatives, which manage the funds allocated for such purposes. With the aim of promoting the creation of new technology-based companies, programs such as CREAR- CIT, PICT Start-up, EMPRETECNO, and PROFIET appeared, driven with the intention of encouraging researchers to bring the best development proposals to the market. Along the same lines, the Venture Capital Creation Promotion Program sought to gather the necessary capital to materialize entrepreneurial initiatives. Among these, EMPRETECNO was the most successful program.

During the 2000s, new players began to join the industry. For example, there were actions by liaison institutions such as the Endeavor Argentina Foundation, bringing entrepreneurs and capital investors together. Companies with strong development potential, such as Patagon.com, Eki Discount, StarMedia, Metrovisión, OfficeNet, El Sitio, Southern Winds, and Finca Pilar were among the first to receive capital contributions. Angel investor networks also joined, which grouped individual investors. By early 2008, 140 investors were participating in the three networks.

A study carried out by the Institute of Scientific and Technological Entrepreneurship revealed that by mid-2008, 16 venture capital funds and angel investor networks were operating in Argentina, managing around USD 100 million, of which only 10% was invested. Among them were Aconcagua Ventures, Business Angel Club IAE, CAP Venture Capital, Chrysalis Argentina, Club de Inversores Ángeles IG, Nexo Emprendedor Banco Santander Río, FS Ventures, Holdinvest Technology Fund LLC, Fondo ILEX, InnovaTekne, Mark Ventures, and Ax Ventures PYMAR. The total amount invested between 2005 and 2007 was USD 11.46 million, of which USD 1.83 million was invested by non-formal investors (those who do not belong to a venture capital fund or angel network, but invest individually based on the projects they receive). In terms of geographic distribution, 28 of the 30 investments were concentrated in companies in CABA and the province of Buenos Aires.

As the industry started consolidating, in 2009, six funds formed the Argentine Association of Private Equity and Venture Capital (AAPEVC), a civil association that initially aimed to promote the risk capital industry and reduce regulatory restrictions that affected the sector. ARCAP's most important objectives included promoting the industry, encouraging funds to interact and make joint investments in projects, and gathering the necessary information to compile sector statistics. The association, which followed the models of Brazil and Mexico, tried to attract representatives from the public sector to join the association and work to reduce the restrictions that affected the formation of funds, including tax restrictions. In the following years, the association was inactive, but it was relaunched at the end of 2016 and resumed continuous operation in early 2017, reflecting the maturity of the industry.

By 2014, the fund scenario has become more dense and had expanded substantially with around two dozen operational venture capital funds, the vast majority of which were located in CABA, although operating not only in the national but also international field. Among them were: Qualcomm Ventures; CAP Venture Capital; Atlantico Ventura Capital; Patagonia Ventures; Quasar Ventures; AxVentures PymarFund; KasZek Ventures; Papaya Ventures; Quorum Digital Venture Partners; Pegasus Capital Advisors; Modena; Sinensis Capital SCR; Riverwood Capital; Mark Ventures; Vitamina Venture Capital; Trindade Investimentos; Cygnus Capital; Enzyme Venture Capital; Aconcagua Ventures; Kibo Ventures; Nazca Ventures; JG Ventures Argentina; ILEX.

In sum, the growth of the early 2000s was supported by the economic recovery and science and technology policies for venture capital development. As a result of this new scenario, a marked growth cycle began in the 2010s, reaching its peak in 2014, mainly favored by new investment and acceleration models for early-stage startups (ARCAP, 2017). Between 2012 and 2016, 284 investments in early-stage projects in Argentina were recorded, with a cumulative value of approximately over USD 200 million invested. The main verticals responded to

Software and Internet Services, followed by Software; and Internet and Direct Retail Marketing (ARCAP, 2017). The growth is also observed in corporate venture capital. 149 corporate investments and total investments disclosed for approximately USD 22 million are observed, reaching its highest peak also in 2014 with over 40 investments (ARCAP, 2017). That said, until the second half of the 2010s, there was not any direct State intervention such as a Fund of Funds in Argentina.

4. The Entrepreneurs Law and the creation of the FONDCE

With a new administration at the national level, on 29th March of 2017, the Argentine Congress unanimously passed the so called “Entrepreneurs Law” creating the most important instrument in the country’s history to support the VC industry, the “Fondo Fiduciario Para el Desarrollo de Capital Emprendedor” (FONDCE). This new fund, partially structured as a Fund of Funds, was the basis for the financing of public programs to support and encourage entrepreneurial activity, accelerators and incubators, and the creation of venture capital funds with public-private participation.

Broadly, the Entrepreneurs Law gave a new impulse, not only to entrepreneurial activity, but also to the generation of financing capital through investment funds. Among other things, the law established the ease of incorporation of companies under the creation of a new legal figure: the Simplified Joint Stock Company (SAS), which was mainly oriented to give a bureaucratic fast-track to new enterprise creation. At the same time, it allows investors who make contributions in the ventures benefited by this regime to deduct from the determination of income tax between 75% and 85% (depending on the geographical area) of such contributions, with a cap of 10% of the net taxable income of the fiscal year, or its proportional to the months of the beginning of activities, as long as the total investment is maintained in the business for at least two years from the first fiscal year in which the investment was made. The law also allows foreign investors to invest in the ventures without the need to settle in the national territory.

4.1. The FONDCE

This section presents data and analyses the contributions and limitations of the FONDCE. In order to meet its objective of strengthening the financing chain and assisting in the development and growth of entrepreneurs and the entrepreneurial ecosystem, three funds financed by the FONDCE were initially launched: the Seed Fund, the Acceleration Fund and the Expansion Fund. The first iteration of these funds would be active for four years from 2018 through 2021, and they constitute our main object of analysis.

4.1.1. Investments, institutions and startups

In total, according to the information processed in August 2021, between 2018 and August 2021, investments were made in 1,367 ventures, of which the largest part corresponds to the seed fund through which 1,199 ventures were supported only with public investments. Secondly, the acceleration fund channeled investments to 69 ventures, and finally the expansion program supported nine ventures.

Table 1. Summary of the Seed, Acceleration and Expansion Funds.

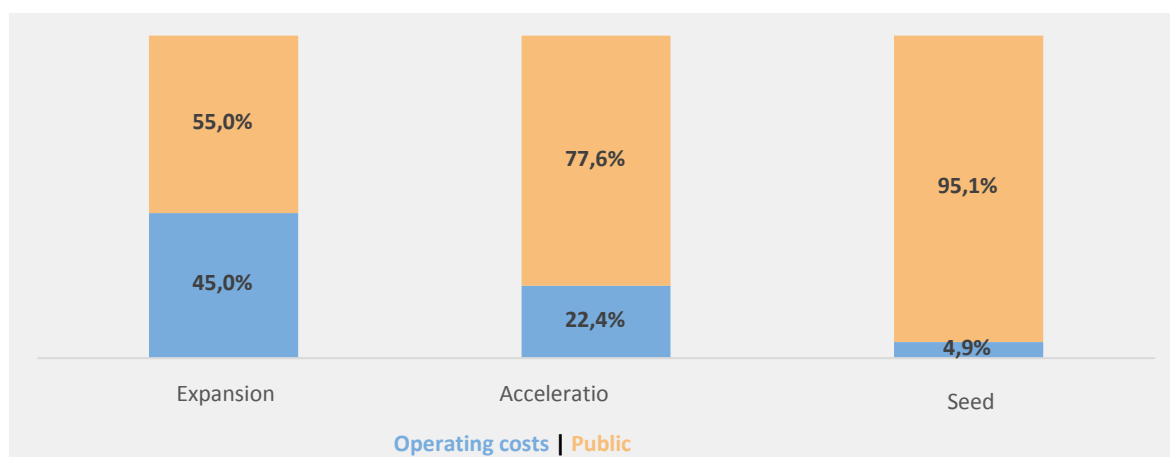
Investor Funds	Operating costs	FONDCE Investments	Private Investments	Participating funds	Number of investment
Semilla	\$14.5 Million pesos	\$280.7 Million pesos	-	132	1199
Acceleration	USD 2.4 Million	USD 8.3 Million	USD 6.2 million	13	69
Expansion	USD 1.8 Million	USD 2.2 million	USD 4.2 million	3	9

Source: Own elaboration based on Ministry of Productive Development

The seed fund channeled \$295.2 million pesos, of which \$280.7 million went directly to finance entrepreneurs and \$14.5 million to finance the operating costs of the supporting institutions. Then, across the acceleration and expansion funds, which operated in dollars, a total of US\$10.5 million was invested with public money (US\$8.3 million towards the acceleration Fund and US\$2.2 million towards the expansion fund). Public disbursements were also made for operating expenses of the accelerators and the expansion funds for US\$4.6 million. This support helped channel private investments totaling US\$10.6 million. In other words, the FONDCE disbursed close to \$300 million pesos, USD 15 million and leveraged USD 10 million from the private sector.

In the case of the expansion fund, of the USD 4 million provided by the FONDCE, 45%, i.e. USD 1.8 million, was used to finance the operating expenses of the three participating expansion companies (an average of USD 600,000 each). Although other countries have also used public funds to finance operating costs of VC institutions for their initial development, the fact that 45% of the funds are oriented to operating expenses, in foreign currency, seems disproportionate.

Figure 1. Structure of Funding provided by the FONDCE



Source: Own elaboration based on Ministry of Productive Development

The opposite must be said of the seed fund. The funding for incubators and supporting institutions, being barely 5% of the total invested in pesos, appears too low considering the number of institutions that participated and even more so that it is a segment that needs to be professionalized and sustained in order to nurture the entrepreneurial ecosystem from the grassroots. This is reinforced by the fact that there is an important federal presence in the incubator segment, as we will show below, which allows for a very important territorial deployment.

Having made this initial stylization, the following is a more detailed analysis of each fund in particular.

4.1.2. Seed Fund

The seed fund was only active for two years, 2018 and 2019, and was cut short when the new administration took office on December 2020. Despite its shortened run, it provided funding for almost 1200 startups, and worked together with 132 incubators and other supporting institutions. Through this fund, startups could access to up to \$250.000 pesos (around 2.000 us dollars) in no- interest and no-collateral loans to be repaid in five years' time. These funds had to be used in either capital goods, workplace improvements or repairs (up to 20%), intangible assets such as certifications, patents and trademarks, and working capital, such as raw materials, labor, professional services (up to 35% of the project cost).

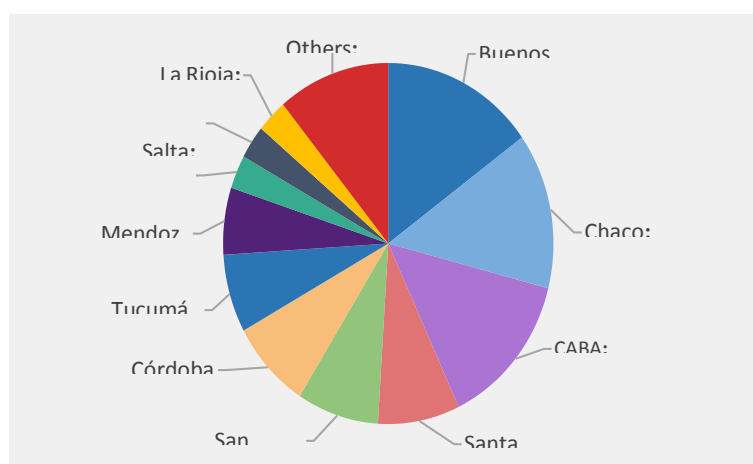
Seed funds were provided to two types of ventures: productive ventures and social impact productive ventures. The former were defined as those that sought to produce innovations and generate a local, regional, national or global economic impact. On the other hand, social impact productive startups were

defined as innovative projects that not only have a business model that sought to generate an economic impact, but also a social or environmental impact at the local, regional, national or global level. Projects with social impact had to have at least one of the following objectives: environmental, health, socioeconomic inclusion, education, social habitat, and/or gender equality. These ventures could be no older than 48 months from the first sale.

On the side of the supporting institutions, through this fund, money was also allocated to them. The aim was to establish a mechanism through which the fund provided financing for incubators and other similar institutions (which were part of an official incubator registry) and in turn, these would provide technical assistance to the ventures that received loans. According to former authorities of the area in charge of the FONDCE, these objectives were only partially met, since the incubators acted mainly as project formulators, without providing sufficient support to the selected ventures or making a selection of ventures with the potential to advance to new stages of entrepreneurial financing.

The seed fund had a truly federal perspective. It supported incubators across the country, and did not target a specific area. The province with the most projects incubated in the program was Buenos Aires, where 15% of the 1,199 projects were incubated. The other regions with most incubated projects were Chaco and the City of Buenos Aires, whose incubators supported a similar number of projects. With the sole exception of Tierra del Fuego (the southernmost province of the country), all provinces had incubators that participated in the program.

Figure 2. Loans by Incubator by Province



Source: Own elaboration based on Ministry of Productive Development

Among the incubators with the highest number of approved projects, there are both public organizations and private initiatives. A diversity of projects and institutions oriented towards the social field can be found, while incubators linked to universities and private initiatives appear which shows that technological/dynamic ventures were also reached. Likewise, from the information search and interviews carried out, it was found that the program contributed to the expansion and growth of the incubators with an important federal imprint, giving visibility to a series of incubators in order to position them within each regional ecosystem.

4.1.3. Acceleration Fund

The accelerator fund consisted in a public-private co-investment scheme. In the first stage of the call for proposals for the acceleration fund, 13 entities were selected (three scientific and ten technological accelerators) that were awarded co-investment privileges with the State. Their day- to-day operations remained unaffected; the State did not become a partner, but a silent investor with fixed rules.

The program worked as so: accelerators would bring forth to the authorities of the Fund, if they desired it, a startup they were going to invest in. If approved (although no investment was ever denied), investments of upwards of USD 25,000 made by technological accelerators were matched up to USD 50,000; while investments (also upwards of USD 25,000) made by scientific accelerators could be doubled, with a hard limit of USD 300,000. Investments made by the Fund had to be returned under certain conditions: a transaction or series of transactions resulting in a change in the ownership rights of more than 50% of the equity or controlling interest in the application at the time of the disbursement and public offering of the venture on any securities market. In the occurrence of any of these “liquidity events”, as they were called, the FONDCE would have to receive three times the money it had invested in the venture.

Accelerators had another benefit in participating in the program. They received from the Fund Non-Reimbursable Contributions (NRCs) to cover administrative, labor and social security costs, external advisors, travel, publicity, dissemination and research and other activities incurred to fulfill the purposes of the program. The NRCs would be for up to 50% of these annual costs with a ceiling of USD 75,000 for technological and social accelerators and up to USD 150,000 for scientific accelerators.

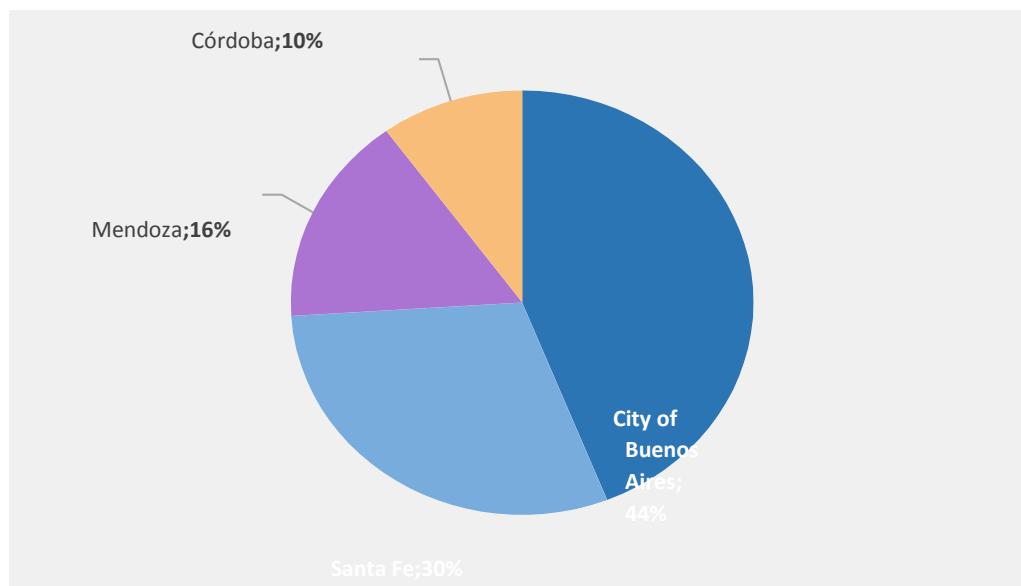
	Operating costs (USD)	Number of supported enterprises	Public investment (USD)	Private investment(USD)
Accelerator 1	385.000	11	3.096.000	2.163.466
Accelerator 2	385.000	9	2.470.000	1.705.677
Accelerator 3	295.080	4	1.000.000	500.000
Accelerator 4	183.000	6	275.000	275.000
Accelerator 5	182.203	3	150.000	175.000
Accelerator 6	175.198	11	305.000	305.176
Accelerator 7	150.000	7	311.513	361.513
Accelerator 8	150.000	4	150.000	200.000
Accelerator 9	150.000	8	345.000	345.000
Accelerator 10	150.000	3	75.000	75.000
Accelerator 11	75.000	3	150.000	150.000
Accelerator 12	75.000	0	-	-
Accelerator 13	75.000			
Total	2.430.483	69	8.327.513	6.255.832

Source: Own elaboration based on Ministry of Productive Development

From 2018 to August 2021, investments were made in 69 projects, and two accelerators participated for one year, for which they received NRCs for expenses, but made no investments and exited the program. The total amount invested by the accelerators was USD 6,255,832 and USD 8,327,513 by the FONDCE. On average, the FONDCE invested USD 120,688 per project and the accelerators, USD 90,664. For each dollar invested by the accelerators, the FONDCE invested 1.33 dollars. In each project, FONDCE invested between 35% and 200% of the amount invested by the accelerator. Regarding the composition of the investments by sector, the FONDCE allocated 42% of the financing to the biotech sector (USD 3.5 million) and 29% to healthcare (USD 3.4 million).

FONDCE contributed USD 2,430,483 to the 13 accelerators in operating costs, an average of USD 35,224 per venture and USD 187,000 per accelerator. The regional distribution of the acceleration fund contrasts sharply with the seed fund. Although the former is a program with fewer actors, it is much more concentrated, and only accelerators from four districts participated, with the particularity that two of them, Mendoza and Córdoba, are each represented by only one accelerator, Embarca and Incutex, respectively. The other two districts are the City of Buenos Aires and Santa Fe, whose accelerators financed 30 and 21 of the 69 ventures, respectively.

Figure 3. Investments by Venture by Accelerator by District.



Source: Own elaboration based on Ministry of Productive Development

4.1.4. Expansion Fund

In the call for proposals, three venture capital fund managers with experience in setting up venture capital funds were initially selected, each with the objective of establishing a fund with a minimum capital of USD 30 million, i.e. a minimum of USD 90 million between the three funds. These funds were to be composed of 60% private capital and the remaining 40% FONDCE contributions, with a maximum FONDCE contribution of USD 12 million (a maximum of USD 36 million in resources placed by FONDCE among the three funds). Financing was offered for up to 50% of pre-operational expenses, especially structure and management costs for private fundraising, with a ceiling of up to 50% of total costs and a nominal maximum of USD 200,000 per company. Funds could also use up to 40% of VCDT investment contributions for operating expenses.

TABLE 3. FONDCE Contributions for Operating Expenses and Number of Supported Enterprises by Fund

	FONDCE Contribution for Operating Expenses	Supported Enterprises
Fund 1	USD 160.606	1
Fund 2	USD 957.167	3
Fund 3	USD 670.262	5 (one enterprise received two investments)

Source: Own elaboration based on Ministry of Productive Development

Overall, although the three selected funds were indeed active and invested in projects, the investment amounts and the number of ventures invested in were very low in relation to the objectives set out in the call for proposals.

Fund and investments by enterprise	Public Investments	Private Investments
Fund 1	1.053.860	1.786.430
Enterprise 1	590.077	1.000.000
Enterprise 2	37.110	100.000
Enterprise 3	29.503	50.000
Enterprise 4	63.600	100.000
Enterprise 5	185.570	314.430
Enterprise 6	148.000	222.000
Fund 2	300.000	450.000
Enterprise 7	300.000	450.000
Fund 3	860.408	1.989.593
Enterprise 8	301.054	698.948
Enterprise 9	185.978	414.022
Enterprise 10	373.376	876.624
Total	2.214.268	4.226.023

Source: Own elaboration based on Ministry of Productive Development

Thus, overall, the private funds invested USD 4,226,023 and the FONDCE USD 2,214,268. For each dollar contributed by the private funds, the FONDCE contributed on average USD 0.52, while it contributed between USD 0.37 and USD 0.67 depending on the project. On average, the FONDCE invested USD 221,426 per project, while private funds invested USD 422,602. Regarding the sectoriality of the investments, FONDCE resources went 41% to the enterprise software & services vertical, 37% to biotech and 14% to e-commerce. On the private funds side, 49% of the investment went to enterprise software & services, 33% to biotech and 11% to e-commerce.

The little more than USD 2 million invested by the FONDCE and the more than USD 4 million invested by private funds in nine projects (one of which received two rounds of investment) until 2020 show that this financing window exists and that there is capacity for leverage. However, the gap between what has been invested and the program's objectives is large. According to the call for proposals, a total of USD 90 million had to be raised for investment, of which a maximum of USD 36 million (USD 12 million per fund) would come from the FONDCE. At the same time, the ratio of operating costs to private investment was also very poor: USD 1.8 million was granted for the former, implying just over USD 2 in private investment for every USD 1 in operating costs.

5. Overall analysis of the FONDCE: contributions and challenges

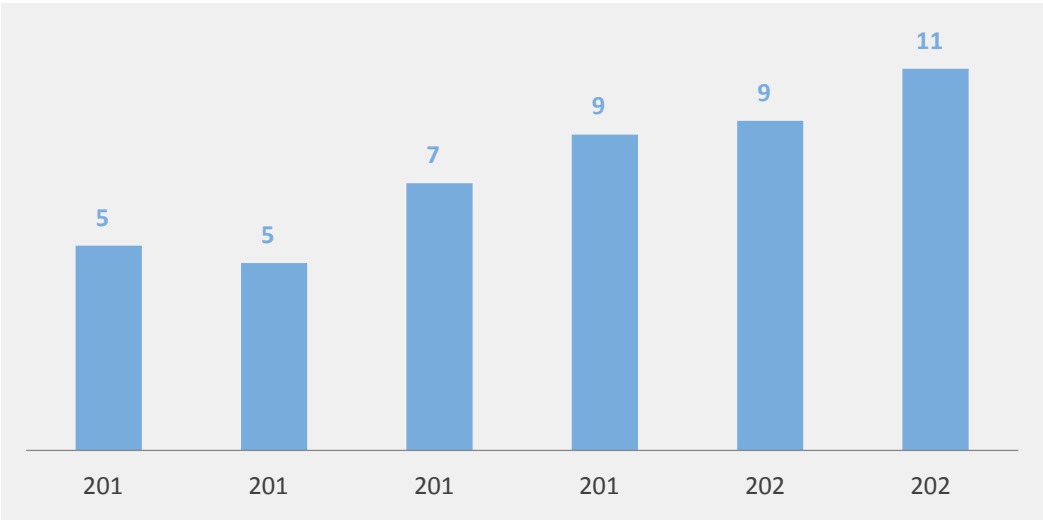
No analysis of FONDCE would be complete without mentioning that this instrument, and the Entrepreneurship Law in general terms, has been in place for only a few years. FONDCE operated between 2018 and 2020, two of which were years of economic recession and exchange rate crisis in Argentina and one of which was a pandemic. This has impacted on the possibilities of generating a sustained, clear and comprehensive impact. In this sense, it is a program that has not yet matured and has already faced significant challenges of different kinds. All this is interesting from an analytical point of view to see how an instrument, that in principle is necessary and relatively adequate, can be impacted by macroeconomic and/or exchange rate conditions.

That said, through the three funds financed by FONDCE, the Seed Fund, the Acceleration Fund and the Expansion Fund, the Argentinean Government intended to encourage an entrepreneurial ecosystem in Argentina by underpinning the entrepreneurial financing chain. In fact, as said before, FONDCE has been the most important initiative that Argentina has had in terms of entrepreneurial financing through capital injections. In general terms, among its most positive aspects is the entry and consolidation of new public, private, national and foreign players (accelerators and expansion firms and funds) that contributed to a learning curve in terms of entrepreneurial financing and to increasing the network of support and venture capital institutions, improving the possibilities of regional and global development of the VC-backed ventures. In particular, the promotion of support institutions for

entrepreneurs and ventures outside the Buenos Aires area stands out, mainly in terms of incubators, but also in the case of accelerators. In addition, many of the ventures invested are still in the market today.

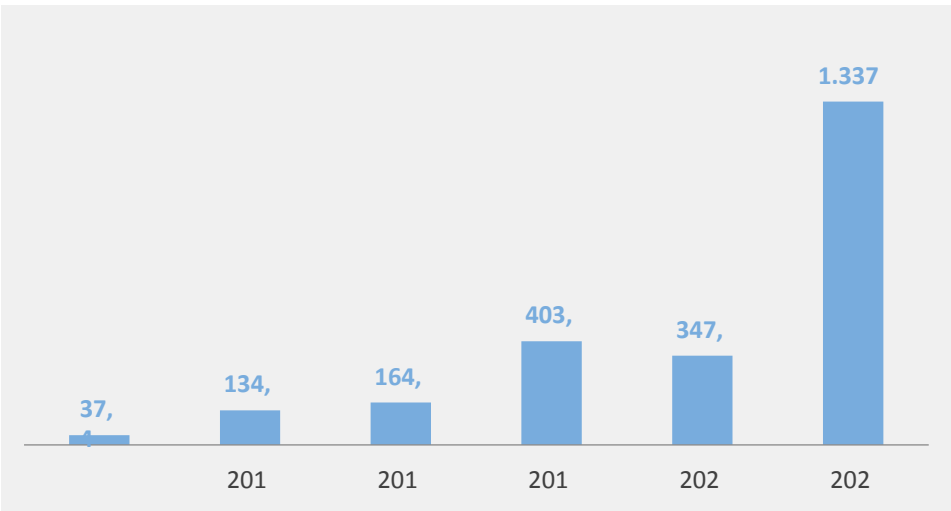
As shown next, both the introduction of the Entrepreneurs Law and the FONDCE have influenced in the steep increases both for deals and in the volume of investments in the Argentinian VC industry since 2018.

Figure 4. Venture Capital Deals per Year, 2016-2021



Source: Own elaboration based on Ministry of Productive Development.

Figure 5. Investments per Year in Million USD, 2016 through first semester of 2021.



Source: Own elaboration based on Ministry of Productive Development.

Despite operating for only two years, the Seed Fund seems to have attracted incubators and reached a wide range of projects. Among those selected for description and analysis (the number of incubators that participated in the programme amounts to more than 100), several of the participating incubators did not offer their own funding before the launch of FONDCE. Thus, even without a define focus, the Seed Fund has generated additionality and has managed to position the incubators among entrepreneurs in a quite federal manner. In addition, the participation of public, university, public-private and non-profit incubators is noteworthy. This positive result was achieved despite the low amounts granted to the incubators to cover the costs of presentation and accountability of the projects. In a more aggressive scheme in terms of incubator support and/or targeted in terms of project profile, the performance could have been even better. In the future, giving greater weight to triple impact projects (gender, environment, inclusion, etc.), to crowdfunding and angel investor-type schemes, and to achieve a greater focus on both the projects and the participating institutions are accessible challenges.

The Acceleration Fund is the one that has worked best and most clearly. Among its objectives was to consolidate and/or create accelerators that would then allow the multiplication of new ventures. Despite the heterogeneity among them, several of the thirteen accelerators of the programme were founded in the same year as the launch of FONDCE. Consequently, the acceleration programme succeeded in generating new investments in new ventures, allowing the expansion of the accelerators and the generation of new companies. Specifically, 69 ventures were financed. Likewise, the co-investment scheme has been noted for its agility and capacity to generate additional investment.

Finally, from the information available, it can be said that the Expansion Fund performed unevenly and the initiative did not comply with the guidelines of the call for proposals. This mainly refers to the fact that the amounts invested were far from what the funds were supposed to commit. A total of 10 investments were made in 9 projects for a total of just over USD 4.2 million, when, according to the call's minimums, a total of USD 90 million was to be raised for investment, of which a maximum of USD 36 million would be from FONDCE. The ratio of operating costs to private investment was also poor: USD 1.8 million was granted in operating expenses, implying just over USD 2 of private investment for every USD 1 of operating costs. The private funds/public funds ratio worsens if the Fund's own investment is added: in total, the State spent more than USD 4 million, of which about half went to cover operating costs for less than 10 ventures invested. The weak performance of the Expansion Fund raises a number of questions: why was it not able to reach a larger universe of projects? Were the low investments mainly due to the difficult macroeconomic and exchange rate context or were there problems in defining objectives and selecting the actors involved? Was it aimed at a profile

of projects that was not yet present in the Argentinean entrepreneurial ecosystem? Is it a problem of lack of maturity and/or mismatch with the acceleration fund?

6. Final remarks

This analysis constitutes a first fundamental input for entrepreneurial financing policy in Argentina, given the scale of the Fund, the novelty of the instrument, and the lack of previous analyses of this type. As the same time, it is therefore also a key element in the study of financing innovation in the Global South.

Overall, the FONDCE, born in a very difficult context for the Argentine economy, is a necessary instrument that deserves to be continued and redefined. The Seed Fund could aim to focus more on dynamic, triple-impact ventures and crowdfunding schemes. The acceleration fund, which has worked best, deserves to be expanded, strengthened and articulated with angel investor network schemes, CVCs and CVCs in public companies and business chambers. The Expansion Fund should be rethought, perhaps concentrating on a smaller universe of companies but with deeper interventions. The projects selected should have an evolutionary and integral logic between the funding stages, with the seed projects being selected with the aim of being accelerated and expanded. Objectives or priorities in terms of the export profile of the ventures and attention to national challenges related to, for example, energy, health or the emergence of new sectors or strategic sectors may even be more transversally highlighted in each of the funds.

Building a VC industry outside North America has not been neither an immediate nor a necessarily successful process (Lerner, 2009; Gonzalo et al, 2022; Gonzalo and Kantis, 2021). Particularly in the countries of the Global South, given their productive, entrepreneurial and institutional heterogeneity, State efforts must be more significant, while there is a possibility that VC may develop while maintaining weak connections with the domestic productive structure, facilitating processes of flight and/or foreignisation of entrepreneurial and productive capabilities and indigenous developed intellectual property and human resources (Gonzalo et al, 2013; Gonzalo, 2015; Kantis et al, 2020; Pires-Alves et al, 2019).

Improving the systemic conditions in order to generate more innovative and dynamic projects, to connect the VC industry with broader national missions oriented to attack socio-environmental challenges, to strengthen the financing chain in order to reduce the entrepreneurial, IP and productive drain, to deepen the Argentinian financing system in order to allow indigenous startups to open their capital within the country, are some of the Argentinian entrepreneurial challenges that are also party of the agenda of other Global South countries (Gonzalo et al, 2022a, 2022b; Gonzalo and Kantis, 2021; Kantis et al, 2020). They will be part of another paper.

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An institutional logic perspective on the relationship between bribery and product innovation: Empirical evidence from MENA region

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Abstract

Evidence on the relationship between bribery and firms' product innovation activity in developing countries is abundant but also mixed. Moreover, limited insights exist on the effect of bribery to address the uncertainty and obstacles to the firm's business operation brought along by political instability. Building on the institutional logic perspective, we examine the relationship between bribery and product innovation. We argue that this relationship depends both on the characteristics of national governance institutions and on the firms' perceptions on how disruptive political instability is to business operations. Using a sample of 1,693 firms located in seven MENA countries, we find that when the firm's environment is characterized by high quality market based institutions, the relationship between bribery and product innovation is positive only when political instability creates an obstacle to firms' business operations; in the absence of such experience, the relationship is negative. In environments characterized by low-quality market-based institutions, the relationship between bribery and product innovation is positive, especially when political instability is not obstructing the firm's business operations. This suggests that the characteristics of the national institutions shape alone do not determine the challenges and opportunities in the use of non-market strategies such as bribery. Firms' specific experience shapes their logic and their perceptions, and the form in which they develop plans to address environmental challenges. In doing that, these findings provide new theoretical insights regarding the impact of institutional determinants on the firm's non-market strategies and eventually its performance in the MENA region. The paper

concludes discussing the implications for further theorizing the use and performance of non-market strategies, as well as the practical implications for managers and policy makers.

1. Introduction

In recent years, the relationship between the use of non-market strategies that enable access to resources and markets, such as bribery, which often takes the form of cash payments to public officials in exchange of certain privileges (e.g. regulatory privileges) or immunities (Uhlenbruck et al., 2006), and firms' performance, attracted the attention of many scholars (Xie et al., 2019; Birhanu et al. 2016). Evidence is now abundant, but also mixed, leading to two alternative theoretical conceptualizations of this relationship. One view argues that bribery has a "sanding effect" as it can extract firms' capital from investment in building new knowledge capabilities and impede them from totally internalizing the benefits of their efforts to innovate (Blackburn and Forgues-Puccio, 2009; Alam et al., 2019; Jung and Lee, 2022; Wellalage and Thrikawala, 2021). The other view argues that bribery has a "greasing effect", as it may help the firm to eliminate political obstacles, to "bend laws" in its favor, to speed up administrative processing, and, often, to gain access to confidential competitor information (Martin et al., 2007; Svensson, 2003; Krammer, 2019). As bribery biases market competition and most often involves the misuse of public resources, it is important to clarify the nature of this relationship.

With the exception of few recent studies (e.g. Jung and Lee, 2022; Krammer and Kafouros, 2022), research on the relationship between bribery and firm's performance tend to assume that the quality of institutions impacts uniformly all firms in a country (Allard et al., 2012), or confounds institutional quality with perceptions regarding institutional quality (e.g. see Xie et al., 2019). In addition, they have mostly neglected that firms may be differently exposed to macro environmental forces, and consequently experience asymmetrically substantive business challenges that calls for a response like bribing.

Extant research on non-market strategies suggests that these strategies are embedded in the specificities of their institutional environment (Nelson and Sampat, 2001; Dorobantu et al., 2017) and shaped by firms' exposure to specific environmental forces (Arora and De, 2020; Gaur, Ma and Ding, 2018). In other words, while firms may be subjected to the same institutional context, they are likely to differ in their exposure to the consequences of environmental instability, and consequently in their perception on the appropriateness of different responses to that environmental discontinuity (Nelson and Sampat, 2001; Arora and De, 2020). For example, political instability (not necessarily in the country the firm is located) may disrupt the business activities of some

firms more than others, creating obstacles not only to their normal operations but also to their innovation activities (Díaz-Díaz et al., 2022; Pertuze et al., 2019). Faced with operations disruption resulting from environmental discontinuity, firms will perceive an increased business uncertainty. In the situation of perceiving high level of uncertainty, firms face logic complexity, and as consequence engage in the re-interpretation of the situations and the value of different business strategies. Thus, firms that experience business disruption due to environmental forces are likely to reconsider their business logics, while changing their current strategies (Ocasio and Radoynovska, 2016). Hence,

Bringing in insights from the institutional logic perspective, we propose investigating the direction of the relationship between bribery and firm's performance requires to account not only for the national institutional setting of the firms, but also for firms' specific experience of disruption of their activities. In doing that, we understand bribery as a non-market business strategy that firms may decide to use to address high complexity and uncertainty related to market and resource access (Thornton et al., 2012). We argue that the relationship between bribery and new product innovation depends on two orthogonal dimensions that characterize firms' perceptions on the net benefits of bribes to accelerate innovation activities: characteristics of national institutions, and firms' experience of uncertainty and complexity affecting their business activities. We then theorize the relationship between bribery and new product innovation in four distinct situations that vary in terms of the quality of national market-based institutions and the experience of business disruption due to political instability. We test our predictions using the World Bank Enterprise Survey data from seven MENA countries.

Results show that the extent of bribes is positively (negatively) associated with product innovation in countries with low (moderate to high) quality market-institutions. In moderate to high quality institutional contexts, firms that experience obstacles to their operations resulting from political instability are likely to experience a positive, rather than a negative relationship between bribing and product innovation. In countries with low institutional quality, the positive association between bribing and product innovation is attenuated for firms experiencing business obstacles created by political instability.

This paper is organized as follows. Section 2 reviews the literature, develops the theoretical framework and the hypotheses. Section 3 presents the methods, while Section 4 shows the results. Section 5 discusses the results, their implication for theory and practice, and the direction for future research.

2. Theory and Hypotheses

2.1. Theoretical Background

Bribery is a non-market strategy that firms may employ to access scarce resources and speed up their actions (Krammer, 2019; Uhlenbruck et al., 2006).

Often considered a major obstacle for doing business due to the additional costs that it may trigger (Fisman & Svensson, 2007; Jung and Lee, 2022), bribery may as well have a “greasing effect” (i.e. a positive effect), especially when governments are ineffective and laws and regulations are rigid but instable (Krammer, 2019; Méon and Weill, 2010). This suggests that prior mixed evidence on the direction of the relationship between bribery and firm performance may result from ignoring the characteristics of firms’ institutional environment (Krammer, 2019).

The institutional economics theory stresses that national institutions create incentives for specific low- cost forms of interaction and knowledge exchange (Nelson and Sampat, 2001; North, 1990). However, while they shape the forms in which people and organizations learn and get things done (Nelson and Sampat, 2001), they are not deterministic of firms’ strategies (Nelson and Sampat, 2001). Firms are exposed to a complexity of institutional logics resulting in the pursuit of different learning paths, and the development of specific capabilities (Nelson, 1993; Lundvall, 2016; Thornton et al., 2012). Firms are then likely to develop different perceptions about the challenges faced and the needed response to those challenges (Ocasio and Radoynovska, 2016; Arora and De, 2020; Gaur, Ma and Ding, 2018). Exposure to an environmental disruption tends to lead the firm to review their strategic logics while developing a particular view on how to address those (Ocasio and Radoynovska, 2016). However, firms sharing the same national institutional setting may be differently exposed to business disruption due to increased uncertain environmental forces (Diaz-Diaz et al., 2022). Examining the relationship between bribery and product innovation while disregarding firms’ heterogeneity in their exposure to increased complexity and uncertainty in their operations due to changes in the environment, may lead to a partially biased understanding of this relationship. To address this gap, we develop a theoretical framework to examine the relationship between bribery and firm’s innovation performance that accounts for the national institutional setting, as well as firms’ experienced business uncertainty due to institutional instability.

2.2. Theoretical Framework

Institutional economics theory suggests that national institutions orient actors to specific patterns for mobilizing and managing resources and consequently to the development of certain capabilities (Freeman, 2004; Nelson, 1993; Lundvall, 2016). Building on this theoretical lens, innumerable studies show that national institutions explain part of the firms’ heterogeneity in the use and in the performance of different strategies and practices. These studies stress that countries characterized by high-quality of market-base institutions, government-controlled resources and services, provide regulatory, contractual and political certainty (Jung and Lee, 2022; Pfeffer and Salancik 1978, Aguilera

et al. 2008), while instead in low-quality market-based institutional environments, firms face higher regulatory and political uncertainty, resulting in higher information asymmetries and consequently power relationships (Khanna and Palepu 1997, Peng 2003). Using an institutional economics lens, one would then propose that, in high-quality market-based institutional setting, bribes may represent a disrespect of established legal rules and may lead to penalizations, while they may be considered as compliance to societal norms in environments where corruption is institutionalized (Collins & Uhlenbruck, 2004; Krammer, 2019). Thus, the possibility that bribes increase business costs and deviate firms' attention and funds away from innovation, or the possibility that they speed up ongoing innovation activities, may differ across institutional setting with different quality of market-based institutions.

The institutional logic perspective instead highlights that firms operate not only under national level institutions but under multiple (multi-level) institutional field-level logics that may be competing and contradictory (Ocasio and Radoynovska, 2016). A multiplicity of different "institutional demands" within a national institutional setting can exist, and there is some possibility for firms to strategically choose the "institutional demands" to adhere to (Arora and De, 2020). Therefore, despite operating under the same national institutional settings, firms may be exposed to different environmental challenges, and some macro institutional challenges may affect firms differently. In addition, this perspective stresses that firms' logics are object of change. Experience of institutional pressures and disruption, increasing firms' logics complexity, often lead to firms' reassessment of the relevance and hierarchy of different field-logics while adopting new interpretations of the business challenges and opportunities. Thus, firms' specific experience shapes their managerial interpretation of the situation, and the strategic alternatives considered (Arora and De, 2020; Nelson, 1991).

Following this perspective, one would then argue that the relationship between bribing and product innovation does not reflect only the national understanding of bribes as a common illegal mode of getting things done or as an illegal practice that can be penalized and increase firms' costs and limit innovation activities. Innovation benefits from bribing also reflect field-level and firm-level specific experiences (Arora and De, 2020). In particular, this relationship is likely to be closely related to the firms' perceived need to act to address disruption in their business activities, resulting from institutional pressure or instability.

This study has the objective to shed new light on the relationship between bribery and new product innovation by bringing in insights from the institutional logic perspective. To get a clearer understanding of this relationship it is important to examine not only the extent to which corruption is pervasive and socially accepted in the institutional setting (Krammer, 2019; Jung and Lee, 2022), but also firms' perception about a major difficulty that

requires costly and illegal responses such as bribing (Ocasio and Radoynovska, 2016). Therefore, we propose that the direction of the relationship between bribery and new product innovation depends on two orthogonal dimensions that characterize firms' cognition and thus strategic logics: characteristics of national market-based institutions, and experience of increased uncertainty in their business activities. Table 1 summarizes our theoretical framework

Table 1: The direction of the relationship between bribery and new product innovation

		National Market-based Institutions	
		Low quality	High quality
Experience of increased business uncertainty	Experienced disruption of business activities due to political instability	Grease effect	Sanding effect
	No experienced disruption of business activities due to political instability	Small Grease effect	Small Grease effect

Countries differ in the quality of their market-based institutions (Jung and Lee, 2022). Some countries have underdeveloped market-based institutions, i.e., markets do not function effectively and courts do not enforce contracts. Other countries instead have relatively strong market-based institutions, where national authorities and courts tend to enforce contracts and laws, corruption is considered a crime and are prosecuted by courts and national authorities. In such setting, firms have clear rules of doing business and these tend to be enforced (Lu et al. 2014). The consequence of firms' bribery on innovation is then likely to differ among firms operating in high and low quality market-based institutional settings. (Alam et al., 2019; Pindado et al., 2015; Krammer, 2019).

High levels of uncertainty brought along by institutional forces, challenge business activities (Knight, 1921; Lampert et al., 2020; Wenzel et al., 2020). Perceiving increased obstacles to the business operations resulting from environmental forces, firms are likely to reconsider the forms in which they organize business processes, access and develop resources, and interact with partners (Lampert et al., 2020). In doing that, they may experience the latent contradiction among different field-logics and alter their cognition of experiences and situations (Greenwood et al., 2011; Ocasio and Radoynovska, 2016). Recent research suggests that faced with political instability, firms are likely to decrease R&D investment, and to exacerbate the need for legal

protection of innovation (Diaz-Diaz et al., 2022). Hence, exposed to a disruption due to political instability, firms may not only revise the expected costs of bribing, but also the form in which they conceive its use or organize innovation activities. Faced with normal business uncertainty, firms, which do not experience disruption due environmental forces, are less likely to recognize latent logics contradiction and to perceive the need to devise an adaptation strategy (Ocasio and Radoynovska, 2016; Wenzel et al., 2020). Thus, firms' perception about bribes' costs and contribution to innovation activities, and the form in which innovation activities are organized, are not likely to suffer much reconsideration, in the absence of experience of disruption due to environmental forces. Hence, experience of business disruption due to environmental forces, such as political instability, may lead to the revision of firms' logics' hierarchy, and eventually the development of an adaptation strategy that may contradict the prescriptions of the national market- based institutions.

Next, we theorize the relationship between bribery and new product innovation in four distinct situations that vary across two dimensions: quality of national market-based institutions and firms' experience of business disruption to political instability. First, we theorize this relationship across different national institutional settings characterized by different quality of their market-based institutions. Second, we theorize this relationship considering differences in firms' experience of business disruption due to political instability along with differences in the quality of national market- based institutions.

2.3. Bribery and product innovation in low and high quality market-based institutional settings

The quality of market-based institutions indicates *"how much firms can depend on sound regulations and rules of laws that govern an entire country"* (Jung and Lee, 2022 p.8).

In countries where market-based institutions are underdeveloped, regulations and laws are not stable, which raises information asymmetries between managers and public officials (Chu et al., 2016; Hall and Lerner, 2010). This is mainly because in such setting, government officials have strong control over resource allocation and the enforcement of laws (Jung and Lee, 2022). Public officials are likely to impose arbitrary penalties and block access to resources that are critical to the introduction of new products, through enforcing extra delays or requirements (Bertrand et al., 2007). They may create numerous obstacles with regards to permits (e.g. construction permit), approvals (e.g. government contracts, customs), and licenses (e.g. import/export license) (Krammer, 2017). These individuals tend to engage in self-interest rent-seeking behavior that may alter the firm's intended outcome. In this context, where markets do not function effectively and courts do not enforce contracts, corruption may become the "norm" to do business, i.e. the form to get things

done, to avoid delays in getting services done, and in guaranteeing access to resources. In other words, despite being illegal, bribery is likely to become a common practice among peers. Bribes are then unlikely to be badly perceived by peer firms and business partners, i.e. they may not be viewed as a disrespect of norms and laws. Given the weakly functioning of markets, bribes may improve access to scarce results, and accelerate innovation activities limits at the expenses of limiting the development of alternative more value-creating business strategies to get access to resources.

Given the risky and long-term nature of product innovations (Katila and Ahuja, 2002), and the associated sunk costs, firms may seek to protect their efforts by paying (in the form of bribes) to minimize arbitrary penalties, such as additional requirements and intentional delays. Bribing firms are likely to have quicker access to the different resources they require to introduce new products, since bribes will likely facilitate access to critical policy insights, and help firms bypass bureaucracies (Krammer, 2017; Xi et al., 2019). Moreover, while bribes ensure, to a certain extent, continuous and easy access to important resources that are needed to develop new products, they also allow firms to establish relationship with public officials, and hence may influence policymaking (REF). This may allow bribing firms to push favorable policies, or obtain privileged information about policy changes, which may motivate or facilitate the introduction of certain products (Chryssochoidis and Wong, 1998; Krammer, 2017), and assure protection of their market advantage. Throughout bribery, firms may gain advantages in obtaining hard-to-access government resources, contracts, and permissions to operate unlawfully, which excludes other firms from fair competition and put them at a cost disadvantage (Nguyen et al., 2020). Such advantages can accentuate the efficiency of their R&D efforts, resulting in higher R&D outcomes.

Non-bribing firms, on the other hand, unlikely to have established strong relationships with public officials, may face arbitrary and capricious regulations (Ades and Chua, 1997; Matta et al., 2018) that can halt the development and introduction of new products. Government agents tend to manipulate economic rules to the benefit of favored economic agents (i.e. bribing firms) (Blackburn and Forgues- Puccio, 2009). As such, bribing firms are likely to gain a competitive advantage over non-bribing firms, as bribes facilitate administrative procedures and access to different resources (Svensson, 2003; Krammer, 2019), and allow firms to shape policies in their favor (Iriyama et al. 2016; Krammer, 2017). Thus, non-bribing firms may lag in accessing innovative inputs, protecting their innovation efforts, and on resolving disputes over contracts, and property rights.

In countries with a relatively high quality of market-based institutions, stable regulations and laws define the rules to access information and resources, courts tend to enforce contracts and laws, and corruption is considered a crime and are prosecuted by courts and national authorities. A strong regulatory

environment may stimulate firms' innovative output by positively influencing the cost of innovation inputs, while protecting the innovation output (Wang et al., 2015). Solid institutions promote investment in education, strong financial systems and legal protection, and stable public policy, which altogether are likely to have a positive impact on firm's performance (Pindado et al., 2015; Varsakelis, 2006; Krammer, 2009). In addition, in high quality governance institutional settings, bribery is not a socially accepted norm to do business (Krammer, 2019), and anti-corruption laws are enforced (Krammer, 2019). In such institutional setting, firms have clear rules of doing business and these tend to be enforced (Lu et al. 2014), permitting firms to avoid costs with rent-seeking agents to get access to scarce resources.

In this context, bribing firms will likely experience high transaction costs given that they will be paying for favors from government agents unnecessarily as rules and laws are unlikely to change arbitrarily. In addition, control on corrupt behavior is systematic, which may endure additional costs. As bribery is considered as divergence from societal norms and expectations, peer firms and peer public officials are likely to report any corrupt suspicious of behavior to concerned authorities. Bribing may then result in sanctions and penalties that trigger additional challenges to the firm's activities and obstruct or delay the introduction of new products.

Bribing firms are likely to try to avoid rumors of facilitated access to resources by implementing secrecy, which besides increasing the cost of bribing, also limits exchange for innovation development. Avoiding or reducing interaction with certain external partners, to avoid disclosure of preferential access to inputs, firms may decrease possibilities of knowledge transfer relevant for innovation (Wadhwa et al., 2017). For example, when collaborating with value-chain partners or public research organizations, bribing firms may not be able to exchange all the required knowledge on inputs, product specifications markets and other relevant accessed resources through bribing. This is likely to delay the innovation process, and consequently the likelihood to introduce new products in the market.

Based on the above discussion, we argue that:

H1: In countries with high quality of market-based institutions, the relationship between the extent of bribery and firms' probability to introduce new product innovations is likely to be negative, while in countries with low quality of market-based institutions, the relationship is likely to be positive, ceteris paribus.

2.4. Experience of disruption due to political instability

Experiencing business disruption due to political instability (in the country in which the firm operates, but also in other countries), firms may perceive the emergence of additional costs to understand the interrelationships between elements within their business environment (Milliken, 1987), and get

increasingly concerned regarding obsolescence of their strategies. Indeed, recent research using data on Spanish firms finds that firms experiencing political instability are likely to decrease R&D investments and to increase attention on innovation protection.

The impact of political instability on business activities is however likely to asymmetrically impact the business activities of firms operating in a specific institutional setting. Some business activities may experience more arbitrary delays and obstacles than others such as new difficulties in accessing complementary resources, which are likely to be exclusively captured and appropriated by those in power (Bertrand et al., 2007; Fuentelsaz et al., 2014). Firms' that experience business disruption due to political instability are more likely than those not experiencing such disruption to engage in a process of reconsideration of logic hierarchy, and revision of business processes and strategies (Ocasio and Radoynovska, 2016). This may eventually lead to the development of an adaptation strategy that may contradict the prescriptions of the national market-based institutions.

Next, we discuss how experience of business disruption due to political instability influence the direction of the relationship between the extent of bribing and new product innovation, in countries with high a low-quality market-based institutions.

Countries with low quality of market-based institutions

Changes in the political system or in public policy may shuffle the power of different interest parties and increase conflict among them, and result in 'shaky' regulations (Kassinis and Vafeas, 2006). Access to specific resources is likely to be captured by different heterogeneous groups that pursue uncoordinated rent-seeking behavior. In this situation, "demand for a bribe by one [party] in exchange for his own governmental good imposes a pecuniary externality on other [parties] by reducing the demand for their governmental goods and, with this, their ability to profit from corruption" (Blackburn and Forgues-Puccio, 2009, p. 790). Thus, firms that experience disruption due to political instability may become confused about whether they are bribing the right person/organization with power to enable access to the specific desired scarce resource. Facing increased competition among different corrupt parties (Blackburn and Forgues-Puccio, 2009), firms' costs of bribing is likely to increase. Also, bribes mostly target shortening administrative delays or reducing unnecessary paperwork to access resources and markets, but they will unlikely be used to exclude other firms from accessing the same procedures or services.

Operating in an institutional environment where corruption laws are not systematically enforced, and bribing is recognized as a form to facilitate access to scarce results, firms that experience business disruption may be obliged to

use alternative strategies. Engaged in identifying the rent-seeking gatekeepers of specific resources in a reshuffled power structure, firms are likely to be distracted from ongoing advances in markets and technologies, and from identifying alternative paths for their innovation activities. Thus, firms that experience business disruption due to environmental instability tend to neglect opportunities to overcome difficulties in accessing specific resources by revising their innovation processes. Changes in the structure of linkages and their governance or in the focus of the innovation, could eventually permit the firm to overcome the experienced disruption on their activities.

Non-bribing firms that experience business disruption due to political instability, on the other hand, may see their disadvantage in relation to their bribing competitors in access to relevant resources decrease. This is because political instability tend to make bribing less efficient, more costly and more demanding of firms' attention. In addition, non-bribing firms may have already identified bribing- alternative strategies for accessing scarce resources, which they may repurpose to address the disruption in their activities caused by political instability.

Bribing firms that do not experience disruption due to political instability are likely to use bribing not only to guarantee speeding up service delivery or facilitating administrative procedures but also to gain exclusive advantages in accessing rare government resources (Nguyen et al., 2020). Thus is likely that they have advantages towards non-bribing firms in their possibilities to develop a product innovation. We then propose:

H2a: In countries with low quality of market-based institutions, the positive relationship between extent of bribery and new product innovation is likely to be attenuated for firms that experience disruption due to political instability.

Countries with high quality of market-based institutions

Experiencing business disruption due to political instability, firms operating in countries with strong governance may still question whether relevant (national or international) institutions will be able to restore business conditions timely. Facing increased business uncertainty due to environmental forces such as political instability, firms face a logics conflict, and tend to reinterpret the different situations and alternative strategies to address them. In doing that, firms may frame strategies in a mode that accept rather than oppose resistance to logics contradiction, and develop an integrated active or a patchy defensive adaptation strategy (Ocasio and Radoynovska, 2016; Wenzel et al., 2020)

Accepting the logics contradiction between market-efficient institutional setting and the inability to get access to relevant inputs, firms may try to restructure innovation activities in order to overcome the need for specific scarce resources. In doing that, firms may engage in a more radical innovation approach (Ocasio

and Radoynovska, 2016; Wenzel et al., 2020), which will most likely delay the possibility to bring to market new products in a timely manner.

Refusing the logics contradiction, the firm may view the situation as qualifying for an extraordinary patchy response that aligns with the experienced consequences of political instability. Bribery is then logically accepted as an extraordinary strategy to reestablish business conditions and access “difficult” key resources for their operations and innovation activities. Given the instability in the relevant inputs markets, firms perceive bribing as less risky, i.e. it is unlikely that preferential access to scarce results will be perceived by peers as a result of bribing. Thus, firms may prepare a discourse to justify access to the resources, and hence keep exchanging knowledge and information with their usual innovation partners. In addition, bribing may eventually permit the firm to access relevant resources and overcome the experienced difficulties, and thus improve the likelihood to innovate.

Bribing when not experiencing business disruption due to political instability means the decision to undertake a quite visible illegal strategy for peers and for firms’ business and innovation partners. To avoid legal consequences, bribing firms may need to implement severe secrecy measures to avoid being pursued by corruption. Secrecy enforcement is likely to limit greatly the benefits of exchanges with different partners for innovation (Wadhwa et al., 2017). Accordingly, we expect:

H2b: In countries with high-quality of market-based institutions, the negative relationship between extent of bribery and new product innovation is likely to be attenuated for firms that experience disruption due to political instability

3. Methodology

3.1 Sample and data

The quantitative analysis is based on firm-level data from the 2013 World Bank Enterprise Survey for seven countries in the MENA region: Morocco, Jordan, Yemen, Lebanon, Djibouti, Israel, and Tunisia. The MENA region experienced high levels of political unrest between late 2010 and 2012. This period was characterized by mass protests that paralyzed most industries, reduced production due to workers’ strikes and absenteeism (Krueger and Mas, 2004), and several reforms, regime reconfigurations and political discontinuities (Malik and Awadallah, 2013), which trigger high uncertainty about the future political and economic agendas (Matta et al., 2018). Our sample only includes firms in countries for which data from 2013, which marks the period right after “Arab Spring”, was available. This era marks a period where institutions are more likely to fail, making rent-seeking behaviors (i.e. bribery) more observable. After removing missing observations, the final sample includes 1,693 firms.

3.2 Measures

3.2.1 Dependent variable

Product innovation: we define the dependent variable using information from the following question:

a) Whether or not the establishment introduced new or significantly improved products or services in the last three years. This variable thus takes the value 1 if the firm has introduced a product innovation, or 0 otherwise. This measure is often used as a proxy to capture the firm's product innovation in the literature (Werner et al., 2017; Garcia and Calantone, 2002; Krammer, 2017), and is thus adequate for this study.

3.2.2 Independent variables

Bribery: We measure bribery using information regarding informal gifts or payments offered to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services, etc. Following Krammer (2017), we use the following question:

It is said that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services etc. On average, what percentage of total annual sales, or estimated total annual value, do establishments like this one pay in informal payments or gifts to public officials for this purpose?

Respondents were asked to specify the percentage of total annual sales paid as gifts and informal payments. We use this information to create our bribery variable, which, measures the ratio of total sales paid as bribes to public officials. (Ref to studies that used the same measurement)

Quality of national market-based institutions: We used the World Governance Indicators (WGI) developed by Kaufmann et al. (2009), which consist of six indicators¹, to measure the national governance institutions' quality (Castellaci et al., 2022; Jung and Lee, 2022). We created a composite measure that takes into account the six dimensions by summing the scores of the different indicators for each country and dividing the total by six. We then rescaled the index, which ranges between -2.5 and 2.5, by adding 2.5² (Krammer et al., 2017). As such, this variable ranges between 0 and 5, with higher values indicating stronger institutional quality.

Experienced disruption due to political instability: This variable captures whether or not political instability is perceived as the most important obstacle to the firm's operations. Respondents had to choose from a list of obstacles related to the business environment, the most challenging obstacle faced by their establishment. This variable thus takes the value 1 (high political

instability) if the firm believes that political instability is the most challenging obstacle, 0 (low political instability) otherwise.

3.2.3 Control variables

We added controls for several variables. First, exporting firms are more likely than non-exporting firms to explore new technological advancements and to learn by inspecting and analyzing breakthrough innovations of international organizations (MacGarvie, 2006), and thus to be more innovative (Wang and Kafourous, 2009). Therefore, we use a dummy variable (1: exporting firm, 0 otherwise) to control for whether or not the firm is directly exporting. Second, since foreign and domestic firms are likely to have important differences (Girma et al., 2009; Krammer, 2017), we control for whether or not the firm has a majority foreign ownership. Third, we control for managerial experience by including a variable that captures the number of years (log) of industry experience of the manager (Krammer, 2017; REF), as well as a variable that captures his/her level of education. Fourth, following Krammer (2017), we control for firm performance using log difference of firm sales minus its labor costs. Fourth, we control for possible size and age effects as bigger firms are more able to devote resources to develop new products, while older firms are likely to have more experience, which is likely to influence innovation (Hansen, 1992). Finally, we add controls for industry and country fixed-effects in order to capture differences in the innovative activity among different sectors and countries.

3.4 Estimation

The dependent variable captures whether or not the firm has introduced new product innovations. Thus, we use a probit regression with robust standard errors clustered at the city level to estimate the probability of a firm to develop product innovations. In addition, given the possible endogeneity issue between bribery and firm performance (Vial & Hanoteau, 2010; Krammer, 2017), we follow the literature (Krammer, 2017; Fisman and Svensson, 2007; Wellalage and Thrikawala, 2021) and instrument the firm-level measure of bribery with the region-sector average of bribery³. In both estimations, we use clustered standard errors at the geographical cluster level, i.e. the city level, to account for heteroskedasticity and correlation between firms in the same geographical region⁴. Table 1 reports the descriptive statistics and the correlation coefficients among the study variables. Overall, the correlations coefficients are low, suggesting that multicollinearity is not an issue.

Common method bias may artificially inflate correlations between variables. The World Bank Enterprise Survey often uses different informants for different variables, as the survey is sometimes conducted over more than one day, ensures full anonymity of the respondents, and relies on establishment records to check the accuracy of some of the constructs. These procedural methods are

likely to decrease common method bias (Vaccaro et al., 2012). In addition, we also examined the data using Harman's one-factor test (Podsakoff and Organ, 1986). The results of the principal component factor analysis revealed seven factors with eigenvalues greater than one, explaining 67.33% of the total variance. The first factor accounted for 16.66% (<50%) of the variance only, which is less than the majority of the variance (Podsakoff and Organ, 1986). Therefore, based on the World Bank's procedural methods and the statistical technique described above, we concluded that the data is unlikely to suffer from common method bias.

(Insert Table 1 about here)

4. Results

Our estimation results are presented in Table 2. Models 1, 2, 3, and 4 report results for the probit estimation. Model 1 is the baseline model with controls only. Model 2 adds the bribery variable. Model 3 adds the quality of national institutions, and the interaction between bribery and quality of national institutions. Model 4 adds experienced disruption due to political instability, and the triple interaction between bribery, the quality of national institutions, and experienced disruption due to political instability. Model 5, report the results for the conditional mixed process model.

Insert Table 2 about here

The coefficient for bribery is positive and significant in all of the models (Model 2, $p < 0.05$; Model 3 and 4, $p < 0.01$; Model 5, $p < 0.05$). The coefficient for the interaction between bribery and the quality of national institutions is negative and significance (Model 3 and 4, $p < 0.01$; Model 5, $p < 0.05$). Since the probit estimation is a non-linear method, we plot the results of the interaction in Figure 1 based on model 4. Figure 1 shows that the quality of institutions attenuates the impact of firms' bribery intensity on the probability to develop product innovations, such that in countries with high-quality market-based institutions the relationship is negative and in countries with low-quality institutions this relationship is positive. These results support H1 on the differentiated relationship between bribery and the introduction of new products in countries with high and low-quality of market-based institutions.

(Insert Figures 1 & 2 about here)

In model 4, the coefficient of the interaction between bribery and national institutions' quality is negative and significant ($p < 0.01$), and the coefficient of the three-way interaction between bribery, national governance institutions' quality and experienced disruption due to political instability is positive and significant (Model 4, $p < 0.01$; Model 5, $p < 0.05$). In order to understand the results of the non-linear probit model, we plotted the results of the three-way interaction (Figure 2) based on the procedure described by Aiken and West

(1991). Figure 3 shows that in countries with high-quality of market-based institutions, experienced disruption due to political instability changes the direction of the relationship between bribery and the probability to develop product innovations. For firms that experienced disruption of business activities, this relationship becomes positive. This result support H2b, which suggest that the sanding effect of bribery in countries with high-quality of market-based institutions could be overturned for firms experiencing business disruption due political instability.

In countries with low-quality of market-based institutions, the direction of the relationship between bribery and product innovation is positive for both firms that experience and do not experience business disruption due to political instability. However, the curve for firms that experienced business disruption is much flatter than for those that did not experience disruption, suggesting a smaller greasing effect. This result partially supports H2a.

The control variables act as follows. Exporting ($p < 0.01$), and older firms ($p < 0.1$) are more likely to introduce new products than non-exporting, or younger firms, respectively. We find no significant effect of the rest of the controls on the propensity to introduce new product innovation⁵.

(Insert Figure 3)

5. Conclusion

This study set up to shed light on the relationship between the non-market strategy of bribing and product innovation. Building on the institutional logic perspective, we propose that the direction of this relationship is not homogenous under the same national institutional setting. Instead, it depends on whether the firm experienced increased uncertainty in their business activities, which is likely to make the firm to reconsider the dominant logics and to reinterpret situations and alternative strategic responses. Therefore, we propose that exposure to increased business uncertainty due to institutional environment pressures is likely to shape the form in which firms organize their innovation activities and how they use specific practices and strategies.

Using a sample of 1,693 firms located in the MENA region, our evidence supports the thesis. Specifically, results show that the extent of bribes is positively (negatively) associated with product innovation in countries with low (moderate to high) quality market-institutions. In moderate to high quality institutional contexts, firms that experience obstacles to their operations resulting from political instability are likely to experience a positive, rather than a negative association between bribing and product innovation. In countries with low institutional quality, the positive association between bribing and product innovation is attenuated for firms experiencing business obstacles created by political instability.

Building on the corruption literature, which emphasizes the role that non-market strategies can play in influencing firms' innovative output (Xie et al., 2019, Krammer and Jiménez, 2020), this study contributes to institutional theory by providing evidence that the influence of firm's non-market strategies, that are likely to influence the firm's innovative output, can be reshaped not only by the quality of institutions, but also by perceptions regarding external uncertainties. We extend previous studies that investigated how the interplay between environmental conditions and bribery (e.g. Xie et al., 2019) influences firms' innovative output by showing that firms bribery activities can have unlike influence on innovation, depending on the quality of the institutions but also on firm's perceptions regarding how disruptive the external environment is to the firm's business operations. We thus extend the literature by conceptualizing and investigating the effect of perceived disruption due to uncertainty on the firm's ability to develop new forms of knowledge and capabilities, and to overcome internal resources constraints under different institutions.

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Table 1. Descriptive Statistics and Correlations

Variable	Mean	SD	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1) Product innovation	.2947431	.4560619	0	1	1.0000										
2) Bribery	2.220057	.5647272	.996	3.181	-0.1836*	1.0000									
3) National governance	.4784406	2.100105	0	30	0.1081*	-0.2892*	1.0000								
4) Political instability	.2864737	.452247	0	1	0.0660*	-0.2728*	0.0572*	1.0000							
5) Exporting	.3490845	.4768216	0	1	0.2332*	0.0234	-0.0075	0.0375	1.0000						
6) Foreign	.0561134	.2302086	0	1	0.0450	0.0075	-0.0250	0.0045	0.1930*	1.0000					
7) Industry experience	3.025306	.6000706	.6931	4.26	0.0004	0.1270*	-0.0440	0.0790*	0.0823*	-0.0553*	1.0000				
8) Education	4.443001	.8497495	1	5	0.0213	0.1832*	-0.076*	-0.0382	0.1739*	0.1055*	-0.136*	1.0000			
9) Financial performance	2.169582	1.390773	-4.499	21.41	0.0066	-0.1053*	-0.0419	0.0625*	0.0469	0.0089	0.0484*	0.0576*	1.0000		
10) Firm size	2.451276	1.121126	.6931	7.601	0.0819*	-0.0484*	-0.0433	0.0237	0.2697*	0.2537*	0.0112	0.1826*	0.0087	1.0000	
11) Firm age	2.818763	.7322081	.6931	4.882	0.0888*	-0.0091	0.0218	0.0549*	0.0927*	-0.0535*	0.4875*	-0.0437	0.0615*	0.0158	1.0000

Table 2. Probit estimation results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
					DV: Product innovation
Bribery		0.0281** (0.0147)	0.137*** (0.0515)	0.208*** (0.0612)	20.82** (8.495)
National governance		0.383 (2.715)	0.210 (2.703)	0.120 (2.697)	0.120 (1.179)
Bribery * National governance			-0.0876*** (0.0319)	-0.138*** (0.0397)	-13.81** (5.481)
Political instability				-0.0699 (0.385)	-0.0699 (0.350)
Bribery * Political instability				-0.245*** (0.0777)	-24.44* (14.58)
National governance * Political instability				-0.00386 (0.187)	-0.00386 (0.167)
Bribery * National governance * Political instability				0.224*** (0.0524)	22.37** (10.71)
Exporting	0.583*** (0.0708)	0.575*** (0.0712)	0.579*** (0.0718)	0.591*** (0.0697)	0.591*** (0.0783)
Foreign	0.0249 (0.183)	0.0252 (0.183)	0.0211 (0.185)	0.0228 (0.185)	0.0228 (0.147)
Industry experience	-0.107 (0.0866)	-0.106 (0.0848)	-0.109 (0.0823)	-0.118 (0.0834)	-0.118* (0.0698)
Completed Primary school	-0.0812 (0.290)	-0.0788 (0.278)	-0.0716 (0.284)	-0.0781 (0.282)	-0.0782 (0.307)
Preparatory or Incomplete Secondary school	-0.146 (0.249)	-0.178 (0.238)	-0.194 (0.241)	-0.193 (0.232)	-0.193 (0.278)
Completed Secondary school	-0.349 (0.223)	-0.382* (0.197)	-0.390* (0.203)	-0.407** (0.206)	-0.407 (0.255)
University degree or higher	-0.0259 (0.225)	-0.0510 (0.206)	-0.0593 (0.211)	-0.0712 (0.210)	-0.0713 (0.253)
Financial performance	-0.0191 (0.0255)	-0.0139 (0.0248)	-0.0109 (0.0244)	-0.00941 (0.0246)	-0.00941 (0.0245)
Firm size	0.0231 (0.0403)	0.0251 (0.0408)	0.0265 (0.0411)	0.0271 (0.0418)	0.0271 (0.0334)
Firm age	0.115* (0.0599)	0.114* (0.0606)	0.114* (0.0603)	0.112* (0.0607)	0.112** (0.0559)
Industries	Yes	Yes	Yes	Yes	Yes
Countries	Yes	Yes	Yes	Yes	Yes
Bribery Average					0.149*** (0.0344)
Observations	1,693	1,693	1,693	1,693	1,693
Log pseudolikelihood	-904.47098	-902.69315	-900.84885	-897.30544	-963.26277
Pseudo R ²	0.1189	0.1206	0.1224	0.1259	

Robust clustered standard errors in parentheses *p<0.1, **p<0.05, ***p<0.01

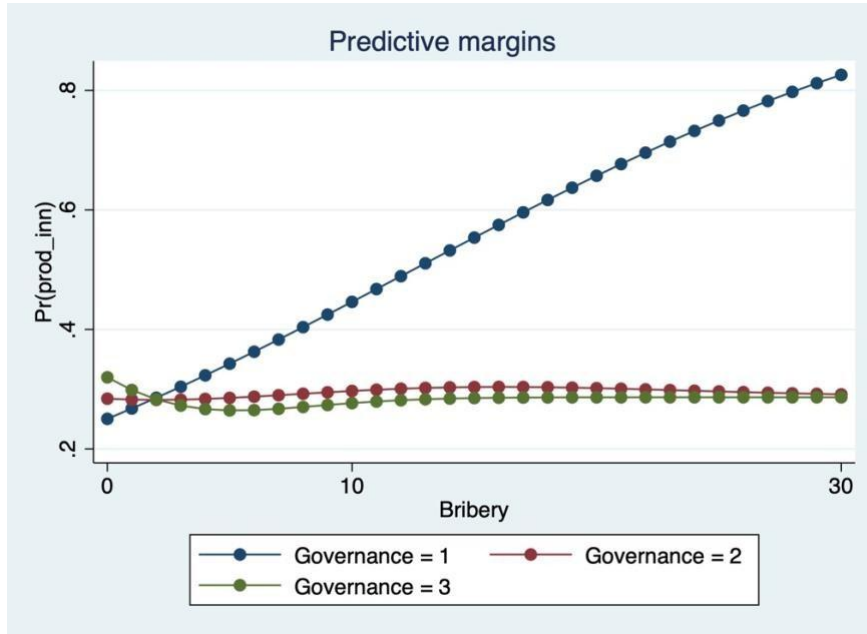


Figure 1. Interaction between bribery and national governance

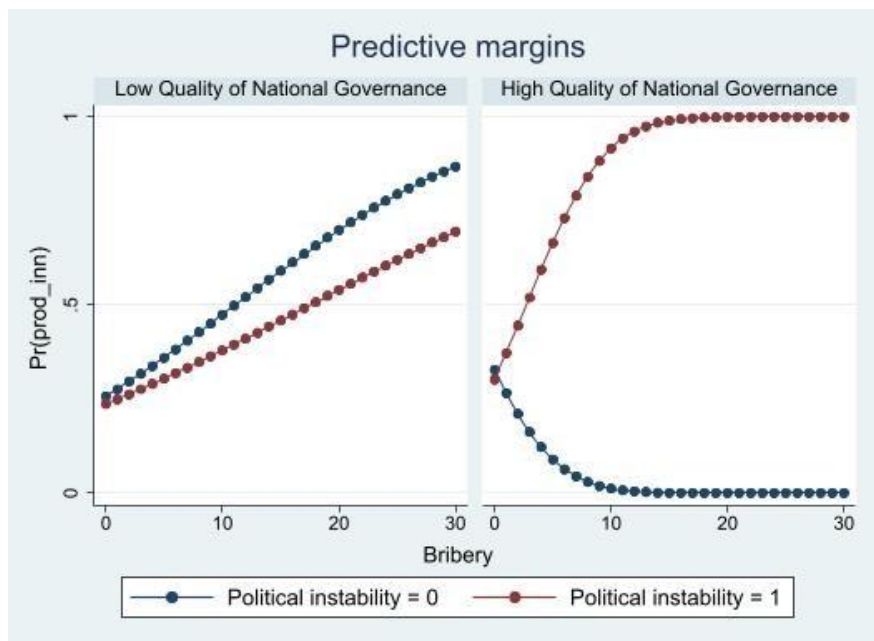


Figure 2. Interaction between bribery, national governance, and political instability

Notes

¹ These indicators are, Control of corruption, Rule of law, Regulatory quality, Government effectiveness, Political Stability and Absence of Violence/Terrorism, and Voice and accountability

² Similar to Krammer (2017), we rescale this variable to simplify interpretation of the coefficients

³ We Exclude the focal firm when calculating the average bribes in a given region-sector

⁴ Results are consistent using robust standard errors

⁵ The results show that firms with managers that completed secondary education are less likely to introduce new product innovation. However, the significance of this variable is not consistent across the models.

A firm-level study of gender diversity of the board composition of Indian firms on innovation and performance

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Abstract

We investigate the impact of gender diversity leadership on firm-level innovation efforts and performance in India. Despite the growing consensus on the benefits of diversity, achieving gender diversity in developing countries remains a significant challenge due to rigid cultural structures. There is limited research on the link between gender diversity on the board of directors and firm-level innovation. Furthermore, despite the increase in affirmative policies focused on inclusion, questions remain about their effectiveness and whether diversity is genuinely being achieved or tokenised. We try to address this gap by examining the relationship between gender diversity on the board of directors and innovation. We use three datasets: CMIE-Prowess, NSE-Infobase, and the National Patent Database of India, covering ten years (2006-2015) and 6151 firms in 32 manufacturing industries. Our findings contribute to the literature on diversity and innovation in emerging economies and aim to inform policy decisions regarding diversity initiatives in leadership positions.

1. Introduction

Diversity has been central to the public debate in the past decade. This debate started in developed countries and has recently reached parts of the developing world. Gender equality is integral to Agenda 2030 of the United Nations and goal number 5 of the 17 Sustainable Development Goals. There is ever-increasing literature stating the benefits and challenges of diversity to different types of performance and innovation outcomes. The main arguments showing the positive mechanisms highlight that diversity and heterogeneity in terms of gender, race and skills generate complementarities that allow for recombination, resulting in environments with creative solutions that can positively adapt to market conditions.

Regarding gender diversity, men have historically occupied, with some notable exceptions, the most relevant positions of power. That pattern remains in contemporary times, either in political or economic positions. Unsurprisingly, males have mostly occupied the composition of board members in the most important firms, which is particularly dramatic in developing countries. Since the last two decades, however, there has been a surge in criticism about the lack of gender diversity in the job market, from the lower positions to the most critical power roles.

A growing literature (Babic & Hansez, 2021; Jalalzai, 2013; Akpinar-Sposito, 2013) on gender has highlighted women's challenges in reaching power positions and imposing a glass ceiling. Especially in the context of Western developed countries, there is a growing consensus that affirmative policies should target women and people with diverse backgrounds to encourage a more diverse work environment. Words such as inclusion and empowerment have entered the public debates and are fundamental values in the current business environment, at least in terms of discourse.

An important part of the literature focuses on the diversity of the board of directors to assess the economic position of power. A growing part of the literature argues (Katmon et al., 2019) that the lack of diversity locks in the creative possibilities of firms. Furthermore, there is a social push from a human rights perspective toward equal opportunities and the idea that people should be judged only by their capacity and not by any gender, ethnic or racial trait.

Although the gender gap in power positions and opportunities persists, there has been a positive shift in recent years towards increased representation of women. In the United States, for instance, women held 28.8% of executive positions in S&P 500 companies in 2021, a notable increase from 21% in 2015. Similarly, in Europe, the proportion of women holding board seats in the largest publicly listed companies rose from 15% in 2010 to 22.2% in 2020. We can attribute this encouraging trend towards greater gender diversity to various factors, including implementing direct policies by firms and government

inclusion policies. Despite the positive trend observed in the US and Europe, marked by a steady increase in the average number of women in power positions, the gender gap in leadership roles and opportunities persists, particularly in developing countries¹. The gender discussions attribute the underrepresentation of women in top posts to various barriers they face, including gender bias and discrimination in the workplace. Hence, while the progress towards greater gender diversity is encouraging, a significant gap exists in creating an equitable and inclusive work environment.

Rigid cultural structures still put barriers against more gender diversity in the context of a "macho" culture, which is still present in many developing countries – with stereotypes such as "Women seen as not capable" and "role of the women is to take care of the house". Furthermore, there are arguments on risk aversion, highlighting that capitalism rewards risk-taking activities. As males tend to be more prone to risk, they are more prone to stay in power positions. Those cultural elements are still strong and widespread in more traditional societies, such as the case of India. Those rigid traditional patriarchal structures have been imposing breaks towards diversity.

There is an international push for diversity. However, with rigid structures, and as more women become members of firms' boards of directors, there are many questions regarding if those positions empower women to take decisions or if diversity exists mainly as an appearance to present a company as diverse. In contrast, the core of decision-making still resides in a male-dominated environment. Is that real empowerment or tokenisation? Having more women on the board does not guarantee that their voice strongly impacts the final decisions. Instead, they might be added as tokens to present an image of diversity without a proper impact (Zimmer, 1988).

Regarding impacts, a central question is how diversity can impact innovation. Internal and external drivers influence innovation. Internal drivers of innovation include a firm's resources, capabilities, and organisational culture. External drivers include market demand, competition, and technological advancements. Diversity can impact both internal and external drivers of innovation. A diverse workforce can enhance a firm's resource base, capabilities, and ability to respond to changing market demand and competition. In addition, diversity in the network of partners and stakeholders can bring novel perspectives and prospects for collaboration that stimulate innovation. Thus, organisations that aim to cultivate an innovative culture should consider the influence of diversity on the drivers of innovation. Hence, in this context, implementing diversity-oriented affirmative action has become prevalent in various countries worldwide. Norway, France, and Israel, among others, have introduced legally mandated quotas for board gender diversity (Terjesen et al., 2015). Hence, further research is needed to investigate how policies promoting corporate board diversity can support and enhance innovation outcomes and other economic outcomes for firms.

The impact of gender diversity on corporate boards on firm-level innovation is a subject of contention due to mixed empirical evidence. Although the literature suggests that women directors bring unique perspectives and experiences that can enhance problem-solving, decision-making, and creativity, there is also negative evidence. For example, increasing gender diversity can lead to conflicts and decreased social cohesion within the board, which may negatively impact innovation outcomes. Additionally, the effectiveness of gender diversity in driving innovation may vary depending on the industry and the type of innovation. Specifically, the literature finds that gender diversity has positively affected innovation outcomes in industries that require high levels of creativity and risk-taking but not in routine-based and standardised industries. Thus, the relationship between gender diversity and innovation is context-specific and multifaceted.

2. Literature Review

There are different ways of categorising diversity. One type of categorisation is social diversity. This preliminary review draws primarily from corporate entrepreneurship and gender literature, linking it with the innovation economics literature. We mainly discuss literature on innovation, leadership diversity, and gender roles in the corporate world.

a. Leadership and Diversity

A central theory in the corporate governance literature is the positivist agency theory (Johnson et al., 1996). The agency theory opens the debate to discuss how the characteristic of board members can affect a firm's performance. However, in a similar context, a second theoretical stream regards the Upper echelons theory (Hambrick, 2007, Hambrick & Mason, 1984). This theory asserts that the different individual traits of the managers, such as education level and diversity in terms of gender, age, and tenure, highly determine a firm's innovation decisions and strategies.

In recent years, there has been significant interest in the economic importance of gender diversity on corporate boards, spurred in part by policymakers and media attention. Prior research has established a link between gender diversity on boards and several positive outcomes, including corporate financial performance (Adams & Ferreira, 2009), patent outcomes (Chen et al., 2014), radical innovation (Díaz-García et al., 2013), creativity (Baer et al., 2014), and fraud reduction (Cumming et al., 2015). These findings are consistent with other theoretical and empirical evidence that suggests that women make financial decisions differently from men (Agnew et al., 2008; Barber & Odean, 2001). For instance, research discusses that women are more ethically sensitive (e.g., Bruns & Merchant, 1990; Cohen et al., 1998; Owhoso, 2002), have less tolerance for failure (Jenkins et al., 2014), exhibit greater risk

aversion (Barber & Odean, 2001; Byrnes et al., 1999), and are less prone to isolated groupthink (Abbott et al., 2012). To expand upon the relationship between the diversity of scope and innovation, Gompers et al. (2014) demonstrate that female venture capitalists exhibit significant underperformance compared to their male counterparts, which the author attributes to a lack of support from their male colleagues.

Furthermore, in an update to this study in 2017, the same authors illustrate that male venture capitalists with daughters perform better than male venture capitalists without daughters. This gender bias in venture capital was evident in a legal dispute at Kleiner Perkins, one of the world's most renowned venture capital funds. A female partner filed a lawsuit against her colleagues for gender discrimination. More generally, numerous firms supported by venture capitalists, including the well-known Google, have been confronted with lawsuits alleging gender discrimination in recent years.

However, Cumming and Leung (2021) argue that the characteristics of the industry in which a firm operates influence the significance of diversity in education, specialisation, technological skill, and gender. In an already diverse industry, the importance of diversity for innovation diminishes. The innovation benefit of diversity in an industry already characterised by diversity is minimal since other organisations in that industry will have already realised the benefits of diversity. In other words, the marginal impact of an additional firm that brings about a representatively diverse perspective will be pretty low in an industry characterised by diverse firms that have already taken advantage of their diverse perspective. On the contrary, firms that operate in industries dominated by males, for instance, will have limited exposure to the innovation value of diversity from a female perspective.

Sufficient attention has been given to how women have overcome the "glass ceiling" and attained membership on the board of directors. In several countries, such as Spain and France, the government mandates that companies allocate board seats to women and imposes penalties for non-compliance (Terjesen et al., 2015). Despite such efforts, the number of women directors remains insufficient to achieve equal representation with their male counterparts (Terjesen et al., 2015).

Empirical studies examining the relationship between gender diversity and innovation outcomes are limited in number and have yielded inconclusive results. Specifically, some authors have argued that board gender diversity has no significant impact on innovation investment (Martin et al., 2012), R&D teams, and incremental innovation (Diaz-García et al., 2013). Moreover, Erkut et al. (2008) and Torchia et al. (2011) have suggested that boards must include at least three women to make a meaningful contribution to board effectiveness. In contrast, other authors have emphasised the importance of women's presence as a key factor in promoting innovation (Torchia et al., 2018)

According to Nielsen and Huse (2010), female directors have a greater sensitivity towards others and a concern for their well-being. They tend to be more accepting of others' viewpoints and may work to reconcile the CEO's and shareholders' interests (Lakhal et al., 2015). As a result, they may improve the monitoring of CEOs and prevent them from focusing solely on short-term performance. Women directors are likely to promote a balance between exploratory innovation, a high-risk, high-reward strategy for the benefit of shareholders, and exploitative innovation promoted by the CEO to generate short-term returns. Female directors are known for their participative leadership style and for collaborating with managers rather than controlling them (Nielsen and Huse, 2010). Munari and Sobrero (2003) suggest that they effectively perform strategic control tasks, which could motivate managers to engage in long-term innovation projects. However, it is important to note that diversity is not equally important in all countries (Adams et al., 2015). Therefore, It is important to separately examine the strength of the relationship between board diversity and various firms' outcomes in each country in specific contexts.

b. Diversity and Tokenisation

Gender diversity is increasingly important in today's corporate world, but achieving true equality requires overcoming many challenges. One of the problems is tokenisation, which occurs when women are added to boards or executive positions merely to fulfil a diversity quota rather than for their skills and qualifications. Tokenisation can marginalise women's voices and limit their ability to effect organisational change.

Additionally, a risk-aversion hypothesis suggests that women are more risk-averse than men, which may affect their performance in industries with higher levels of dependency and innovation intensity. However, recent research has shown that gender-diverse teams can be more innovative and productive due to the diversity of perspectives and ideas brought to the table.

Another issue is the behavioural and signalling effects of firms. Companies that prioritise gender diversity are more likely to be seen as socially responsible and ethical, which can enhance their reputation and attract talent. However, some firms may only focus on diversity to signal their commitment to social responsibility rather than implementing real change within their organisation.

Theories such as "tokenisation" and "macho theory" perpetuate misconceptions about the role of women in society and the workplace. The macho theory suggests that women are not suited to leadership roles due to their supposed lack of aggression and competitiveness. At the same time, tokenisation implies that women are only included in leadership positions to meet diversity quotas. These misconceptions are often rooted in societal norms and beliefs that limit the opportunities available to women.

To address these challenges, companies need to implement policies and practices that promote genuine diversity and inclusion. That includes actively seeking qualified women candidates for leadership positions, supporting and mentoring female employees, and creating a workplace culture that values diversity of thought and perspective. By doing so, companies can reap the benefits of a diverse and inclusive workforce, including improved performance and a more substantial reputation.

c. Diversity and Innovation:

Innovation is a complex process influenced by various internal and external drivers. Internal drivers refer to the factors within the organisation, such as its resources, capabilities, and culture. External drivers, on the other hand, refer to factors outside the organisation, such as market demand, competition, and technological advancements.

Internal drivers of innovation include a firm's resources, capabilities, and organisational culture. Resources refer to a firm's tangible and intangible assets, such as financial capital, human capital, and technological know-how. In contrast, capabilities refer to the firm's ability to utilise its resources effectively and efficiently to achieve its goals. Finally, organisational culture refers to the shared values, beliefs, and norms that guide the behaviour of employees within the organisation. A positive and supportive culture can foster creativity and risk-taking, which are essential for innovation.

External drivers of innovation include market demand, competition, and technological advancements. Market demand refers to the needs and wants of customers in the market. Understanding customer needs and preferences is crucial for developing innovative products and services. Competition can also drive innovation by motivating firms to improve their products and processes to stay ahead of their rivals. Technological advancements can create new opportunities for innovation as firms seek to leverage the latest technologies to improve their products and processes.

Diversity can be linked to innovation as it can impact both internal and external drivers of innovation. A diverse workforce can bring various perspectives, experiences, and knowledge to the organisation, enhancing its resource base and capabilities. For example, a gender-diverse workforce can bring different perspectives on customer needs and preferences, leading to the development of more innovative products and services. Similarly, a culturally diverse workforce can provide insights into new markets and customer segments, driving innovation.

Diversity can also impact external drivers of innovation. For example, a diverse workforce can enhance a firm's ability to respond to changing market demand and competition by providing a broader range of ideas and solutions. Additionally, a diverse network of partners and stakeholders can bring new

ideas and opportunities for collaboration, which can drive innovation. The impact of board diversity on innovation has remained fairly inconclusive. Though most studies find a positive impact of board-level gender diversity on innovation, studies under the risk tolerance theory's purview find a negative impact.

Chen et al.(2018) investigated the link between female participation on boards of directors and corporate innovation using a sample of US-based firms between 1998 and 2006. Their findings indicated that greater female representation on boards was associated with increased innovation success, leading to improved firm performance in industries that rely heavily on innovation. These results align with previous research by Miller and del Carmen Triana (2009), Torchia et al. (2011), Loyd et al. (2013), and Ritter-Hayashi et al. (2016), which also demonstrated that boards with gender diversity contribute more to organisational innovation than male-dominated boards, thus underscoring the significance of gender diversity in enhancing innovation in firms.

Contrary to the abovementioned perspective, research in psychology and economics, primarily based on laboratory evidence, has consistently demonstrated that women exhibit lower levels of overconfidence than men (Croson and Gneezy, 2009). However, on average, women demonstrate greater patience and exhibit less impulsiveness than men when weighing present versus future values (McLeish and Oxoby, 2007). As a result, the immediate impact of female directors on innovation output may not be significant due to these inherent traits. Despite the stated findings, female directors, in general, can significantly contribute to the long-term growth of innovation output (Barber and Odean, 2001; Byrnes et al., 1999). Nevertheless, risk tolerance theory suggests that greater conservatism and risk aversion among female directors may potentially discourage board decisions that prioritise innovation. Thus, this dimension underscores the possibility of a negative association between board diversity and corporate innovation activity (Vafaei, 2021).

3. Research Question and Hypothesis

In the context discussed in the previous section, our research question covers: **What is the impact of gender diversity board on firm-level innovation effort, innovation performance, and firm reputation in an emerging economy such as India? A firm-level study of the diversity of the board composition of Indian firms on innovation and performance.**

We collected data from CMIE-Prowess, NSE-Infobase, and the National Patent database to answer this question. The first dataset (CMIE-Prowess) provides financial information on 20,000 firms on the Bombay Stock Exchange. The NSE-Infobase shows personal information at the director level of the firm listed on the National Stock Exchange. Finally, the National Patent Database of India

provides patent filing and approval data. Our study covers ten years (2006-2015) and includes an unbalanced panel of 6151 firms belonging to 32 different two-digit manufacturing industries.

There is growing recognition that a more diverse board of directors can positively impact firm performance and innovation efforts. That has led us to think of several hypotheses, exploring the relationship between gender diversity on the board of directors and the innovation efforts and performance of the firm:

H1: The more excellent the gender diversity on the board of directors, the higher the innovation effort and performance of the firm.

H2: The interaction effect of age and gender diversity on the board of directors positively influences the innovation effort and performance of the firm.

H3: The interaction effect of education and gender diversity on the board of directors positively influences the innovation effort and performance of the firm.

H4: Gender diversity on the board of directors positively moderates the relationship between firm-level competition and innovation effort and performance.

H5: The lack of gender diversity on the board of directors can lead to tokenisation, where the decision-making process does not give proper weight to women's voices.

4. Theoretical context

What we observe is that there is a steady increase in the number of women on the board, and this increase does not show positive outcomes for the firms that showed higher diversity. We argue that this result is not a case against diversity but rather a situation in which we do not see real diversity. Instead of empowerment, we observe a widespread process of tokenisation, which is more intense than the one observed in Western economies. We plan to undertake a questionnaire-based survey to gain more insight into the narrative of the tokenisation of diversity. We select the female board of directors randomly from our dataset. The comprehensive questionnaire covers all aspects of the tokenisation debate on diversity.

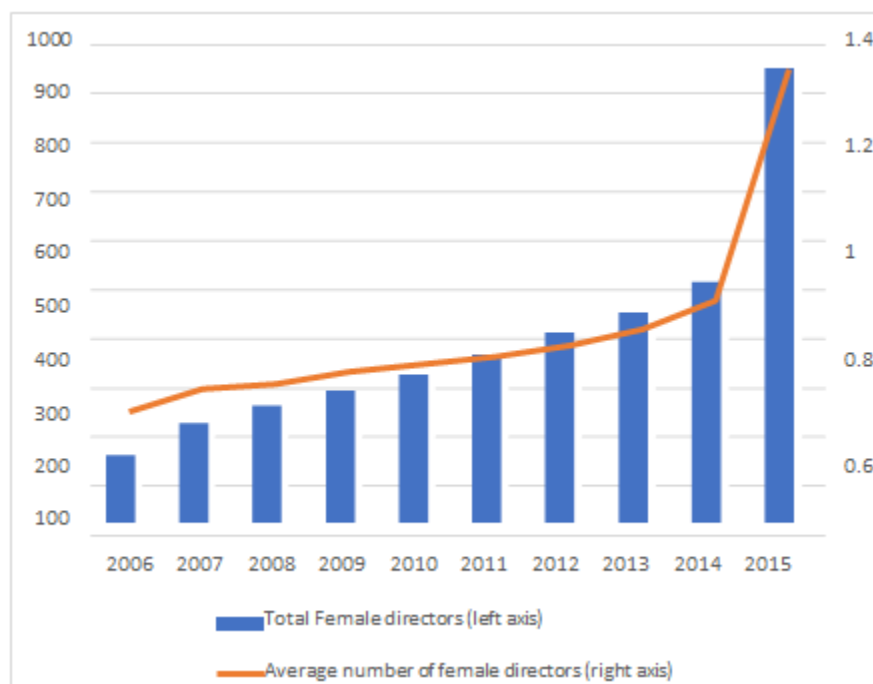


Figure 1. The total and average number of female directors on firm's board in India (2006- 2015)

In India, the period spanning from 2006 to 2015 witnessed a marked increase in female directors, rising from 138 to 926. Furthermore, the average number of female directors per board showed an upward trend, escalating from less than one to 1.3. This development led to a significant surge in female board representation, ascending from 4.3% to 9.6%. Figure 1 above describes the same changes over the sample period.

5. Data

We use three different datasets. The first one, which gives us the indicators of the R&D-related activities, is the CMIE-Prowess dataset. It provides financial details of 20,000 firms listed on the Bombay Stock Exchange (BSE), of which 5,000 firms belong to the manufacturing sector. CMIE collects the financial details of those firms through the firm's published annual reports. The broad spectrum of firms in the database constitutes 70% of the economic activity of the organised industrial sector in India. To classify firms by industry affiliation, we sort them into industries at a level equivalent to a two-digit standard industrial classification (SIC) and use categories for 32 distinct industries.

The second dataset is the NSE-Infobase, which consists of the firm's board of director-level details. This dataset provides all of the detailed personal information at the director level of the firm listed at the National Stock Exchange (NSE). The database offers personal demographic characteristics, all education details, and the history of directorial positions.

The third dataset is the database compiled from the website of National patent accounts. This dataset has been collected manually from the Intellectual Property of India's website maintained by the Ministry of Commerce and Internal Trade. The data on patent filing and patent approval have been collected and compiled from the online patent search system of the website.

This paper covers ten years (2006-2015). 2006 is chosen as starting year because the WTO's TRIPs agreement became binding from 2005 onwards as India has a ten-year transition period (1995-2005) to make the domestic legislation compatible with TRIPs. Apart from that, NSE- Infobase, i.e., the board of directors' dataset, is only available from 2006. The final dataset consists of an unbalanced panel of 6151 firms belonging to 32 different two-digit manufacturing industries spanning ten years, from 2006 to 2015.

6. Methodology

To examine how female board representation affects the firm's innovation activities, we propose the following baseline empirical model:

$$(Innovation_{i,t+1}) = \alpha + (Fraction\_female\_directors_{i,t}) + 4X_{i,t} + I_i + Y_t + 7i_t$$

We measure firms' resource input into innovation activities by the natural logarithm of R&D expenditures following Aghion et al. (2013). Though the input-oriented measure is straightforward, it fails to capture the quality of innovation. Therefore, we apply the output-oriented measures of the patent count. Nevertheless, patent count alone may prove insufficient in measuring innovation productivity as patents diverge significantly in their technological and economic significance. Regrettably, patent citation data remains unavailable in India. Finally, Z is a vector of firms and board-level characteristics that impact innovation activities. I_i represents industry-fixed effects, Y_t captures the year-fixed effects and $7i_t$ is the error term.

6.1. Variable of interest

In two ways, we measure the key independent variable of interest, female board representation. Firstly, we calculate the equally weighted fraction as the number of female directors divided by the total number of directors on the board. This measure has been used in the existing board gender composition literature (Adams and Ferreira, 2009; Gul et al., 2011; Levi et al., 2014).

Secondly, we use the tenure-weighted measure, dividing the total sum of tenures held by female directors by the sum of tenures of all directors on the board, with greater weight given to those with longer tenures. We have decided to use this measure for two reasons. Firstly, Schwartz- Ziv and Weisbach (2013) have demonstrated that directors with longer tenures are more engaged in monitoring activities and more likely to take action towards internal governance. By prioritising experienced and proactive directors, the tenure-

weighted measure, we capture the influence of female board representation on innovation more accurately. Secondly, we address the issue of matching between female directors and firms with a high innovation potential by reducing the weight assigned to newly appointed directors since matching effects are typically strongest immediately after appointment (Hirshleifer et al., 2012). Consequently, we expect the tenure-weighted measure to be less vulnerable to the matching problem if it does exist.

6.2. Control Variables

This study examines several firm and board-level characteristics linked to innovation. To begin with, we measure firm size as the natural logarithm of market capitalisation, considering the potential for economies of scale in generating patents due to the fixed costs associated with maintaining a legal department that deals with Intellectual Property (IP) matters. Prior research has argued for a positive relationship between firm size and patenting activities (Hall and Ziedonis, 2001).

We consider the effect of capital intensity on a firm's patenting behaviour, as proposed by Hall and Ziedonis (2001). Hall and Ziedonis (2001) suggest that patenting becomes more important as capital intensity increases, as it protects against costly litigation. Capital intensity is defined as the ratio of net property, plant, and equipment ratio to total assets.

Furthermore, we account for board independence, defined as the fraction of independent directors on boards. Adams and Ferreira (2009) have reported that most female directors serve as independent directors. Thus, controlling for board independence enables us to rule out the possibility that independent directors rather than female directors drive the effects of monitoring on innovation.

Furthermore, we utilise ownership information to regulate the ownership structure of firms, distinguishing between domestic/foreign and private/government entities. The findings of Park et al. (2018) indicate that foreign ownership has no significant impact on R&D activities. Nevertheless, they concluded that foreign ownership, in general, may increase the likelihood of innovation. However, in contrast to domestic firms from developing countries, Western foreign firms confront the obligation to uphold gender diversity on their boards in compliance with their respective national norms. The adoption of this norm by foreign firms could exert pressure on the developing world's domestic firms to prioritise board diversity.

In line with previous research (Fich and Shivdasani, 2012; Tian and Wang, 2014; Bhagat, 2017), we also consider other standard determinants of innovation, including profitability (ROA), growth opportunities (Tobin's Q), and leverage. While analysing innovation output, we control for R&D expenditures to avoid

confusion about the effect of female board representation on innovation input (Farrell and Hersch, 2005).

6.3. Endogeneity

The inherent endogeneity of corporate boards poses challenges in comprehending the observed positive association between female board representation and innovation. It remains difficult to discern whether our findings are attributable to the influence of female directors on innovation or the matching of female directors with firms demonstrating high innovation potential. The estimates we present may be subject to bias as innovative firms may be more responsive to calls for greater female board representation from external sources, or female directors may selectively opt for better-performing innovative firms, as posited by Farrell and Hersch (2005). To mitigate these concerns, we plan to adopt three methodological approaches: First, we use the fixed effect model to address the issue of unobserved time-invariant heterogeneity by depending on within-firm variation over time. Second, we use propensity score matching to mitigate the matching concern based on observable firm characteristics. Third, we use the instrumental variable (IV) approach to manage the potential endogeneity of our interest variable. The potential for reverse causality represents a significant concern when exploring the relationship between gender diversity on corporate boards and firm performance. One plausible mechanism through which this reverse causality could operate is via internationalisation. Specifically, more internationalised firms may be more likely to adopt international organisational standards, which could lead to a greater emphasis on gender diversity on their boards.

To mitigate this potential source of bias, we propose using an instrumental variable approach. Our instrumental variable is the level of exports of the firm. We argue that a firm's level of exports serves as a valid instrument for its degree of internationalisation. We assume that firms with greater export levels are likely to be more internationalised and, therefore, more likely to adopt international organisational standards, including gender diversity, on their boards. The IV approach can help to address concerns about reverse causality and provide more robust estimates of the causal relationship between gender diversity on boards and firm performance.

7. Basic Descriptives

The primary analysis of the secondary data shows that the extent of participation and recruitment of females on the board is exceptionally low. Though their total participation in the board has been increasing, their average number has been very low compared to their male counterparts. Similarly, Table 1 shows the total number of female directors in India from 2006 to 2015, along with the average number of female directors, P50, standard deviation, minimum, and maximum number of female directors. The data indicate an

overall increasing trend in the number of female directors over the years, with a significant jump from 2014 to 2015

Table 1. Descriptive Statistics of female directors

Year	Total Female directors	The average number of female directors	P50	SD	Min	Max
2006	138	0.356	0	0.641	0	4
2007	204	0.422	0	0.681	0	4
2008	239	0.435	0	0.701	0	4
2009	270	0.470	0	0.734	0	4
2010	302	0.491	0	0.759	0	5
2011	344	0.513	0	0.774	0	5
2012	388	0.543	0	0.816	0	5
2013	429	0.590	0	0.843	0	5
2014	491	0.672	0	0.894	0	5
2015	926	1.33	1	0.800	0	5

Source: author's calculation

Despite its positive trend, the average number of female directors over the data period has been very low. The average number of female directors has increased from 0.356 in 2006 to 1.33 in 2015. However, the P50 (50th percentile) remained at zero throughout the years, indicating that half of the firms had no female directors. The standard deviation also increased over the years, indicating a wider distribution of female directors among the firms.

The minimum and maximum number of female directors remained constant at 0 and 5, respectively, for most of the years. However, in 2015, the maximum number of female directors increased to 5. Still, the minimum remained at zero, indicating that although some firms had many female directors, others still had none.

Overall, the data suggests that although there has been progress in increasing the number of female directors in India, there is still a long way to go to achieve gender diversity on boards.

Nevertheless, upon scrutinising female directors and their contributions to the input and output of innovation, it becomes apparent that there is still a considerable way to go in achieving diversity, particularly within innovative firms. The findings in Table 2 demonstrate that companies with a greater proportion of female board members exhibit lower innovation input and output

levels. Conversely, those firms with a minimal fraction of female directors appear to be the most innovative, allocating the most resources to research and development and exhibiting a higher number of patents. These fundamental outcomes prompt us to question whether gender equality in the Indian corporate innovation ecosystem, a mere facade is indeed true or not. To explore this further, we intend to delve deeper into these dynamics and uncover whether gender diversity within the corporate innovation landscape is genuinely transpiring or is merely being utilised as a superficial token of diversity, lacking any real substance.

Table 2: Gender Diversity and innovation outcomes

Fraction of female directors	Average R&D Expenditure (in Million Rupees)	Average Patent Filed	Average Patent Granted
>0-5	1107.578	16.512	8.975
5-10	337.218	6.246	2
10-15	394.568	3.323	1.214
15-20	188.480	2.025	0.935
20-25	65.183	1.209	0.512
25-30	16.930	0.226	0.065
30-35	68.167	0.200	0.200
35-40	5.950	0.100	0.000
40-45	6.87	0.100	0.500

Source: author's calculation

Table 2 presents the relationship between gender diversity on boards and innovation outcomes, including the fraction of female directors, average R&D expenditure, average patent filed, and average patent granted. The findings suggest that companies with a more significant proportion of female board members exhibit lower innovation input and output levels. In contrast, those with a minimal fraction of female directors appeared to be the most innovative.

7.1. Summary Statistics

We report the summary statistics for the principal variables and Board-level and firm-level control variables in Table 3. After eliminating anomalies from the dataset, we end up with 6,151 observations in the final analysis spanning a decade. The summary statistics presented below use pre-logarithmic data.

Table 3: Summary statistics of dependent and explanatory variables

Variables	Mean	P25	Median	P75	SD	Min	Max
Board Level							
Board Size	11.57	8	10	14	5.12	3	25
Share of Female Directors	5.10	2.22	2.10	9.50	3.01	0	50
Share Independent Director	53.58	46.15	54.54	61.53	12.86	0	100
Share Insider Director	46.41	38.46	45.45	53.85	12.86	0	100
Term Length	6.66	3.49	5.95	10.34	5.74	0.04	42.58
Firm-level							
R&D Expenditure (Million Rupees)	372.32	8	33.33	148.1	145.51	0	22043
R&D intensity (in %) (R&D_Sales_Ratio)	5.00	0.02	0.04	3.21	1.12	0	54.09
Patent filed	5.1	1.1	2	3.2	1.67	0	546
Patent granted	2	0.5	0.75	0.96	0.11	0	223
Capital intensity	0.27	0.13	0.25	0.39	0.19	0.001	0.97
ROA (in %)	93.07	45.78	83.63	95.66	60.07	5	98
Size (Million Rupees)	2519.09	1145.53	1517.4	2875.7	14758.6	8.72	3298.95
Debt Ratio (in %)	34.67	7.22	31.48	38	31	3.33	201.74
Tobin's Q	2.1	1	1.55	1.76	1.37	0.01	3
Number of observations	6151						

According to the results reported in Table 3, the average representation of women on boards among firms in our sample is a mere 5%, which is remarkably low. Our analysis revealed that some firms lack female representation, while others have only one female director, indicating tokenism.

On the other hand, concerning innovation input and output, the average R&D expenditure is 372.32 million rupees, and firms file an average of 5 patents, with only two patents granted on average. The control variables in our study mostly fall within the range recommended by previous literature.

Table 4 below presents the Pearson correlations among variables. Correlations are consistent with our hypothesis that a higher fraction of female reorientations on board positively correlates with innovation. Though the correlation is not very strong, it still indicates a positive association and points towards the direction of our predictions. However, Table 4 also shows that the extent of correlations among control variables is low. To look into the extent and nature of the causal relationship, we discuss the empirical results in more detail next section.

Table 4: Correlations among the variables in consideration

	R&D Expenditure	Patent filed	Patent granted	Fraction offemale directors	Capital Intensity	Firm size	Fraction of independent directors	ROA	Tobin's Q	Debt Ratio	Age	Ownership
R&D Expenditure	1											
Patent filed	0.44	1										
Patent granted	0.43	0.83	1									
Fraction of female directors	0.51	0.51	0.52	1								
Capital intensity	0.16	0.18	0.14	0.06	1							
Firm size	0.43	0.34	0.33	0.31	0.17	1						
Fraction of independent directors	-0.015	0.10	0.16	0.09	0.02	0.05	1					
ROA	-0.03	-0.03	-0.02	-0.03	0.18	0.14	0.13	1				
Tobin's Q	-0.12	-0.12	-0.09	-0.12	0.38	-0.24	-0.09	-0.28	1			
Debt ratio	-0.15	-0.16	-0.12	-0.02	0.16	-0.19	-0.13	-0.30	0.29	1		
Age	0.33	0.35	0.36	0.24	0.32	0.09	0.39	-0.12	0.26	0.28	1	
Ownership (fraction foreign)	0.45	0.49	0.43	0.32	0.34	0.19	0.21	0.09	0.11	0.08	0.11	1

8. Basic Results

To test our primary hypothesis, we first run the OLS as a baseline; then, we run our fixed effect panel data estimates. In the baseline specification, our primary variable of interest is an equally weighted and tenure-weighted fraction of females on a firm's board. In that specification, our key three dependent variables are the natural logarithm of R&D expenditure which accounts for the input of innovation, and on the output side of innovation, we use the number of patents filed and patents granted. We measured all variables at their one-period lead value to account for the impact gap of innovation. Table 5 A below presents the baseline regression results with an equally weighted fraction of female directors.

Table 5A: Baseline OLS and Fixed effect Regression of Innovation and Fraction of Female Directors

	Panel A <i>Ln_R&D Expenditure</i>		Panel B <i>Patent_Filed</i>		Panel C <i>Patent_Granted</i>	
Dependent variables	OLS	FE	OLS	FE	OLS	FE
Equally_weighted_fraction_female	-7.79** (3.03)	-2.87* (1.64)	0.74** (0.35)	0.36* (0.21)	0.09*** (0.02)	0.011** (0.004)
Fraction_independent_directors	-0.007 (0.007)	-0.009 (0.007)	-0.09* (0.05)	-0.08 (0.05)	-0.012 (0.014)	-0.009 (0.014)
Capital_Intensity	0.54 (0.94)	0.99 (1.06)	-2.78 (3.21)	-3.20 (3.50)	-2.12* (1.18)	-2.41* (1.32)
Log(Size)	0.58*** (0.09)	0.59*** (0.002)	2.83*** (0.76)	2.87*** (0.75)	1.09*** (0.3)	1.10*** (0.31)

ROA	-0.001 (0.002)	-0.001 (0.002)	-0.29** (0.012)	-0.03*** (0.01)	-0.013** (0.005)	-0.013*** (0.005)
Tobin's Q	0.01 (0.07)	-0.03 (0.11)	-0.65 (0.57)	-0.74 (0.076)	0.07 (0.15)	0.093 (0.19)
Debt_Ratio	-0.01* (0.006)	0.012* (0.006)	0.017 (0.16)	0.018 (0.016)	0.01* (0.005)	0.01*** (0.004)
Ownership	0.01 (0.40)	0.04 (0.42)	-19.13* (11.40)	-21.13* (11.41)	-6.63** (3.22)	-7.29** (3.23)
Intercept	Yes***	Yes***	Yes***	Yes***	Yes***	Yes***
Industry Fixed Effect	Yes	No	Yes	No	Yes	No
Year Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	4833	6101	4833	6101	4833	6101
Adjusted R ²	0.45	0.21	0.26	0.16	0.17	0.15
F value	40.93	10.99	22.11	17.13	11.67	11.22

Note:

The coefficients and p-values (in parentheses) are reported. Heteroscedasticity robust standard errors are shown in brackets.

*, **, and *** indicate a significance level of 10%, 5%, and 1%, respectively. Industry dummies include 32 industrial categories, and time dummies include nine time periods. While taking log of R&D expenditure, we take the $\ln(1+R\&D)$ to avoid the issue of defining the log of R&D of those firms whose R&D expenditure is 0.

Panel A of Table 5A, where we take R&D expenditure as a dependent variable, reports that our interest variable, i.e., `Equally weighted_fraction_female` is negative and significant at a 5% level in the OLS column and 10% in the FE column. This finding alligns with the risk aversion hypothesis where authors like (Barber and Odean, (2001); Byrnes et al., (1999) etc. argued that in general women are in general risk-averse investors, taking immense caution while spending huge sums on R&D. Due to this, women tend to take R&D decisions slowly to avert the risks and failure associated with the R&D. However, their response is different when it comes to innovation outcome. As they tend to take more well-judged spending decisions, it can be very well perceived in the purview of the literature that their better investment decisions will yield better outcomes for innovation efforts. In line with this argument, the results from Table 5A show that a higher fraction of women representation of women at the board level has a positive and significant impact on the outcome of innovation shown by `Patent_filed` and `Patent_granted`. Panel B shows the positive impact of gender diversity on the extent of patents filed, whereas panel C shows the impact on patents granted. These findings are in alignment with the finding of Miller and del Carmen Triana (2009), Torchia et al. (2011), Loyd et al. (2013), and Ritter- Hayashi et al. (2016) etc. Our baseline findings confirm our predictions of hypothesis one.

The findings for the control variables also contribute to the literature's mixed stand. `Fraction_independent_director` variable is negative and insignificant in all of the panels, indicating the fact that the independence of the directors, irrespective of their gender, does not matter for innovation. Whereas `capital_intensity` is negative in panels B and C, it is only significant in panel C, indicating the importance of patenting as capital intensity increases to protect the firm against costly litigation (Hall and Ziedonis, 2001; Chen et al., 2018). The firm size estimator is positive and significant, indicating that big firms have upper hand in innovation compared to small and medium firms (as in Bolli et al., 2018, and Kumar and Aggarwal, 2005) in all specifications. On the other hand, the ownership dummy is negative and significant at 5% and 10% levels in panels B and C. This outcome indicates that domestic firms in India are significantly less innovative, supporting the view of (X) that foreign firms in developing countries have more resources and hence are more active innovators than their domestic counterparts. The rest of the control variables shows a mixed response and significance per the available literature.

9. Next steps

In this study, we investigate the impact of gender diversity on the board of directors on innovation efforts, performance, and reputation in Indian firms. To achieve this objective, we developed hypotheses that explore the relationship between gender diversity, innovation efforts, and performance. Our study uses three datasets covering ten years and 6151 firms in 32 manufacturing industries. We believe that the findings of this study will contribute significantly to the literature on diversity and innovation in emerging economies, particularly in the context of India. Additionally, we hope our study will inform policy decisions regarding diversity initiatives in leadership positions.

Overall, the results suggest that there is still a significant lack of gender diversity on corporate boards in India. Although there is progress, there is still a long way to go to achieve gender equality in the Indian corporate innovation ecosystem. The findings also raise questions about whether gender diversity within the corporate innovation landscape is genuinely transpiring or utilised as a superficial token of diversity, lacking any real substance.

To gain a deeper understanding of the narrative of tokenisation, we would like to finish our IV analysis and conduct a questionnaire-based survey. We expect that this survey will provide us with valuable insights into the experiences and perspectives of individuals who have been subject to tokenisation. We believe that the results of this study can help firms and policymakers to understand the importance of diversity in leadership positions and promote diversity initiatives in developing countries such as India.

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Notes

¹ Based on the World Economic Forum's Global Gender Gap Report 2021, there is an average global gender gap of 31.5% in domains of political empowerment, economic participation, educational attainment, and health and survival. This gap is particularly acute in developing countries. India, as one such country, ranks 140th out of 156 countries in the Global Gender Gap Index with a gender gap of 62.5%. This can be attributed to factors such as female infanticide, child marriage, limited access to education, and patriarchal societal norms that impede women's economic and political participation

Which Businesses Enroll in Innovation Training? Evidence from a Field Experiment

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Abstract

We report results from a field experiment testing hypotheses that examine what drives firms to seek new learning opportunities. Specifically, we draw on behavioral theory of the firm to predict how prior performance affects the likelihood a firm enrolls in business training. We also evaluate cognitive mechanisms connecting recruitment messaging and CEO growth orientation to firm participation. Our study randomly allocates over 10,000 firms to one of three experimental conditions—prevention, promotion, and neutral messaging—that vary the framing of a recruitment message for an innovation program for small and medium enterprises (SMEs) in Singapore. We leverage pre-treatment heterogeneity in firm performance and CEO orientation to better understand the differential impact of the three message types. We find that businesses with declining performance are 64% more likely to register than those with performance improving year over year. In addition, we find mixed evidence of a congruence effect—where messages (i.e., promotion) resonate more with CEOs with matching orientations. Surprisingly, we find that the neutral messaging performs 46% better than the promotion message and 115% better than the prevention message in spurring enrollment. Our work sheds light on both the frictions and remedies for scaling up the diffusion of new knowledge to businesses. Specifically, we find that subtle differences in recruitment strategy affect who enrolls and the overall demand for business training. Overall, our findings suggest that targeted firm performance-heterogeneity and the varied experimental recruitment efforts significantly affect enrollment. Researchers must pay careful attention to selection in attempting to understand who benefits from the training.

1. Introduction

An extensive literature has studied how management and strategic interventions such as business training, peer advice, competitor benchmarking, and consulting can improve the performance of small and medium sized businesses (e.g., Bloom et al., 2013; Camuffo et al., 2018; Chatterji et al., 2019; Kim, 2019). This research is grounded in the belief that large reservoirs of performance remain untapped due to significant gaps in the knowledge and skills of founders and managers (Bloom and Van Reenen, 2007). Many scholars have attempted to mitigate these gaps by using field experiments with firms to test theories about what drives performance. Given this evidence on how to improve firm performance, a key hurdle for both scholars and policymakers is scaling up such interventions to have maximum impact (e.g., Chatterji et al., 2016).

Indeed, both researchers and practitioners aim to increase the number of businesses that access and benefit from this knowledge. Prior research suggests considerable frictions prevent firms from seeking out opportunities to acquire training and productivity enhancing knowledge. Such frictions may be due to the lack of awareness, beliefs about the value of the knowledge in general, and its value to an individual's specific business. In addition to affecting the diffusion of this knowledge, the "adoption challenge" also affects the scientific research process to generate new knowledge about what interventions improve firm performance. For instance, field experiments use random allocation of firms into treatment and control conditions to allow for more accurate inferences about the effect of an intervention. Consequently, an inherent promise of these studies is the ability to assess the potential to achieve a broader effect on businesses and the economy by scaling successful interventions. However, challenges in subject recruitment and unobserved heterogeneity in which firms enroll in field experiments limit the broader applicability of even the best-designed studies (Falk and Heckman, 2009; Heckman and Smith, 1995). Consequently, there is lingering uncertainty about the generalizability of inferences drawn from these studies due to an unclear understanding of what drives firms to seek training in the first place.

In this article, we seek to understand better which firms, given their performance history, are likely to enroll in training and how the content of the message inviting them to the training influences their enrollment. Our predictions and research design draw from two theoretical perspectives regarding why firms and individuals search for new knowledge and solutions. First, we build on work in behavioral theory of the firm from the Carnegie School tradition and test the hypothesis that firms which perform below

aspirations (e.g., experience a drop in performance) are more likely to seek new knowledge and solutions (Cyert et al., 1963; Simon, 1979). Second, we focus on a cognitive mechanism to evaluate whether the managers of our sample are moved to sign up to access the specific innovation training by varying the framing of recruitment messages. Our intervention uses three message framings: loss prevention, growth promotion, or a neutral condition and evaluates the varying rate of firm participation by firm and manager type (Brockner and Higgins, 2001; Brockner et al., 2004).

We conduct a field experiment with over 10,000 Singaporean small and medium enterprises; we evaluate the mechanisms that limit or encourage firms' enrollment in a training program. Our pre-registered research design tests two primary determinants of firms' willingness to acquire new knowledge: (a) the heterogeneity in firms' past performance and (b) the interaction of the framing of why firms will benefit from training with the manager type. We document our sample's systematic response rate heterogeneity that varies with prior firm performance and message type. First, we find that firms with decreased performance in the past year compared to the preceding year were 61% percent more likely to register. These findings corroborate predictions regarding problemistic search. Second, we observe considerable differences in registration rates based on the messages type. Surprisingly, we find that the neutral message led to the highest sign-ups at 3.2%, whereas the prevention and promotion messages worked considerably less well at 1.5% and 2.2%, respectively. Finally, we find systematic heterogeneity in who responds to what message. Specifically, we see that managers who used more 'growth' words in their online profiles responded more when receiving the growth email, providing partial support for prior research on regulatory focus theory.

Overall, our findings suggest that performance heterogeneity and the varied recruitment efforts of researchers and practitioners significantly affect participation. Specifically, our research suggests that firm performance and message framing affect total enrollment. Indeed, a neutral message in our study leads to 115% more signups than a loss framing. In addition to total numbers, it is important to note that the final sample of firms that sign up is qualitatively different from the population on both easily observable and less-observable characteristics such as manager's cognitive orientation. Given this difference, researchers must pay careful attention to understanding who benefits from the training given this selection and how the effects may generalize to the overall population. More detailed information on which firms are selected into the study sample can help researchers and policymakers interpret treatment effects with more nuance.

2 Theoretical Framework

2.1 What drives firms to seek new learning?

A growing literature in management and strategy examines how business knowledge and training affect firm performance (e.g., Anderson et al., 2018; Cohen and Hochberg, 2014; Cai and Szeidl, 2018; Chatterji et al., 2019). Scholars have studied how new knowledge acquired through peers, mentors, consultants, and formal instruction impacts business decision-making and long-term performance. Yet, despite what is now a sizable body of work, researchers have found only mixed support for a meaningful learning and performance effect. Some theorize that changing the performance of businesses may be difficult due to the inherent diversity of problems faced by businesses (Fischer and Karlan, 2015) so that no single training can fulfill all the business needs. Thus, a fundamental challenge in understanding who benefits from business training is understanding which firms are most likely to seek it in the first place. This question is critical in designing studies that evaluate the impact of business training and the scaling-up of training to improve business performance in industries and regions.

We study how firm-specific and behavioral factors impact the decision of SMEs' owners and managers (e.g., CEOs) to seek new learning opportunities by signing up for an innovation training program. In this section, we begin by presenting a theoretical framework for a firm's decision to enroll in a training program. Specifically, we test

(a) how the firm's prior performance triggers the managers' search orientation for new alternatives and (b) how the fit between individual regulatory and growth orientation and the message used to communicate program information influences sign-ups.

2.2 Prior performance and the demand for training

The choice to commit costly resources and time to seek out training contains essential information about a firm's demand for new knowledge (e.g., Guzman et al., 2020) and the training's potential effect on its performance. Prior theory suggests that not all firms have the same learning incentives (March and Olsen, 1975). The Carnegie School tradition, formalized as the Behavioral Theory of the Firm (BTF), argues that firms seek new knowledge when their performance falls below aspiration levels (Cyert et al., 1963; Simon, 1979). Managers are assumed to be boundedly rational actors whose search is triggered when the organization's performance falls below its aspirations, as measured by historical performance and social comparison (Greve, 2003, 2008). Under the BTF, a firm whose current performance is lower than their aspiration may seek to understand how to fix it using "problemistic search". In this paradigm of problemistic search, managers deviate from existing underperforming routines

and practices to sequentially evaluate alternatives and terminate search when they identify an alternative that will restore the organization's performance.

In our context, where training can be considered one treatment alternative, problemistic search by firms performing below aspirations may make them more likely to seek training. Thus, we expect that managers of underperforming firms are more likely to feel the need and sign up for an innovation training program.

Hypothesis 1 Performance below aspiration is positively associated with signing up for the innovation training program.

2.3 Promotion- and prevention-oriented managers

The second question is how the recruitment message is likely to influence training enrollment. In a review of BTF, Posen et al. (2018) cautions that a firm's decision to undertake a problemistic search may depend on the cognition and attention of the individual manager. According to established research, the motivations of individuals can vary considerably. More specifically, a stream of research on regulatory focus theory (RFT) argues that individuals display a predominant regulatory orientation either promotion or prevention (Higgins, 1997). This orientation is stable and based on a manager's inherent disposition, though subsequent work has shown that regulatory orientation can also be induced by the environment (Scholar et al., 2010). An individual's orientation affects their goals and actions taken to achieve these goals. Specifically, promotion-oriented individuals are motivated to achieve growth and prefer contexts and activities to create such growth.

In contrast, prevention oriented individuals are motivated to avoid losses. They take steps that safeguard them from failures, often by conservative actions such as eliminating unsuitable alternatives. A significant consequence of these orientations is that individuals will persist longer when pursuing actions that match their orientation (Forester et al., 1998). It is important to stress that RFT does not predict differentiated success based on orientation and that both orientation types can achieve success in their goals through different pathways.

2.4 Prevention, promotion and neutral messages

RFT implies that varying how specific opportunities or goals are communicated can lead to differential actions by individuals who vary in their orientations. That is, the same goal – high sales revenue – can be framed as either promotion or prevention (Cesario et al., 2004). For example, achieving high sales revenue is emphasized with a promotion framing, whereas the risk of losing high sales revenue is highlighted under prevention framing. Although the literature hitherto emphasized either a promotion or a prevention framing, our focus on the message content spurs us to consider a neutral messaging setting that is primarily informational and lacks the positive or negative valence (e.g., Labroo

and Lee, 2006; Wang and Lee, 2006). Note that RFT does not explicitly theorize about the impact of the message framing but focuses on how promotion and prevention types respond to matching message framing.

2.5 Matching managers and messages

Given that managers and messages can vary in their regulatory orientation (i.e., prevention versus promotion), we should expect there to be heterogeneous effects of messaging depending on manager type. Specifically, business training can be proposed to promote growth or prevent decline. Differences in positioning the value of the business knowledge may interact with differences in the motivations of individuals to seek new knowledge. Building on the concepts of psychological orientation and message framing, RFT suggests that the match between manager orientation and message framing as focused on promoting or preventing specific outcomes should lead to differential effects (Brockner and Higgins, 2001; Brockner et al., 2004; Higgins, 1998).

Specifically, we anticipate that promotion (prevention) oriented individuals are more likely to take actions in response to messages that fit their regulatory focus (Gamache et al., 2015). Thus, we expect promotion (prevention) oriented managers to sign up for the innovation training program when receiving the promotion (prevention) message. Finally, given the absence of a regulatory fit of either manager orientation with the neutral framing, we expect it to perform less well than the promotion or prevention message, respectively.

Hypothesis 2 (a) *Promotion-oriented managers are more likely to sign up when receiving promotion than prevention or neutral messages.*

(b) *Prevention-oriented managers are more likely to sign up when receiving prevention than promotion or neutral messages.*

2.6 Prior performance and message fit

In addition to the match-specific effects of message type and manager orientation, we might expect heterogeneity of message effects based on firm performance. For instance, scholars have shown that an individual's environment can induce a promotion or prevention regulatory orientation (e.g., Scholer et al., 2010; Boldero and Higgins, 2011). Furthermore, a person's context can affect decision making like a chronic regulatory orientation (Cesario et al., 2013). Zou et al. (2014) shows that after significant gains, decision-makers become more risk averse as they are motivated to maintain their past performance and prevent decline, corresponding to a prevention orientation. Conversely, decision makers who have experienced losses would be more willing to take risks to achieve growth, making them promotion oriented. Consequently, high and low performing firms may both seek to learn, but this may depend on how the value of the new knowledge is framed.

Managers of firms performing above (below) aspiration experience prevention (promotion) regulatory focus. This match their regulatory fit with the message framing and their measurable sign up action. Accordingly, we hypothesize that firms performing above (below) aspiration are more likely to sign up with a prevention (promotion) message than a promotion (prevention) or neutral message.

Hypothesis 3 (a) *SMEs performing above aspiration are more likely to sign up when receiving prevention versus promotion or neutral messages.*

(b) *SMEs performing below aspiration are more likely to sign up when receiving pro- motion versus prevention or neutral messages.*

3 Methods and data

Below, we describe the experimental setting, sampling methodology, and the operationalization of the hypotheses discussed above.

3.1 Business context

We invited CEOs, Managing Directors, and owners of Singaporean SMEs for an innovation training program held at a public university with the support of Singaporean public institutions such as A*Star, Enterprise Singapore, Singapore Chinese Chamber of Commerce and Industry (SCCCI), Singapore Polytechnic and Temasek Polytechnic and a Ministry of Education research grant. The research team offered the training program free of charge to the SME participants in March or September 2021. Program staff would randomly assign participants to the first or second cohort upon enrolling. The study described in this paper utilizes this SME training program's recruitment process to understand better which firms are most likely to seek new knowledge opportunities.

3.2 Sampling Method

For this study, it is essential to understand the sampling process used and how it may affect our final sample of registered firms. We delineate the steps to build our sample below and illustrate them in Figure 1. We describe the sampling frame and list the causes of attrition in this section. The results section tests and discusses the differences between the firms in the initial sampling frame and the firms enrolled in the study and the implications for the subsequent field experiment on training.

[Figure 1 about here.]

The field experiment's beginning sampling frame the 'population' includes 41,616 Small and Medium Enterprises in Singapore. To be in the population, a firm must have been in operation for five years or more, have less than SGD 100 million in revenue, and have filed revenue information with the Singapore

registry of companies, the Accounting and Corporate Regulatory Authority (ACRA). The data filed with ACRA are collected in the ORBIS database provided by Bureau van Dijk. In addition to this corporate and financial information, we collected data on the emails of the owners or CEOs of the 41,616 companies from publicly available sources using research assistants. We found a total of 12,606 email IDs, consisting of individual email IDs for 7,499 CEOs, owners, or managing directors (e.g., CEOname@companyname.com) and 5,107 generic email IDs (e.g., enquiry@ or sales@companyname.com).

In 2021, on February 5, 10, 11, 18, and 22, we contacted a total of 12,606 companies via email, divided into three random samples of roughly 4,200 each for the Neutral, Promotion, and Prevention condition. Each sub sample received one of the cover emails (promotion, prevention, neutral) with a matching brochure in attachment. Two thousand one hundred and forty two emails bounced back, reducing our effective sample to 10,469 companies the 'convenience sample'. Post randomization and email ID validation, there were no systematic differences by firm size and profitability in the three sub samples (see Appendix Table A.1). The email was sent from our project mailing account set up on the university's server. Where the name of the CEO, owners, or managing director thus targeted was known, we attempted to collect their LinkedIn profile. We were able to collect 6,203 LinkedIn profiles.

To summarize, from the population of 41,616 SMEs with financial information in the ORBIS database, we built a convenience sample of 10,469 companies with a valid email ID, which yielded a registered sample of 239 participant firms.

3.3 Variables

3.3.1 Dependent variable

Registration in the program: Our dependent variable is an indicator that is set to '1' for individuals who formally registered for the program and '0' otherwise. Out of the 10,469 firms whose emails did not bounce back, 239 registered (2.3% of the convenience sample) the 'registered sample'.

3.3.2 Independent variables

Performance Below Aspiration: To test Hypothesis 1, we measure performance below aspiration using an indicator variable if the firm's performance was below its performance level in the past year. Specifically, we compared performance in 2018, as a proxy of aspiration for 2019, with the actual performance in 2019. We built the Decreased ROA indicator variable as our performance indicator following Greve (2008).

$$\text{Decreased ROA} = \begin{cases} 1, & \text{if } \text{ROA}_{2019} < \text{ROA}_{2018}, \\ 0, & \text{otherwise} \end{cases} \quad \text{ROA} = \frac{\text{net income}}{\text{total assets}} \quad (1)$$

With 52% of firms decreasing their ROA, the median firm performed below aspiration and did not grow ROA.

Prevention, Promotion and Neutral Messages: We created three indicator variables: Promotion Message, Prevention Message, and Neutral Message. We set each respective variable to 1 if the firm received the corresponding email and 0 otherwise. Samples of the emails are shown in Appendix Figure A.2. We performed a manipulation check on the promotion and prevention focus emails with 200 individuals in Prolific in February 2021. The individuals' answers to a survey questionnaire confirmed that the individuals understood the promotion and prevention framing of the workshop (results in Appendix Table A.2). By design, one-third of the convenience sample was randomly selected to receive each type of email (see Appendix Table A.1).

Regulatory Orientation: Past research has classified individuals into promotion and prevention orientation after ranking their answers to a standard questionnaire asking them to rate their agreement with promotion and prevention framed sentences. Because we would not be able to measure the regulatory orientation of business owners who do not register, we decided to use the LinkedIn profiles of the business owners. We classified the business owners' orientation based on the regulatory focus words (promotion and prevention) found in those LinkedIn profiles (see Appendix Table A.3 for a detailed list of promotion and prevention words and other related details). There is an established tradition in social psychology that uses text to classify an individual's psychology orientation (e.g. Tausczik and Pennebaker, 2010). Studies have used emails (e.g. Srivastava et al., 2018), messages (e.g. Choudhury et al., 2019), or Twitter (e.g. Fisch and Block, 2021) to classify individuals' psychological orientation. We use the presence of regulatory focus words (promotion or prevention) as a proportion of total words in the LinkedIn profile to measure the extent of an individual business owner's regulatory focus. While some researchers force individuals to be either promotion or prevention-oriented, others have argued for more continuous measures. The latter argue that individuals may exhibit promotion focus on certain occasions and prevention focus on others (e.g. Gamache et al., 2015), such that individuals may score high on both promotion and prevention counts. A continuous measure of both orientations allows to control for the individual's level on the non-focal regulatory orientation in the regressions which a categorical variable cannot accommodate.

The concern regarding the use of LinkedIn text rather than a survey measure to determine an individual's regulatory orientation is that the measure will be extremely noisy. We argue this is a conservative bias that may lead to a lack of statistical significance or noisy point estimates. Furthermore, in the absence of an alternate measure to classify the individuals' psychological orientation, a noisy measure is preferred to a measure that can only capture those who registered for the training program. A second concern is that there may be false positives or negatives of regulatory orientation words when using LinkedIn profiles. We hired RAs to examine each classification record to check veracity (see note in Appendix Table A.3).

For each LinkedIn profile, we create the two variables *Promotion Orientation* and *Prevention Orientation* measuring the proportion of promotion and prevention words used by the manager. The average proportion of promotion words used is 0.25% (min= 0, max = 12.9%) and prevention words is 0.28% (min = 0, max = 9.1%). The median person does not use any promotion or prevention words. Thus, the concern that the measurement is noisy and may not yield hypothesized results remains relevant given our measurement strategy.

Regulatory fit: Hypothesis 2 predicts that the fit between individual regulatory orientation and the content of the recruitment message is likely to lead to higher registration. Consequently, we define two variables, Promotion Regulatory Fit and Prevention Regulatory Fit, as the interaction between the corresponding regulatory framing and regulatory orientation.

Promotion Regulatory Fit = Promotion Message * Promotion Orientation
Prevention Regulatory Fit = Prevention Message * Prevention Orientation

3.3.3 Control Variables

Our analysis controls for several factors that may affect the firms' propensity to register for a free innovation workshop, such as size, industry, and communication timing. We used operating revenues of 2019 to control for firm size. This variable was winsorized to address outliers. We used NACE rev 2 to control for industry effects. The European standard classification of productive economic activities constitutes 18 sectors. The majority of the convenience sample were classified as Whole sale and retail trade, repair of motor vehicles and motorcycles (19.5%), followed by Professional, scientific and technical activities (12.8%), Manufacturing (11.8%) and Financial and insurance activities (11.2%).

We also control for the probability of reaching the CEO and Managing Director using an indicator value for generic (e.g., sales@companyname.com) or personalized email (e.g., CEOname@companyname.com). Of the 12,606 addresses, 36% of the emails are generic, and 64% are personalized. We also controlled by the date of email delivery. We sent the first batch of emails on the 5th of February. In contrast, the last one was on the 22nd of February, giving

potential participants 17 fewer days to register by the closing day of registration, the 5th of March

3.4 Estimation Strategy

We test our hypotheses with both an ordinary least squares (OLS) and logistic regressions to predict the business owners' likelihood of registering for the training program. We report the OLS results in the paper. The logistic regressions are at the end of the appendix.

4 Results

4.1 Prior performance and the demand for training

Before discussing the impact of performance below aspiration on registration, we briefly highlight the significant control variables predicting registration. Unsurprisingly, we find that the variables Batch and Generic Email were negatively related to registration. Recipients in later batches had less time before the closing of registration, and messages sent to generic email addresses may not have been opened by the intended person the director, CEO, or owner of the SME and hence have been discarded out of hand. Revenues in 2019, a measure of firm size, was also a negative predictor of registration. We conjecture this could be because managers in firms with a larger revenue have higher opportunity costs and are thus less likely to sign up for training that takes up a significant amount of their time (six half days in total). We note that the message type is a significant predictor of registration, with the prevention message performing significantly worse than the neutral message in our sample. We investigate the impact of the message framing after discussing Hypothesis 1.

Hypothesis 1: Does search orientation lead to Registration?

We test Hypothesis 1 in the convenience sample of 10,469 firms contacted to participate in the training program. In Tables A.5 and A.6 in Appendix, we present descriptive statistics of the registered sample and the convenience sample. Firms that registered for the training program had significantly lower shareholder funds and total assets than firms that did not. As predicted in Hypothesis 1, registered firms were more likely to have a decreased ROA than firms that did not register (p-value = 0.004). We use OLS regression to test whether a contacted firm registered for the training program or not and report the results in Table 1. Model 1 contains the control variables, and Model 2 introduces the indicator variable Decreased ROA. As predicted in Hypothesis 1, there is a positive relationship between Decreased ROA and registering for the training program ($b = 0.008$, p-value = 0.005). Firms that experienced a decrease in ROA are 61% more likely to register than firms that did not, confirming the hypothesized role of the firm's search orientation on registration.

[Table 1 about here.]

Descriptive Statistics by Message Framing and Registration:

Before we test Hypothesis 2, examining the fit between individual orientation and message framing (promotion, prevention, or neutral), we discuss the unexpected significant impact of the message framing on registration. As mentioned in the Methods section (and shown in Appendix Table A.1), there are no differences based on the accounting measures by the type of message. However, there are stark differences in registration levels as a function of message framing (see Figure 2). We found that 111 firms that registered had received the neutral message, 76 firms that registered had received the promotion message, and 52 firms that registered had received the prevention message. A neutral message is 46% more likely to lead to registration than promotion (p -value = 0.008) and 115% more likely than prevention messages (p -value = 0.001). While we did not make any predictions about the message framing, in the discussion section, we underscore the implication of the differential impact of the message framing for researchers recruiting participants for field experiments and for the literature on regulatory focus theory.

[Figure 2 about here.]

4.2 Fit between Managerial Orientation and Message Type

Out of the 10,469 firms contacted by us by email, we were able to find LinkedIn information of the CEO/owner for 6,203 firms. In Tables A.7 and A.8 in the Appendix, we test the differences in accounting measures and type of messages sent by firms with LinkedIn information and firms in the convenience sample. Unsurprisingly, we found that firms with LinkedIn information of the CEO/founders have higher revenues (p -value = 0.006) and ROA (p -value = 0.074), but are no different in the decrease in ROA (p = 0.676). Thus, our tests of Hypothesis 2 may be contingent on larger firms being included in the subsample with LinkedIn information used to test the hypothesis.

1. We use OLS to test whether CEOs/owners of SMEs who are promotion (prevention) oriented respond more positively to a message with regulatory fit than messages without regulatory fit. To test whether promotion-oriented CEOs/owners are more likely to register with a regulatory fit, we compare registration under regulatory fit with registration under prevention and neutral messages respectively in Table 2. Models 1 and 3 have all the control variables and the main effects of the interaction terms of interest. In Model 2 (Model 4), we introduce the interaction terms between the CEO/owner's promotion orientation and promotion message and prevention (neutral) message. We find the promotion regulatory fit to be positive and significant (b = 0.022, p -value = 0.026) compared to the prevention message, but not the neutral

message ($b = 0.005$, $p\text{-value} = 0.651$)¹. An increase in the promotion orientation of CEOs/owners from one standard deviation below the mean to one standard deviation above the mean increases the likelihood of registration by 64% under the promotion message but decreases the likelihood by 25% under the prevention message.

[Table 2 about here.]

To test whether prevention-oriented CEOs/owners are more likely to register with a regulatory fit, we compare registration under regulatory fit with registration under

prevention and neutral messages respectively in Table 3. Models 1 and 3 have all the control variables and the main effects of the interaction terms of interest. In Model 2 (Model 4), we introduce the interaction terms between the CEO/owner's prevention orientation and prevention message and promotion (neutral) message. We find the effect of prevention regulatory fit to be opposite to the hypothesized effect, with a negative and significant effect ($b = -0.023$, $p\text{-value} = 0.010$) compared to the neutral message, but no effect compared to the promotion message. An increase in the prevention orientation of CEOs/owners from one standard deviation below the mean to one standard deviation above the mean decreases the likelihood of registering by 16% under the prevention message but increases the likelihood of registering by 57% under the neutral message.

[Table 3 about here.]

4.3 Prior performance and message type

We use the convenience sample to test Hypothesis 3. We have argued that the performance aspiration gap induces situational regulatory orientation based on prior work. We use the firm's situational regulatory orientation promotion or prevention to verify whether the fit between the performance aspiration gap and message type increases registration. Similar to the test of Hypothesis 2, we perform a pairwise comparison for each situational regulatory orientation. In Table 4, Models 1 and 3 show the main effects of the interaction variables for the promotion and prevention or neutral, respectively. Models 2 and 4 show the interaction of performance below aspiration, which induces a promotion regulatory orientation, with promotion message compared to prevention or neutral message, respectively. The interaction of 'performance below aspiration' and 'promotion message' is not a positive predictor of registration.

[Table 4 about here.]

In Table 5, Models 1 and 3 show the main effects of the interaction variables for the prevention and promotion or neutral messages, respectively. Models 2 and 4 show the interaction of performance below aspiration, which induces a

promotion regulatory orientation, with prevention message compared to promotion or neutral message, respectively. The interaction of 'performance below aspiration' and 'prevention message' is not a negative predictor of registration. Thus, Hypothesis 3 is not supported.

[Table 5 about here.]

To summarize, our results show that there may be systematic differences in those who sign up based on the performance below aspiration, the message framing (significant main effect of the neutral message, although not hypothesized), and the fit between individual regulatory orientation and message regulatory framing. We do not find empirical support for the combined effect of 'performance below aspiration' and 'message framing.'

4.4 Robustness tests

4.4.1 The impact of neutral message length on signups

A surprising result from our primary experiment is the significantly higher response from the neutral message as compared to the prevention and promotion messages. Although not part of our hypotheses, the main effect of the neutral message when compared to promotion and prevention leading to higher registration is worth further investigation. The neutral message following convention in several studies (Gaddis et al., 2004; Stam et al., 2018; Khoa et al., 2021), presents a concise message excluding the additional promotion or prevention-orientation orientation part, hence it is typically shorter than the other messages. However, this raises a concern regarding whether the shorter length of the message is more likely to lead to greater registration.

To investigate the possibility, we conducted a robustness test of the impact of message length on sign-up rates. We designed a field experiment using another recruitment drive for a business innovation webinar run by one of our partners, SCCCI, for their SME members. SCCCI would not share details of their members to conduct any additional analysis due to personal data protection. SCCCI had identified a target pool of 3,980 SME members, which they offered to randomize and send messages to from their system. We created a short and a long version of an electronic direct mail (EDM) with neutral messages without regulatory focus words. SCCCI members were randomly selected to either the long or short neutral messages. Given the sample size of 3,980 SMEs and our experience with a low response rate, we estimated the sample size needed to detect effects to be over 2,500 for two conditions. Therefore, due to sample size restrictions, we were unable to test the promotion and prevention regulatory focus messages. Recall our sole concern was to test if shorter messages are preferred to longer. Therefore, testing neutral short and long messages would address the concern. We find that registration was higher for the longer message (mean = 1.8%, s.d.= 0.133) than for the shorter message (mean = 0.7%,

s.d.= 0.086) and the difference was significant (p-value = 0.001). Thus, the concern that shorter messages lead to greater registration does not hold in the second field experiment.

4.4.2 Analysis of complete sampling process

As a final series of additional analyses and robustness checks, we perform an extended analysis of the sampling process.

We have established that the registered sample differs from the convenience sample in predictable ways, based on the firms' performance compared to aspiration and the CEOs/owners promotion (prevention) orientation and message received. Our discussion section will detail how this may affect our field experiment. However, the more significant question remains whether the registered sample is representative of the population as a whole. After all, the field experiment results should apply to the population of interest (e.g., SME's in Singapore) and not the convenience sample. This section will systematically investigate this in the remainder of this section.

Representativeness of experimental sample: To reach out to the firms, we chose to use email rather than a postal address, thus creating a convenience sample of firms with valid email IDs which differed from the population of firms. This sampling choice may be an underlying cause for heterogeneity between the population of firms and the firms in the registered sample. To answer this question, we examine and present the differences in Tables A.9 and A.10 in Appendix between the firms in the population (41,616) and the firms in the convenience sample (10,469). We find that firms in the convenience sample posted a significantly higher revenue (p-value = 0.001) but a lower ROA (p-value = 0.001) than the firms in the population. The firms did not differ in decrease in ROA (p-value = 0.346). We also find that firms in the convenience sample are less likely to come from the financial industry but more likely to be in the education, manufacturing, or infocomm industry.

Representativeness of registered firms to population: We provide descriptive statistics for the 41,616 firms in the population and the 239 firms in the registered sample and test for differences in Tables A.11 and A.12 in Appendix. Suppose there are no differences between the firms in the population and firms in the registered sample. In this case, the use of a convenience sample based on the availability of valid email IDs of CEOs/owners of the SMEs to recruit firms for the training program despite being skewed towards larger and more profitable firms is no barrier to obtaining a representative registered sample that allows inference from the findings of the training to the population.

We find no differences in financial measures between firms in the population and the registered sample except for the performance below aspirations variable predicted in Hypothesis 1, namely performance below aspiration measured by a decrease in ROA (p-value = 0.006). Therefore, researchers

should be cognisant of the potential differences in firms responding to training based on their immediate past performance. Furthermore, we find that financial services are underrepresented, whereas the education, manufacturing, and infocomm industry are over represented. Fortunately, researchers can easily control for those industry differences by focusing on a specific industry

5 Discussion and Conclusion

In this article, we theorize about and attempt to address some of the frictions that limit the diffusion of new business knowledge to firms. This challenge is central to both the process of researchers testing the impact of specific types of business training and practitioners attempting to improve business performance more broadly. To bring this issue to the fore, we use the recruitment for an innovation program in Singapore as a field experiment and hypothesize about the firm and individual level mechanisms that drive firms to seek new learning opportunities.

Our study consists of a pre-registered field experiment with over 10,000 Singaporean small and medium enterprises. We test two primary determinants of firms' willingness to acquire new knowledge: (a) the heterogeneity in firms' past performance and (b) the interaction of the framing of why firms will benefit from training with the manager orientation. We find that firms with decreased performance in the past year compared to the preceding year were 61% percent more likely to register, consistent with the Behavioral Theory of the Firm. Second, we observe considerable differences in registration rates based on the message type i.e., prevention, promotion, and neutral. In our study, the neutral message led to the highest sign-ups at 3.2%, whereas the prevention and promotion messages worked considerably less well at 1.5% and 2.2%, respectively. In support of some, though not all the psychological mechanisms posited in prior work, we find systematic heterogeneity in who responds to what message. Managers who used more 'promotion' words in their online profiles responded more when receiving the promotion email, providing partial support for regulatory focus theory.

On an additional note, an essential innovation of our research methods is the exploitation of the individual's digital footprint the recipients' LinkedIn profiles to measure promotion and prevention orientation using textual analysis. Questions surrounding personality traits can typically only be collected from participants through questionnaires they fill out upon registering or during the treatment. By using this publicly available source of information, we can access material by individuals who are not in our sample to include their data in our analysis. This extra information while undoubtedly sparse can give us a window into understanding sample selection bias in our field experiments and offer pointers to new ways to improve the fidelity of results from field experiments.

Finally, our study is not without limitations. We have defined the population as the firms in Singapore older than five years and not above SGD 100 million in revenue. We do not know the size and profitability of firms that do not file accounting data with the Singapore government registry and thus cannot say how our results apply to such firms. Typically, new firms, inactive firms, or holding companies do not file accounting information without any commercial activities. There may be firms that fit our definition of the sample population excluded from the starting sample because accounting information was unavailable. We have no way to test the extent of this bias other than assuming that much smaller firms and inactive firms are left out of our population. Second, while our measure of psychological orientation is creatively based on LinkedIn data, it is sparse and was not pre-registered. With the benefit of hindsight, we should have anticipated that testing Hypothesis 2 on regulatory fit within the registered sample would not be appropriate. While LinkedIn data emerged during the research process, that data is widely and publicly available, offering researchers the opportunity to measure the psychological orientation and other relevant characteristics of the managers that they may reach out to.

In conclusion, our work seeks to increase understanding of which firms enroll in business training and shows how the registered sample differs from the population in predictable ways, based on the participants' search orientation and regulatory orientation. We systematically consider and discuss the theoretical drivers of registration to uncover the causes of the differences between the registered sample and the population. Our research design allows us to uncover the role of the field experimenter in skewing the registered sample, as we observe that the message has a significant impact on the number of participants and their regulatory orientation.

By considering the nature of the biases introduced in the registered sample, we can work to preserve the benefits of field experiments scalability and generalizability to strengthen the quality and impact of our research. We believe that the research stream using field experiments in management can benefit from a greater focus on identifying, analyzing, and fixing sampling biases in field experiments. Given the cost and effort of conducting field experiments, we expect that improvements to sampling could create significant value to researchers, policymakers, and practitioners in the future.

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Table 1: OLS Estimations linking Registration to Performance below Aspiration			
<i>Dependent variable</i>			
Register			
	(1)		(2)
Batch	–0.006*** (0.002)		–0.005*** (0.002)
Generic Email	–0.009*** (0.003)		–0.009*** (0.003)
Revenues in 2019	0.000* (0.000)		–0.000** (0.000)
ROA in 2019	–0.002 (0.004)		0.002 (0.004)
Promotion Message		–0.006*	–0.005 (0.003)
Prevention Message		–0.011***	–0.012*** (0.003)
Decreased ROA			0.008*** (0.003)
Constant	0.024 (0.031)		0.019 (0.031)
Industry Control	C		C
Observations	9,330		8,520
R ²	0.005		0.006
Adjusted R ²	0.002		0.003
Residual Std. Error	0.130 (df = 9306)		0.129 (df = 8495)
F Statistic	1.875*** (df = 23; 9306)		1.963*** (df = 24; 8495)

Notes: We estimate OLS regression in Models (1) and (2). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. We included indicator variables representing Promotion and Prevention framed messages respectively in both models and purposely omitted the indicator variable representing the Neutral framed messages. Generic Email, Batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, were added as a control in all models. The variable of interest Decreased ROA 18-19 indicates that the company decreased ROA in 2019, compared with 2018. Power analysis, considering a significance level of 0.05, indicates a power of 0.998 for Model 2.

p<0.1; **p<0.05; ***p<0.01

Table 2: OLS Estimations linking Registration to Promotion Orientation and Regulatory Fit

Dependent variable: Register				
	(1)	(2)	(3)	(4)
	Promotion & Prevention Conditions		Promotion & Neutral Conditions	
Batch	– 0.004	– 0.004	– 0.009 ^{hh}	– 0.009 ^{hh}
	(0.003)	(0.003)	(0.004)	(0.004)
Generic Email	0.002	0.002	–0.010	–0.010
	(0.006)	(0.006)	(0.008)	(0.008)
Revenues in 2019	–0.000 ^{hh}	–0.000 ^{hh}	–0.000 ^h	–0.000 ^h
	(0.000)	(0.000)	(0.000)	(0.000)
ROA in 2019	0.014 ^h	0.014 ^h	0.012	0.012
	(0.008)	(0.008)	(0.009)	(0.009)
Decreased ROA	0.011 ^{hh}	0.011 ^{hh}	0.013 ^h	0.013 ^h
	(0.005)	(0.005)	(0.007)	
Promotion Orientation	0.004	–0.006	0.011 ^h	0.008
	(0.005)	(0.007)	(0.006)	(0.008)
Prevention Orientation	0.004	0.004	0.013 ^{hhh}	0.013 ^{hhh}
	(0.004)	(0.004)	(0.005)	(0.007)
Promotion Message	0.009 ^h	0.003	– 0.014 ^{hh}	– 0.015 ^{hh}
	(0.005)	(0.006)	(0.006)	(0.007)

Pro Orientation *		0.022 ^{hh}		0.005
Pro Message		(0.010)		(0.012)
Constant	0.003 (0.054)	0.002 (0.054)	0.029 (0.067)	0.029 (0.067)
Industry Control	J	J	J	J
Observations	2,971	2,971	2,899	2,899
R ²	0.008	0.010	0.013	0.013
Adjusted R ²	-0.0001	0.001	.004	0.004
Residual Std. Error	0.141 (df = 2945)	0.141 (df = 2944)	0.173 (df = 2873)	0.173 (df = 2872)
F Statistic	0.992 (df = 25; 2945)	1.146 (df = 26; 2944)	1.485 ^h (df = 25; 2873)	1.436 ^h (df = 26; 2872)

Notes: We estimate OLS regression in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the prevention condition, accounting for the different size of the data in both sets of models. We included one indicator variable representing Promotion messages in all models and purposely omitted the indicator variable representing Prevention (Models (1) and (2)) or Neutral (Models (3) and (4)) framed messages. Generic email and recruitment batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models. Power analysis, considering a significance level of 0.05, indicates a power of 0.913 and 0.974 for Models 2 and 4. <0.1; hh p<0.05; hhh p<0.01

Table 3: OLS Estimations linking Registration to Prevention Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention Conditions	(2) Promotion & Prevention Conditions	(3) Prevention & Neutral Conditions	(4) Prevention & Neutral Conditions
Batch	-0.004 (0.003)	-0.004 (0.003)	-0.010 ^{hhh} (0.004)	-0.010 ^{hhh} (0.004)
Generic Email	0.002 (0.006)	0.002 (0.006)	-0.013 ^h (0.007)	-0.012 ^h (0.007)
Revenues in 2019	-0.000 ^{hh} (0.000)	-0.000 ^{hh} (0.000)	-0.000 ^h (0.000)	-0.000 ^h (0.000)
ROA in 2019	0.014 ^h (0.008)	0.014 ^h (0.008)	0.017 ^h (0.009)	0.017 ^h (0.009)
Decreased ROA	0.011 ^{hh} (0.005)	0.011 ^{hh} (0.005)	0.013 ^{hh} (0.006)	0.014 ^{hh} (0.006)
Promotion Orientation	0.004 (0.005)	0.004 (0.005)	-0.000 (0.005)	0.000 (0.005)
Prevention Orientation	0.004 (0.004)	0.004 (0.005)	0.015 ^{hhh} (0.005)	0.027 ^{hhh} (0.007)
Prevention Message	-0.009 ^h (0.005)	-0.009 (0.006)	-0.023 ^{hhh} (0.006)	-0.016 ^{hh} (0.006)
Pre Orientation * Pre Message		-0.0002 (0.007)		-0.023 ^{hh} (0.009)
Constant	0.012 (0.054)	0.012 (0.054)	0.037 (0.066)	0.034 (0.066)
Industry Control	J	J	J	J
Observations	2,971	2,971	2,884	2,884
R ²	0.008	0.008	0.017	0.020
Adjusted R ²	-0.0001	-0.0004	0.009	0.011

Notes: We estimate OLS regression in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the

dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the promotion condition, accounting for the different size of the data in both sets of models. We included one indicator variable representing Prevention messages in all models and purposely omitted the indicator variable representing Promotion (Models (1) and (2)) or Neutral (Models (3) and (4)) framed messages. Generic email and recruitment batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models. Power analysis, considering a significance level of 0.05, indicates a power of 0.813 and 0.999 for Models 2 and 4. h p<0.1; hh p<0.05; hhh p<0.01

Table 4: OLS Estimations linking Registration to Situational Promotion Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention Conditions	(2) Promotion & Prevention Conditions	(3) Promotion & Neutral Conditions	(4) Promotion & Neutral Conditions
Batch	-0.004 ^h (0.002)	-0.004 ^h (0.002)	-0.006 ^{hh} (0.003)	-0.006 ^{hh} (0.003)
Generic Email	-0.007 ^h (0.004)	-0.007 ^h (0.004)	-0.018 ^{hhh} (0.005)	-0.019 ^{hhh} (0.005)
Revenues in 2019	-0.000 (0.000)	-0.000 (0.000)	-0.000 ^h (0.000)	-0.000 ^h (0.000)
ROA in 2019	0.005 (0.006)	0.005 (0.006)	0.000 (0.006)	0.000 (0.006)
Decreased ROA	0.007 ^h 0.015 ^{hh} (0.004)	0.008 (0.005)	0.010 ^{hh} (0.005)	0.007 (0.007)
Promotion Message	0.008 ^{hh} (0.004)	0.009 (0.006)	-0.006 (0.005)	-0.002 (0.007)
Decreased ROA * Pro Message		-0.001 (0.008)		-0.009 (0.009)
Constant	0.008 (0.042)	0.008 (0.042)	0.026 (0.049)	0.023 (0.049)
Industry Control	J	J	J	J
Observations	4,720	4,720	4,686	4,686
R ²	0.006	0.006	0.008	0.008
Adjusted R ²	0.001	0.001	0.003	0.003
Residual Std. Error	0.131 (df = 4696)	0.131 (df = 4695)	0.154 (df = 4662)	0.154 (df = 4661)
F Statistic	1.280 (df = 33; 4696)	1.227 (df = 34; 4695)	1.637 ^{hh} (df = 33; 4662)	1.610 ^{hh} (df = 34; 4661)

Notes: We estimate OLS regressions in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the prevention condition, accounting for the different size of the data in both sets of models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models. Power analysis, considering a significance level of 0.05, indicates a power of 0.906 and 0.977 for Models 2 and 4. †p<0.1; p<0.1; hh p<0.05; hhh p<0.01

Table 5: OLS Estimations linking Registration to Situational Prevention Orientation and Regulatory Fit

	Dependent variable:			
	Register			
	(1) Promotion & Prevention Conditions	(2) Promotion & Prevention Conditions	(3) Prevention & Neutral Conditions	(4) Prevention & Neutral Conditions
Batch	-0.004 ^h (0.002)	-0.004 ^h (0.002)	-0.007 ^{hhh} (0.002)	-0.007 ^{hhh} (0.002)
Generic Email	-0.007 ^h (0.004)	-0.007 ^h (0.004)	-0.015 ^{hhh} (0.004)	-0.015 ^{hhh} (0.004)
Revenues in 2019	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
ROA in 2019	0.005 (0.006)	0.005 (0.006)	0.002 (0.006)	0.002 (0.006)
Decrease ROA	0.007 ^h (0.004)	0.006 (0.005)	0.011 ^{hhh} (0.004)	0.015 ^{hhh} (0.006)
Prevention Message	-0.008 ^{hhh} (0.004)	-0.009 (0.006)	-0.014 ^{hhh} (0.004)	-0.011 ^h (0.006)
Decreased ROA * Pre Message		0.001 (0.008)		-0.008 (0.008)
Constant	0.036 (0.042)	0.036 (0.042)	0.030 (0.050)	0.026 (0.050)
Industry Control	J	J	J	J
Observations	4,720	4,720	4,648	4,648
R ²	0.006	0.006	0.030	0.030
Adjusted R ²	0.001	0.001	0.005	0.005
Residual Std. Error	0.131 (df = 4696)	0.131 (df = 4695)	0.140 (df = 4624)	0.140 (df = 4623)
F Statistic	1.280 (df = 23; 4696)	1.227 (df = 24; 4695)	2.058 ^{hhh} (df = 23; 4624)	2.014 ^{hhh} (df = 24; 4623)

is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the promotion condition, accounting for the different size of the data in both sets of models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models. Power analysis, considering a significance level of 0.05, indicates a power of 0.906 and 0.995 for Models 2 and 4. †p<0.1; p<0.1; hh p<0.05; hhh p<0.01

Figure 1: Sampling Method

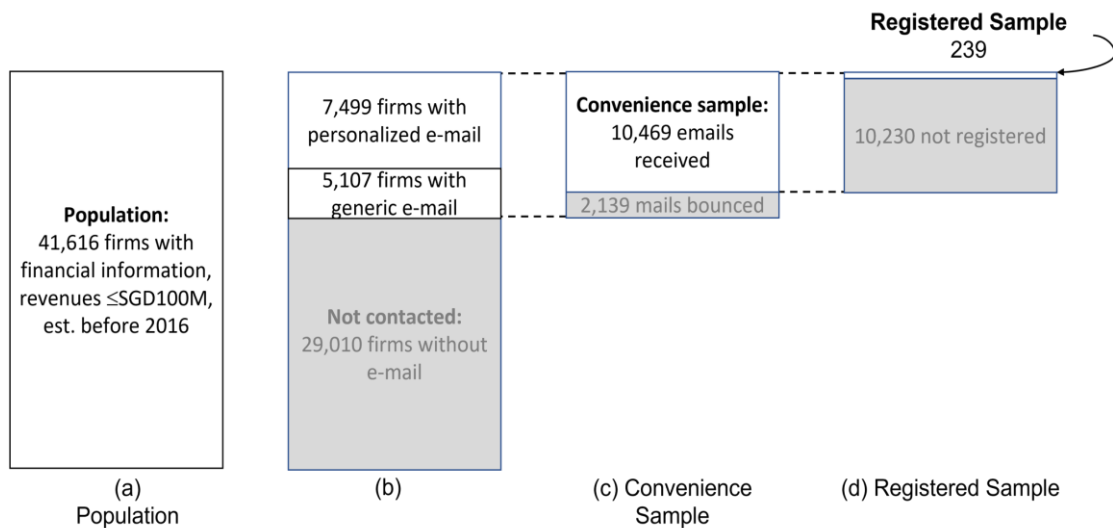


Figure 2: Proportion of Registration per Message Treatment

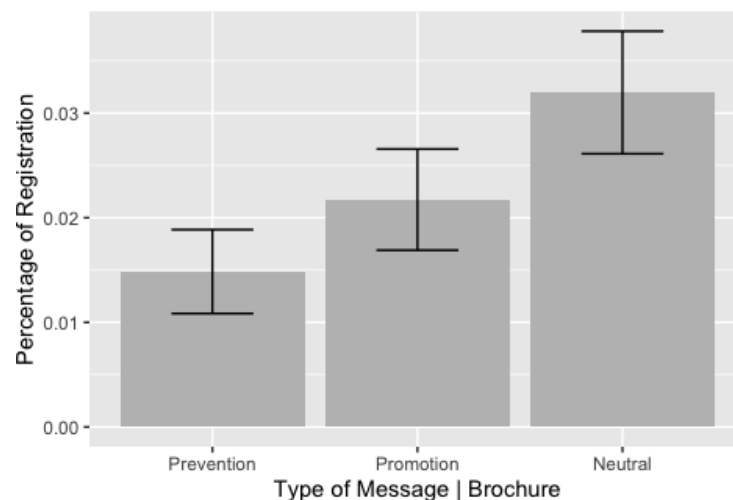


Figure A.1: AsPredicted Submission #57917 created 10 February 2021





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Promotion/Prevention vs Aspiration: Sign Ups (Full Sample) (#57917)

Created: 02/10/2021 01:52 AM (PT)

This is an anonymized copy (without author names) of the pre-registration. It was created by the author(s) to use during peer-review. A non-anonymized version (containing author names) should be made available by the authors when the work it supports is made public.

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
We will invite SME CEOs and directors to attend a (free) workshop on open innovation. We will send them three different versions of the invitation, with a promotion, prevention or neutral focus. We will be testing the following three hypotheses:
H1: SMEs performing below aspiration are more likely to sign up than SMEs performing above aspiration.
This is because performance below aspiration has been shown to increase action and risk taking to restore performance - signing up for the workshop on innovation displays the willingness to take action and consider risky innovation to improve performance.
H2a: Promotion-focused individuals will be more likely to sign up when receiving the promotion than the prevention or neutral message.
H2b: Prevention-focused individuals will be more likely to sign up when receiving the prevention than the promotion or neutral message.
Literature has shown that people are more likely to respond to messages that display regulatory fit with their own chronic self-regulatory focus.
H3: SMEs performing above (below) aspiration are more likely to sign up when receiving prevention (promotion) message than promotion (prevention) or neutral message.
Self-regulatory focus can be chronic or situational. We argue that performing above (below) aspiration induces a prevention (promotion) self-regulatory focus.

3) Describe the key dependent variable(s) specifying how they will be measured.
Click through rate and sign-ups of SME CEOs and directors for a free workshop.

4) How many and which conditions will participants be assigned to?
Three conditions - promotion, prevention and neutral/baseline mail and brochure (with identical wording in mail and brochure). The SME's will be approached as follows:
- emails of SMEs, their CEO or managing director will be sent a promotion/prevention/neutral cover letter, with corresponding promotion/prevention/neutral brochure for the event attached.
- where LinkedIn account information is available, if CEOs or managing directors have not responded to the email, they will be approached on LinkedIn with a promotion/prevention/neutral message inviting to connect if they have not responded to the mail. Upon accepting the connection, they will receive the promotion/prevention/neutral mail and brochure again.
- where phone numbers are available, if CEOs or managing directors have not responded to the email or LinkedIn message, they will be approached by phone with a promotion/prevention/neutral message asking them whether they are interested to receive the promotion/prevention/neutral brochure.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
t-test and regressions for the main hypotheses will be done for the sign ups resulting from emails only (i.e., not having received LinkedIn or phone follow-ups)

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
None

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
We will offer the programme until 300 people have enrolled or until March 6, 2021, whichever is earlier.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
We will also collect data on economic performance, aspiration and self-regulatory focus of the participants, as well as manipulation check questions to be used for the analysis to justify the theoretical pathways of our hypotheses. We will pool the full sample with the pilot data performed earlier if there are no errors.

Figure A.2: Screenshots of Promotion, Prevention and Neutral Framed Messages E-mails

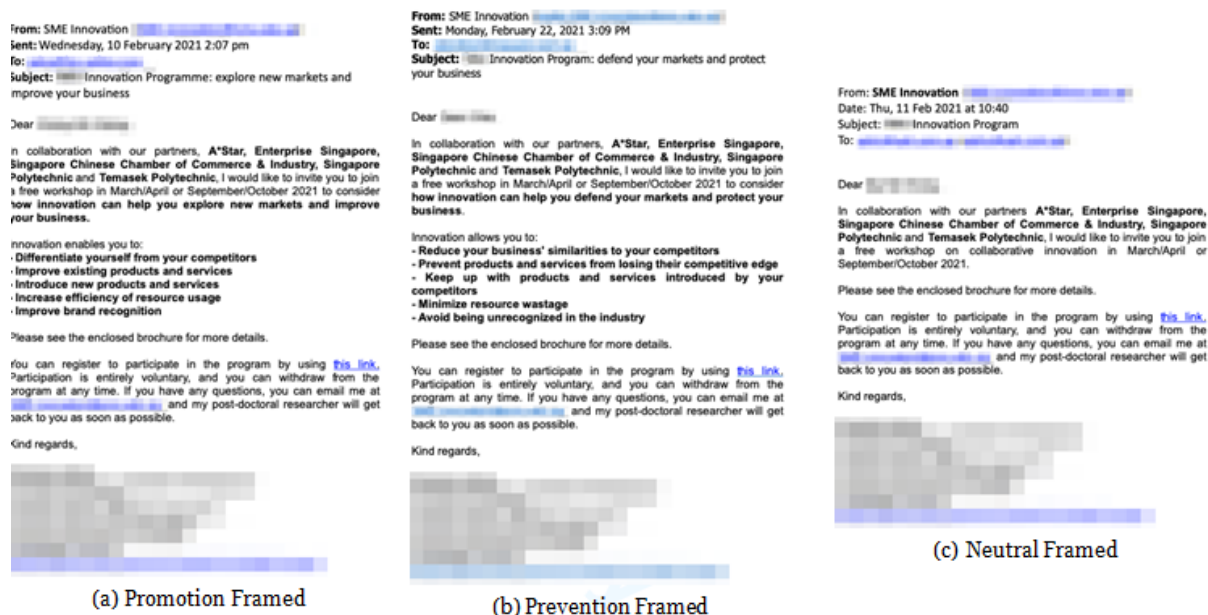


Table A.1: Difference in means of the descriptive statistics by pairs of treatment

	Prevention (N=3500)	Promotion (N=3497)	P-value
Registered			
Mean (SD)	0.0149 (0.121)	0.0217 (0.146)	0.032
Recruitment Batch			
Mean (SD)	2.64 (0.863)	2.66 (0.865)	0.461
Generic E-mail			
Mean (SD)	0.429 (0.495)	0.423 (0.494)	0.609
Revenues in 2019			
Mean (SD)	6430 (10300)	6540 (10400)	0.715
ROA in 2019			
Mean (SD)	-0.0954 (0.395)	-0.0860 (0.378)	0.385
Decreased ROA 18-19			
Mean (SD)	0.517 (0.500)	0.533 (0.499)	0.255

(a) Promotion vs Prevention

	Neutral (N=3472)	Prevention (N=3500)	P-value
Registered			
Mean (SD)	0.0320 (0.176)	0.0149 (0.121)	<0.001
Recruitment Batch			
Mean (SD)	2.65 (0.857)	2.64 (0.863)	0.696
Generic E-mail			
Mean (SD)	0.433 (0.496)	0.429 (0.495)	0.752
Revenues in 2019			
Mean (SD)	6540 (10400)	6430 (10300)	0.715
ROA in 2019			
Mean (SD)	0.0973 (0.387)	-0.0954 (0.395)	0.863
Decreased ROA 18-19			
Mean (SD)	0.512 (0.500)	0.517 (0.500)	0.769

(b) Neutral vs Prevention

	Neutral (N=3472)	Promotion (N=3497)	P-value
Registered			
Mean (SD)	0.0320 (0.176)	0.0217 (0.146)	0.008
Recruitment Batch			
Mean (SD)	2.65 (0.857)	2.66 (0.865)	0.728
Generic E-mail			
Mean (SD)	0.433 (0.496)	0.423 (0.494)	0.409
Revenues in 2019			
Mean (SD)	6540 (10400)	6540 (10400)	0.998
ROA in 2019			
Mean (SD)	-0.0973 (0.387)	-0.0860 (0.378)	0.293
Decreased ROA 18-19			
Mean (SD)	0.512 (0.500)	0.533 (0.499)	0.153

(c) Neutral vs Promotion

Figure A.3: Percentage of Registration per Industry Sectors

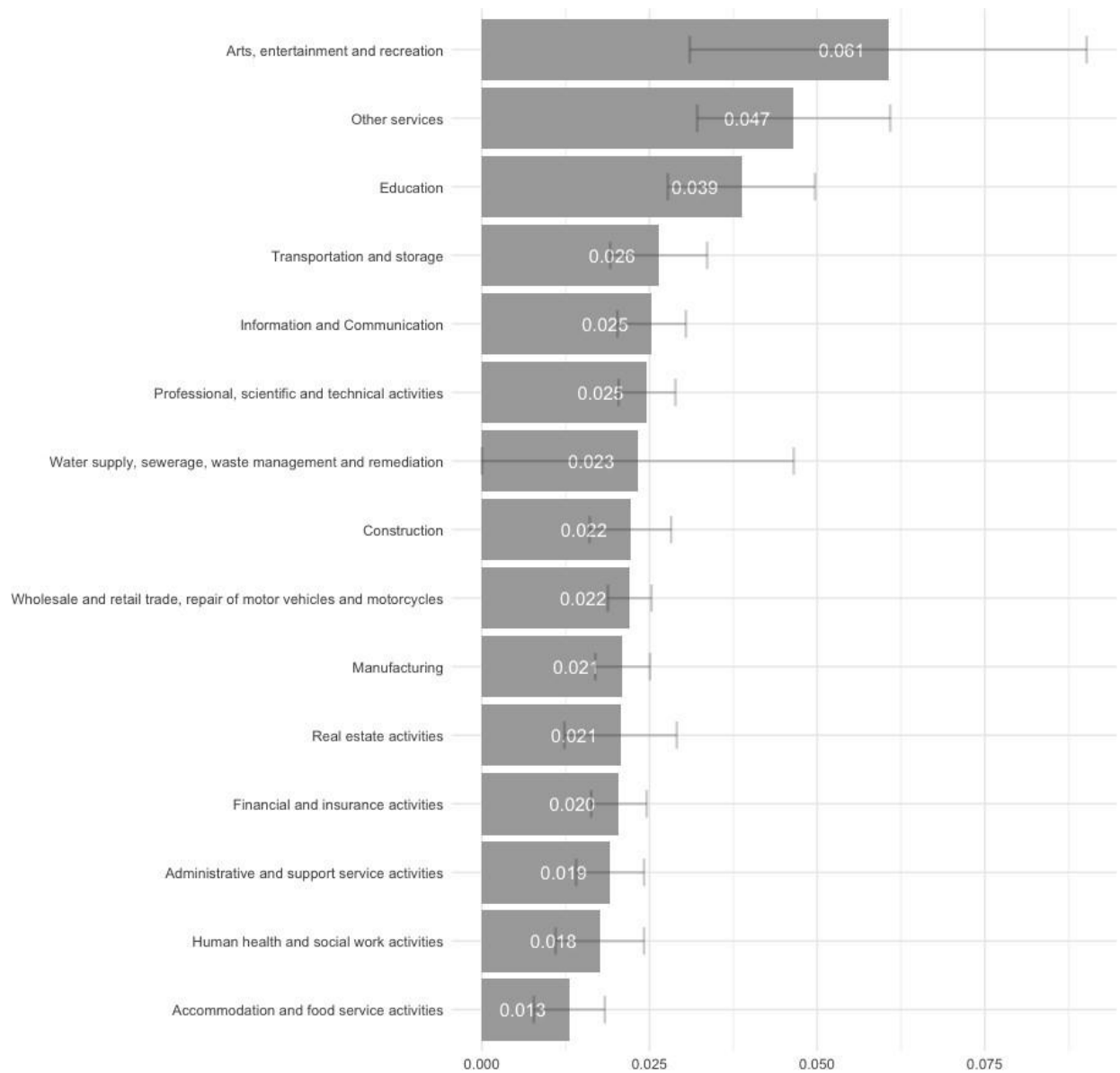


Table A.2: Absorption of Message Treatment Test in Prolific

	Prevention (N=101)	Promotion (N=99)	P-value
Promotion Focus Variables			
Positive Benefits			
Mean (SD)	4.20 (1.85)	4.86 (1.60)	0.01
Future Benefits			
Mean (SD)	4.27 (1.80)	4.85 (1.57)	0.02
Future			
Mean (SD)	3.98 (1.76)	4.54 (1.68)	0.02
Prevention Focus Variables			
Negative Consequences			
Mean (SD)	3.31 (1.76)	2.86 (1.77)	0.07
Threats			
Mean (SD)	3.57 (1.69)	3.27 (1.78)	0.22
Current Situation			
Mean (SD)	3.93 (1.55)	4.39 (1.78)	0.05

□

Table A.3: Regulatory Focus Words

Promotion Words	Prevention Words
<i>Accomplish</i>	<i>Improve</i>
<i>Achieve</i>	<i>Increase</i>
<i>Advancement</i>	<i>Momentum</i>
<i>Aspiration</i>	<i>Obtain</i>
<i>Aspire</i>	<i>Optimistic</i>
<i>Attain</i>	<i>Progress</i>
<i>Desire</i>	<i>Promoting</i>
<i>Earn</i>	<i>Promotion</i>
<i>Expand</i>	<i>Speed</i>
<i>Gain</i>	<i>Swift</i>
<i>Grow</i>	<i>Toward</i>
<i>Hope</i>	<i>Velocity</i>
<i>Hoping</i>	<i>Wish</i>
<i>Ideal</i>	
	<i>Accuracy</i>
	<i>Afraid</i>
	<i>Careful</i>
	<i>Anxious</i>
	<i>Avoid</i>
	<i>Conservative</i>
	<i>Defend</i>
	<i>Duty</i>
	<i>Escape</i>
	<i>Escaping</i>
	<i>Evade</i>
	<i>Fail</i>
	<i>Fear</i>
	<i>Loss</i>

Notes: These words are taken from Gamache et al. (2015). Our dictionary also captured alternative tenses of the words used.

We used LIWC to identify promotion/prevention words. We created a list with all variations of these words found in all our LinkedIn profiles and ended up with 333 words, half promotion and half prevention. We verified each variation manually and excluded 84 variations of them (40 promotion and 45 prevention) as these variables did not maintain the same meaning as the original promotion/prevention word.

E.g., the prevention word "care". We identified 21 different variations for the term. After manual inspection, we included care, careful, careful and excluded variations such as career and caregiver. The promotion word "speed". We identified 14 different variations for the term. After manual inspection, we included variations such as speeding and speedily and excluded variables such as speedo and speedboats.

Table A.4: Correlation Table - Dependent and Independent Variables

	Click	Register	Batch	Generic Email	Grow ROA
Click					
Register	0.61***				
Batch	-0.05***	-0.04***			
Generic Email	-0.03***	-0.02*	-0.05***		
Grow ROA 18-19	-0.02	-0.03*	0.05***	-0.01	
Revenue in 2019	0.00	-0.01	-0.25***	0.01	-0.03*

Table A.5: Descriptive statistics of Registered Sample vs. Convenience Sample

	Registered Sample (N=239)	Convenience Sample (N=10469)	P-value
Year of foundation			
Mean (SD)	2000 (10.4)	2000 (11.6)	0.294
Net income in 2019			
Mean (SD)	242 (1200)	358 (1440)	0.223
Revenue in 2019			
Mean (SD)	5730 (3450)	6500 (10400)	0.248
Shareholder funds 2019			
Mean (SD)	3550 (9030)	6070 (14000)	<0.001
Total assets in 2019			
Mean (SD)	10200 (21800)	14600 (29300)	0.012
ROA in 2019			
Mean (SD)	-0.0924 (0.370)	-0.0929 (0.387)	0.987
Decreased ROA 2018-19			
Mean (SD)	0.638 (0.482)	0.521 (0.500)	0.004
Current ratio in 2019			
Mean (SD)	2.18 (2.36)	2.15 (2.66)	0.853
Solvency ratio in 2019			
Mean (SD)	32.9 (42.8)	33.4 (44.6)	0.878
Number of directors			
Mean (SD)	2.59 (1.62)	2.74 (1.93)	0.162
Number of advisors			
Mean (SD)	1.06 (0.967)	1.02 (1.18)	0.476
Number of shareholders			
Mean (SD)	2.54 (3.87)	2.85 (6.00)	0.233
Number of subsidiaries			
Mean (SD)	0.573 (1.52)	0.930 (4.24)	0.001

Table A.6: Differences between Registered Sample_{vs} Convenience Sample: Industries

Industry Sector	Registered Sample (N=239)	Convenience Sample (N=10469)	P-value
			0.421
Accommodation and food service activities	6 (2.5%)	460 (4.4%)	
Administrative and support service activities	14 (5.9%)	732 (7.0%)	
Agriculture, forestry and fishing	0 (0%)	22 (0.2%)	
Arts, entertainment and recreation	4 (1.7%)	66 (0.6%)	
Construction	13 (5.4%)	537 (5.6%)	
Education	12 (5.0%)	310 (3.0%)	
Electricity, gas, steam and air-conditioning supply	0 (0%)	12 (0.1%)	
Financial and insurance activities	24 (10.0%)	1174 (11.2%)	
Human health and social work activities	7 (2.9%)	398 (3.8%)	
Information and Communication	24 (10.0%)	948 (9.1%)	
Manufacturing	26 (10.9%)	1233 (11.8%)	
Mining and quarrying	0 (0%)	20 (0.2%)	
Other services	10 (4.2%)	215 (2.1%)	
Professional, scientific and technical activities	33 (13.8%)	1340 (12.8%)	
Real estate activities	6 (2.5%)	290 (2.8%)	
Transportation and storage	13 (5.4%)	493 (4.7%)	
Water supply, sewerage, waste management	1 (0.4%)	43 (0.4%)	
Wholesale and retail trade, repair of motor vehicles	45 (18.8%)	2042 (19.5%)	
Missing	1 (0.4%)	79 (0.8%)	

Table A.7: Descriptive statistics of Sample with LinkedIn Collected_{vs} Convenience Sample

	Sample with LinkedIn (N=6203)	Convenience Sample (N=10469)	P-value
Neutral Brochure			
Mean (SD)	0.327 (0.469)	0.332 (0.471)	0.56
Median [Min, Max]	0 [0, 1]	0 [0, 1]	
Promotion Brochure			
Mean (SD)	0.335 (0.472)	0.334 (0.472)	0.949
Median [Min, Max]	0 [0, 1]	0 [0, 1]	
Prevention Brochure			
Mean (SD)	0.338 (0.473)	0.334 (0.472)	0.606
Median [Min, Max]	0 [0, 1]	0 [0, 1]	
Revenues in 2019			
Mean (SD)	7040 (10600)	6500 (10400)	0.006
Median [Min, Max]	2030 [0, 36400]	1500 [0, 36400]	
Missing	1502 (24.2%)	2734 (26.1%)	
ROA in 2019			
Mean (SD)	-0.0803 (0.377)	-0.0929 (0.387)	0.074
Median [Min, Max]	0.0123 [-1.28, 0.432]	0.00795 [-1.28, 0.432]	
Missing	1505 (24.3%)	2738 (26.2%)	
Decreased ROA 18-19			
Mean (SD)	0.525 (0.499)	0.521 (0.500)	0.676
Median [Min, Max]	1.00 [0, 1]	1.00 [0, 1]	
Missing	1924 (31.0%)	3438 (32.8%)	

□

Table A.8: Differences between Sample with LinkedIn Collected *vs* Convenience Sample: Industries

Industry Sectors	Sample with LinkedIn (N=6203)	Convenience Sample (N=10469)	P-value
			<0.001
Accommodation and food service activities	251 (4.0%)	460 (4.4%)	
Administrative and support service activities	442 (7.1%)	732 (7.0%)	
Agriculture, forestry and fishing	13 (0.2%)	22 (0.2%)	
Arts, entertainment and recreation	35 (0.6%)	66 (0.6%)	
Construction	312 (5.0%)	587 (5.6%)	
Education	190 (3.1%)	310 (3.0%)	
Electricity, gas, steam and air-conditioning supply	6 (0.1%)	12 (0.1%)	
Financial and insurance activities	736 (11.9%)	1174 (11.2%)	
Human health and social work activities	209 (3.4%)	398 (3.8%)	
Information and Communication	673 (10.8%)	948 (9.1%)	
Manufacturing	703 (11.3%)	1238 (11.8%)	
Mining and quarrying	12 (0.2%)	20 (0.2%)	
Other services	104 (1.7%)	215 (2.1%)	
Professional, scientific and technical activities	914 (14.7%)	1340 (12.8%)	
Real estate activities	178 (2.9%)	290 (2.8%)	
Transportation and storage	301 (4.9%)	493 (4.7%)	
Water supply, sewerage, waste management	25 (0.4%)	43 (0.4%)	
Wholesale and retail trade, repair of motor vehicles	1099 (17.7%)	2042 (19.5%)	
Missing	0 (0%)	79 (0.8%)	

Table A.9: Descriptive statistics of Convenience Sample *vs* Population

	Convenience Sample (N=10469)	Population (N=41616)	P-value
Revenues in 2019			
Mean (SD)	6500 (10400)	5440 (9600)	<0.001
Median [Min, Max]	1500 [0, 36400]	1040 [0, 36400]	
Missing	2734 (26.1%)	11054 (26.6%)	
ROA in 2019			
Mean (SD)	-0.0929 (0.387)	-0.0765 (0.380)	<0.001
Median [Min, Max]	0.00795 [-1.28, 0.432]	0.0109 [-1.28, 0.432]	
Missing	2738 (26.2%)	11106 (26.7%)	
Decreased ROA18-19			
Mean (SD)	0.521 (0.500)	0.527 (0.499)	0.346
Median [Min, Max]	1.00 [0, 1]	1.00 [0, 1]	
Missing	3438 (32.8%)	13337 (32.0%)	

Table A.10: Differences between Convenience Sample and Population: Industries

Industry Sectors	Convenience Sample (N=10469)	Population (N=41616)	P-value
Accommodation and food service activities	460 (4.4%)	1676 (4.0%)	<0.001
Administrative and support service activities	732 (7.0%)	2952 (7.1%)	
Agriculture, forestry and fishing	22 (0.2%)	81 (0.2%)	
Arts, entertainment and recreation	66 (0.6%)	212 (0.5%)	
Construction	587 (5.6%)	1925 (4.6%)	
Education	310 (3.0%)	695 (1.7%)	
Electricity, gas, steam and air-conditioning supply	12 (0.1%)	58 (0.1%)	
Financial and insurance activities	1174 (11.2%)	8018 (19.3%)	
Human health and social work activities	398 (3.8%)	1070 (2.6%)	
Information and Communication	948 (9.1%)	2999 (7.2%)	
Manufacturing	1238 (11.8%)	3440 (8.3%)	
Mining and quarrying	20 (0.2%)	118 (0.3%)	
Other services	215 (2.1%)	707 (1.7%)	
Professional, scientific and technical activities	1340 (12.8%)	4815 (11.6%)	
Real estate activities	290 (2.8%)	1629 (3.9%)	
Transportation and storage	493 (4.7%)	2374 (5.7%)	
Water supply, sewerage, waste management	43 (0.4%)	102 (0.2%)	
Wholesale and retail trade, repair of motor vehicles	2042 (19.5%)	7979 (19.2%)	
Missing	79 (0.8%)	757 (1.8%)	

Table A.11: Descriptive statistics of Registered Sample vs. Population

	Registered Sample (N=239)	Population (N=41616)	P-value
Revenues in 2019			
Mean (SD)	5730 (8450)	5440 (9600)	0.665
Median [Min, Max]	1830 [0, 36400]	1040 [0, 36400]	
Missing	74 (31.0%)	11054 (26.6%)	
ROA in 2019			
Mean (SD)	-0.0924 (0.370)	-0.0765 (0.380)	0.582
Median [Min, Max]	0.0145 [-1.28, 0.432]	0.0109 [-1.28, 0.432]	
Missing	74 (31.0%)	11106 (26.7%)	
Decreased ROA18-19			
Mean (SD)	0.638 (0.482)	0.527 (0.499)	0.006
Median [Min, Max]	1.00 [0, 1]	1.00 [0, 1]	
Missing	90 (37.7%)	13337 (32.0%)	

Table A.12: Differences between Registered Sample and Population: Industries

	Registered	Sample	Population	P-value
Industry Sectors		(N=239)	(N=41616)	<0.001
Accommodation and food service activities		6 (2.5%)	1676 (4.0%)	
Administrative and support service activities		14 (5.9%)	2952 (7.1%)	
Agriculture, forestry and fishing		4 (1.7%)	81 (0.2%)	
Arts, entertainment and recreation		13 (5.4%)	212 (0.5%)	
Construction		13 (5.4%)	1925 (4.6%)	
Education		12 (5.0%)	695 (1.7%)	
Electricity, gas, steam and air-conditioning supply		12 (0.1%)	58 (0.1%)	
Financial and insurance activities		24 (10.0%)	8018 (19.3%)	
Human health and social work activities		7 (2.9%)	1070 (2.6%)	
Information and Communication		24 (10.0%)	2999 (7.2%)	
Manufacturing		26 (10.9%)	3449 (8.3%)	
Mining and quarrying		0 (0%)	118 (0.3%)	
Other services		10 (4.2%)	707 (1.7%)	
Professional, scientific and technical activities		33 (13.8%)	4815 (11.6%)	
Real estate activities		6 (2.5%)	1629 (3.9%)	
Transportation and storage		13 (5.4%)	2374 (5.7%)	
Water supply, sewerage, waste management		1 (0.4%)	102 (0.2%)	
Wholesale and retail trade, repair of motor vehicles		45 (18.8%)	7979 (19.2%)	
Mining		1 (0.4%)	757 (1.8%)	

Table A.13: Logistic Estimations linking Registration to Performance below Aspiration

	<i>Dependent variable:</i>	
	Register	
	(1)	(2)
Batch	-0.339--- (0.070)	-0.312--- (0.070)
Generic Email	-0.571--- (0.126)	-0.594--- (0.126)
Revenues in 2019	-0.000--- (0.000)	-0.000--- (0.000)
ROA in 2019	-0.117 (0.182)	0.107 (0.182)
Promotion Message	-0.297--- (0.115)	-0.271--- (0.115)
Prevention Message	-0.666--- (0.087)	-0.739--- (0.088)
DecreasedROA		0.461--- (0.081)
Constant	-16.145 (226.613)	-16.474 (226.605)
Industry Control	C	C
Observations	9,330	8,520
Log Likelihood	-790.244	-709.557
Akaike Inf. Crit.	1,628.489	1,469.114

Notes: We estimate Logistic regression in Models (1) and (2). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. We included indicator variables representing Promotion and Prevention framed messages respectively in both models and purposely omitted the indicator variable representing the Neutral framed messages. Generic Email and Batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, were added as a control in all models. The variable of interest Decreased ROA 18-19 indicates that the company decreased ROA in 2019, compared with 2018.

$p < 0.1$; $p < 0.05$; $p < 0.01$

Table A.14: Logistic Estimations linking Registration to Promotion Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention	(2) Conditions	(3) Promotion & Neutral	(4) Conditions
Batch	-0.242 (0.170)	-0.235 (0.171)	-0.340 ^{hh} (0.146)	-0.341 ^{hh} (0.146)
Generic Email	0.125 (0.301)	0.136 (0.302)	-0.351 (0.277)	-0.353 (0.277)
Revenues in 2019	-0.000 ^{hh} (0.000)	-0.000 ^{hh} (0.000)	-0.000 (0.000)	-0.000 (0.000)
ROA in 2019	0.740 (0.451)	0.763 ^h (0.457)	0.386 (0.343)	0.386 (0.343)
Decreased ROA	0.551 ^{hh} (0.278)	0.571 ^{hh} (0.279)	0.424 ^h (0.228)	0.420 ^h (0.228)
Promotion Orientation	0.162 (0.188)	-0.431 (0.560)	0.264 ^h (0.145)	0.176 (0.188)
Prevention Orientation	0.145 (0.143)	0.164 (0.146)	0.283 ^{hhh} (0.103)	0.282 ^{hhh} (0.104)
Promotion Message	0.462 ^h (0.270)	0.185 (0.306)	-0.465 ^{hh} (0.220)	-0.581 ^{hh} (0.254)
Pro Orientation * Pro Message		0.978 (0.616)		0.309 (0.321)
Constant	-17.321 (1,486.078)	-17.332 (1,484.354)	-16.445 (1,486.310)	-16.432 (1,488.422)
Industry Control	J	J	J	J
Observations	2,971	2,971	2,899	2,899
Log Likelihood	-280.452	-278.488	-383.460	-383.005
Akaike Inf. Crit.	612.903	610.976	818.919	820.011

Notes: We estimate Logistic regression in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the prevention condition, accounting for the different size of the data in both sets of models. We included one indicator variable representing Prevention messages in all models and purposely omitted the indicator variable representing Promotion (Models (1) and (2)) or Neutral (Models (3) and (4)) framed messages. Generic Email and Batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models.

^hp<0.1; ^{hh}p<0.05; ^{hhh}p<0.01

Table A.15: Logistic Estimations linking Registration to Prevention Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention	(2) Conditions	(3) Prevention & Neutral	(4) Conditions
Batch	-0.242 (0.170)	-0.242 (0.170)	-0.445 ^{hhh} (0.164)	-0.443 ^{hhh} (0.164)
Generic Email	0.125 (0.301)	0.123 (0.301)	-0.576 ^h (0.313)	-0.573 ^h (0.314)
Revenues in 2019	-0.000 ^{hh} (0.000)	-0.000 ^{hh} (0.000)	-0.000 (0.000)	-0.000 (0.000)
ROA in 2019	0.740 (0.451)	0.739 (0.451)	0.766 ^h (0.418)	0.788 ^h (0.423)
Decreased ROA	0.551 ^{hh}	0.550 ^{hh} (0.278)	0.533 ^{hh} (0.279)	0.533 ^{hh} (0.250)
Promotion Orientation	0.162 (0.188)	0.159 (0.190)	0.029 (0.188)	0.044 (0.193)
Prevention Orientation	0.145 (0.143)	0.133 (0.182)	0.342 ^{hhh} (0.110)	0.436 ^{hhh} (0.135)
Prevention Message	-0.462 ^h (0.270)	-0.474 (0.292)	-0.945 ^{hhh} (0.256)	-0.815 ^{hhh} (0.278)
Pre Message * Pre Orientation		0.032 (0.290)		-0.275 (0.262)
Constant	-16.859 (1,486.078)	-16.853 (1,485.844)	-15.966 (1,597.030)	-16.033 (1,599.365)
Industry Control	J	J	J	J
Observations	2,971	2,971	2,884	2,884
Log Likelihood	-280.452	-280.446	-326.267	-325.626
Akaike Inf. Crit.	612.903	614.891	704.535	705.251

Notes: We estimate Logistic regression in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the promotion condition, accounting for the different size of the data in both sets of models. We included one indicator variable representing Prevention messages in all models and purposely omitted the indicator variable representing Promotion (Models (1) and (2)) or Neutral (Models (3) and (4)) framed messages. Generic Email and Batch were added as a control in all models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both winsorized to address outliers, and Decreased ROA 18-19 were added as a control in all models.

^hp<0.1; ^{hh}p<0.05; ^{hhh}p<0.01

Table A.16: Logistic Estimations linking Registration to Situational Promotion Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention	(2) Conditions	(3) Promotion & Neutral	(4) Conditions
Batch	-0.242 ^h (0.144)	-0.242 ^h (0.144)	-0.279 ^{hh} (0.122)	-0.277 ^{hh} (0.122)
Generic Email	-0.417 ^h (0.240)	-0.418 ^h (0.240)	-0.861 ^{hhh} (0.221)	-0.863 ^{hhh} (0.221)
Revenues in 2019	-0.000 (0.000)	-0.000 (0.000)	-0.000 ^h (0.000)	-0.000 ^h (0.000)
ROA in 2019	0.290 (0.348)	0.291 (0.348)	0.011 (0.273)	0.013 (0.273)
Decreased ROA	0.412 ^h (0.236)	0.583 (0.383)	0.443 ^{hh} (0.203)	0.576 ^{hh} (0.273)
Promotion Message	0.476 ^{hh} (0.231)	0.647 ^h (0.379)	-0.268 (0.192)	-0.084 (0.513)
Decreased ROA * Pre Message		-0.276 (0.478)		-0.294 (0.396)
Constant	-17.120 (1.239)	-17.206 (1.239)	-16.468 (1.235)	-16.565 (1.237)
Industry Control	J	J	J	J
Observations	4,720	4,720	4,686	4,686
Log Likelihood	-398.984	-398.817	-516.316	-516.041
Akaike Inf. Crit.	845.968	847.634	1,080.632	1,082.082

Notes. We estimate Logistic regressions in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the prevention condition, accounting for the different size of the data in both sets of models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both *winsorized*, to address outliers, and Decreased ROA 18-19 were added as a control in all models.
^hp<0.1; ^hp<0.1; ^{hh}p<0.05; ^{hhh}p<0.01

Table A.17: Logistic Estimations linking Registration to Situational Prevention Orientation and Regulatory Fit

	Dependent variable: Register			
	(1) Promotion & Prevention	(2) Conditions	(3) Prevention & Neutral	(4) Conditions
Batch	-0.242 ^h (0.144)	-0.242 ^h (0.144)	-0.388 ^{hhh} (0.142)	-0.387 ^{hhh} (0.142)
Generic Email	-0.417 ^h (0.240)	-0.418 ^h (0.240)	-0.809 ^{hhh} (0.237)	-0.809 ^{hhh} (0.237)
Revenues in 2019	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
ROA in 2019	0.290 (0.348)	0.291 (0.348)	0.129 (0.316)	0.129 (0.316)
Decreased ROA	0.412 ^h (0.236)	0.308 (0.296)	0.576 ^{hh} (0.225)	0.591 ^{hh} (0.274)
Prevention Message	-0.476 ^{hh} (0.231)	-0.647 ^h (0.379)	-0.760 ^{hhh} (0.222)	-0.732 ^{hh} (0.373)
Decreased ROA * Pre Message		0.276 (0.478)		-0.044 (0.465)
Constant	-16.644 (1.239)	-16.559 (1.239)	-16.134 (1.369)	-16.151 (1.370)
Industry Control	J	J	J	J
Observations	4,720	4,720	4,648	4,648
Log Likelihood	-398.984	-398.817	-435.128	-435.123
Akaike Inf. Crit.	845.968	847.634	918.255	920.246

Notes. We estimate Logistic regressions in Models (1) to (4). We use robust standard errors clustered on industry classification. The indicator variable Register is the dependent variable across all models. Models (1) and (2) were run without the data from the neutral condition, whereas Models (3) and (4) were run without the data from the promotion condition, accounting for the different size of the data in both sets of models. The 2019 revenues measured in thousands of United States dollars and the 2019 ROA, both *winsorized*, to address outliers, and Decreased ROA 18-19 were added as a control in all models.
^hp<0.1; ^hp<0.1; ^{hh}p<0.05; ^{hhh}p<0.01

Notes

¹We check power calculation to see if the sample size is sufficient to detect effects at a significance level of 0.05. The test suggests the sample size is adequate with a power of 0.977 for Model 4. For more detail, readers can find power size calculations under each table in Appendix.

High-altitudes wines and wine tourism: resources and capability building from the periphery of La Rioja, Argentina

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Abstract

This paper presents and analyzes the productive, technological and entrepreneurial evolution of Chañarmuyo Winery, located in Chañarmuyo Valley, La Rioja, Argentina. Through a case study, productive efforts to transform the Chañarmuyo Valley into a wine region are identified and highlighted as well as commercial efforts oriented to define the wine market segment. Elements of Penrose's (1959) theory of resources and capabilities and the evolutionary theory of technological change are combined in relation to the growth of the firm and its links with innovation systems. The financial capacity of its owner, the managerial team and the natural conditions of Chañarmuyo Valley stand out as critical resources of Chañarmuyo Winery. In terms of their links with the regional system of innovation, relationships of technical and financial support are identified, in particular with the Government of La Rioja, the FONTAR (Argentine Technological Fund), and with other relevant wineries of Mendoza (the main province in terms of wine production in Argentina). The paper contributes to the documentation and conceptualization of unexplored business cases in La Rioja and Northwest Argentina (NOA), one of the less developed regions of Argentina

Key Words: La Rioja; Wine industry; Penrose, Regional system of innovation, Periphery.

1. Introduction

La Rioja, still far behind the province of Mendoza¹ in terms of the Argentinian wine production, has a long productive history linked to winemaking and a number of wineries with a long history and present relevance (Economic Commission for Latin America and the Caribbean [ECLAC], 2021; Interdisciplinary Center for Studies in Science, Technology and Innovation [CIECTI], 2020). Culture, climate and geography have been structural factors that allowed the development of vineyards in the valleys of La Rioja. In particular, within the Antinaco-Los Colorado's² Valley lies the main Rioja wine-growing department, Chilecito, from which around 80% of the province's wines are produced (ECLAC, 2021; National Institute of Viticulture [INV], 2022). Within the valley, there are wineries producing and exporting wines that have managed to take advantage of the natural conditions of La Rioja and develop enological, productive and commercial knowledge and capabilities. For instance, "La Riojana Cooperativa" is the main producer of Torrontés Riojano wine in Argentina and a pioneer in the development of organic and biodynamic production in La Rioja (Mazzola, 2014; Pizarro Levi et al., 2022; Starobinsky et al., 2020a) and "Valle de La Puerta S.A" produces fine wines, mainly Malbec and Bonarda, standing out for its advanced technology in the Northwest of Argentina (NOA) (D'Alessandro et al., 2021; Pizarro Levi et al., 2022).

Far from finding geographical limits in the "traditional" areas, La Rioja's viticulture continued its expansion in the early 2000s towards an area that was initially considered unsuitable for viticulture due to its altitude and the low fertility of its soils³: the Chañarmuyo Valley⁴. Thus, based on the investment incentive provided by tax deferrals, in 2001 Bodega Chañarmuyo was founded (hereinafter "Bodega Chañarmuyo"). In little more than 20 years, Bodega Chañarmuyo went through a trial and error process that allowed it to reach a soil suitable for vine growing, developed articulations with different winemaking actors, mostly from Mendoza, who transmitted their knowledge and experiences, and consolidated a growth process that allowed it to position itself through the production and commercialization of "high altitude wines" that stand out for their terroir, characterized by the 1,720 meters above sea level. Currently, Bodega Chañarmuyo has 105 hectares cultivated with vines, mostly Malbec, a French technology wine production plant, and exports mainly to the United States (USA) and Brazil. It also has a Hotel "Casa de Huéspedes", through which it promotes wine tourism.

This paper presents and analyzes the productive, technological and business evolution of Bodega Chañarmuyo. It aims to: a) identify, document and highlight the efforts and strategies developed by Bodega Chañarmuyo to overcome the challenges and limitations that have been present during its trajectory, b) detect the competitive advantages and particularities of the

company that differentiate it in the Rioja and Argentine wine industry, c) give account of the articulations with actors and institutions of the regional innovation system that have collaborated in overcoming the productive challenges. This work is part of a line of research that aims to document and problematize business cases in a peripheral region of Argentina, such as La Rioja (Borello, 2005; ECLAC, 2021; D'Alessandro et al., 2021; Gonzalo et al., 2022; Pizarro Levi et al., 2022; Starobinsky et al., 2020a; 2020b). Therefore, a contribution is made to the documentation and conceptualization of unexplored business cases, although relevant for the productive and technological development of La Rioja and the NOA.

The next section presents the conceptual-methodological approach guiding the research. Then, the case is developed. It concludes with the overall analysis and final reflections.

2. CONCEPTUAL-METHODOLOGICAL APPROACH

The research is based on a case study, a methodological tool that favors the analysis of the particularities of a phenomenon in its natural environment, providing answers to questions about how and why the processes under study occur. This method allows individualizing trajectories that contribute to the understanding of the causes and the process that generated the analyzed phenomenon (Eisenhart, 1999; Eisenhardt and Graebner, 2007; Gonzalo, 2013; Gonzalo et al., 2014; Jácome Lara and López Vera, 2016; Vasilachis de Gialdino, 2006; Yin, 1984). In turn, in line with the conceptual- methodological approach adopted in Barbero (2014), Coriat and Weinstein (2011), Guimarães (1982), Kerstenetzky (2007, 2017), among others, this paper draws on conceptual elements that inform the analysis. Elements of Penrose's (1959) theory of resources and capabilities and the evolutionary theory of technological change are combined in relation to the growth of the firm and its links with the innovation systems.

Penrose (1959) contributes to the study of firm growth by highlighting the relevance of combining different internal productive resources and capabilities to cope with changes in the external environment, emphasizing the central role of management in detecting and taking advantage of productive opportunities (D'Alessandro et al., 2021; Gonzalo, 2013; Gonzalo et al., 2014; Starobinsky et al., 2020a). Following this idea, authors such as Nelson and Winter (1982) and Nelson (1991), state that companies evolve, adopt new dynamics and strategies and orient efforts to adapt and respond to new trends and transformations that arise in their environment. In this sense, learning and capacity building processes are not automatic, but are cumulative and require time, effort and resources. Thus, paths are generated that have a social and contextual character, through which companies can "learn by doing", "learn by using", "learn by interacting" (López, 1998; Lundvall and Johnson, 1994; Nelson and Winter, 1982).

The innovation systems approach, which complements the conceptual approach of this paper, analyzes the existence of articulations and linkages between the firm and the network of actors and institutions of the environment in which it is inserted, and investigates the role of this interaction in the generation and transfer of knowledge for the development of capabilities (Freeman, 1987; Gonzalo, 2022; Nelson, 1993; Yoguel et al., 2009). Such innovation systems can be studied from different emphasis and focuses: national, regional, local and others (Borello, 2016; Cassiolato and Lastres, 1999; 2005; Gonzalo, 2016; Niembro, 2017; Starobinsky, 2016). In this case, the aim is to highlight the capabilities and challenges faced by local actors inserted in a peripheral regional innovation system, characterized by various structural problems presented by the productive sector of the province of La Rioja, such as the high cost of transportation and energy, the low density and articulation of support institutions, the difficulty to attract and retain human resources, among others (ECLAC, 2021; CIECTI, 2020; D'Alessandro et al., 2021; Gonzalo et al., 2022; Pizarro Levi et al., 2022; Starobinsky et al., 2020a; 2020b).

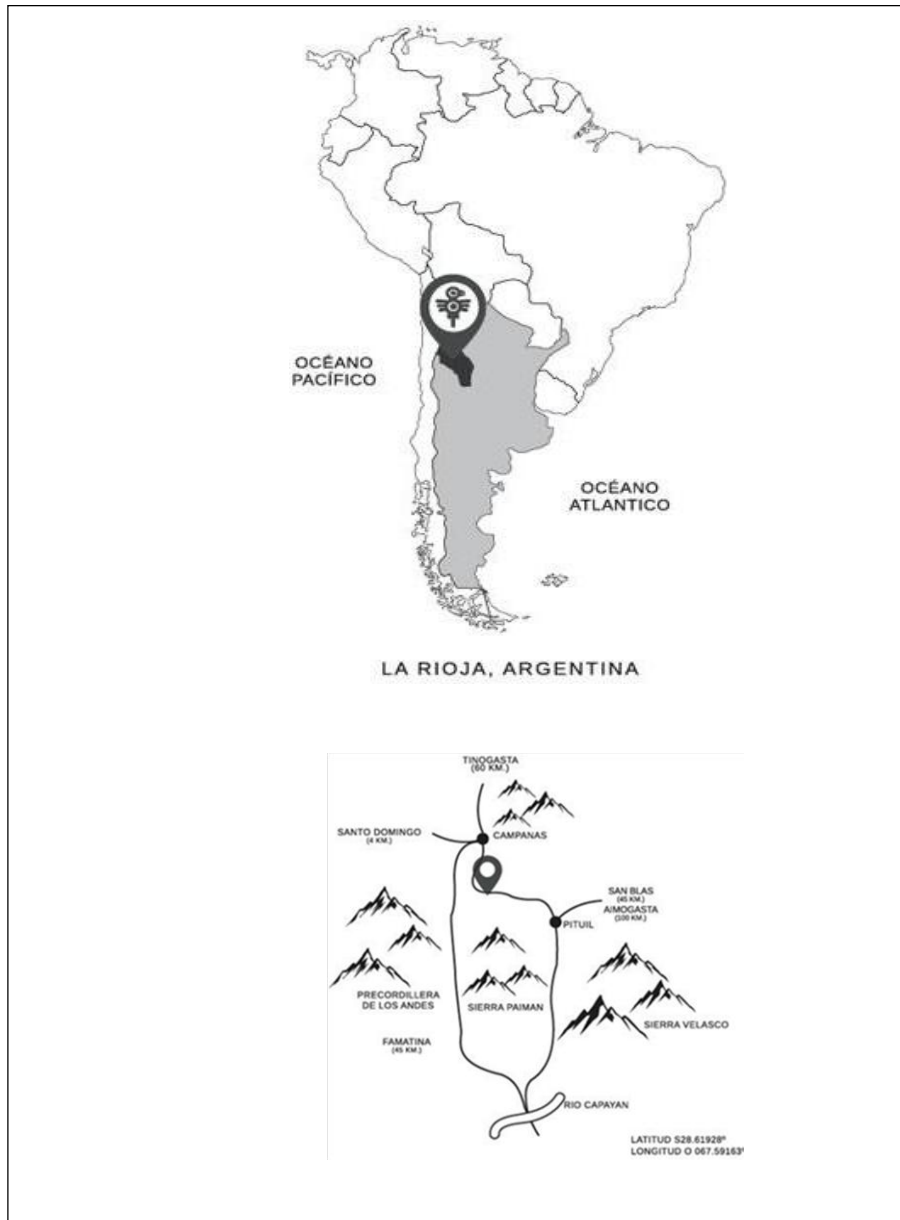
Regarding data collection techniques, both primary and secondary sources and interviews with key actors were used. In the first instance, information available on the company's official website and in a digital brochure provided by the winery's Commercial Department staff was considered, as well as documents, press releases and audio-visual content disseminated on the web. In a second stage, a round of interviews guided by a semi-structured questionnaire was carried out with company personnel: Commercial Manager, Production Manager, Winemaking Manager and Administrative Manager of the hotel. These interviews took place between April and June 2022, virtually, with the exception of the interview with the Production Manager, which was conducted in person through a visit to the winery. Once the round of interviews was completed, the interviews were recorded and processed, and, together with the information gathered in the first instance, a chronological analysis was carried out in an attempt to highlight the aspects in line with the objectives and the conceptual approach.

3. THE CASE OF CHAÑARMUYO WINERY

3.1 The Chañarmuyo Valley

Bodega Chañarmuyo is located in the Chañarmuyo Valley (hereinafter "Chañarmuyo") in the Department of Famatina, northeast of the province of La Rioja, Argentina (Map 1). Originally inhabited by aboriginal peoples, its name refers to the place of the chañar trees: "Chañar" is a tree, and "muyo" in the indigenous language means "full of". The topography of the valley reaches altitudes of over 1,700 meters above sea level, while in the surrounding Sierras del Paimán, the altitude is between 2,000 and 2,200 meters above sea level. The climate, characteristic of northwestern Argentina, is continental, warm-temperate with semi-arid conditions, and average annual rainfall of 250 mm

concentrated between September and February. Due to the low level of annual rainfall, the water reserve from the Chañarmuyo dam is of great importance, which, in addition to being used for irrigation in productive activities, provides water for the homes in the area (Rolón and Rotondaro, 2011).



Source: <https://chanarmuyo.com/>

the dynamics of a rural town and a little less than 300 inhabitants (National Institute of Statistics and Census [INDEC], 2010), Chañarmuyo is characterized by agricultural production activities and domestic animal husbandry, which are linked to other nearby towns, such as Pituil and Campanas. Currently, the most important productive activity is the cultivation of grapes -of the 158 ha planted

in the town⁵, 105 ha correspond to the largest farm, Bodega Chañarmuyo-. In addition, walnut trees, apples, peaches, pears, tomatoes, cereals and forage crops are also grown (Rolón and Rotondaro, 2011).

During the 1990s, a dynamic prevailed in which the low production and the lack of job opportunities put the town at risk of extinction, which, until then, did not meet the characteristics required by the winemaking industry -or at least that was believed to be the case-. Thus, the positioning of Bodega Chañarmuyo in the town of Chañarmuyo has tended to change to some extent the reality of the town, not only at a productive level, giving centrality to the wine industry, but also in terms of labor and tourism.

3.2 Evolutionary phases of Bodega Chañarmuyo

Three stages in the development of Bodega Chañarmuyo are identified, defined and presented below.

3.2.1) First phase: Gestation and adaptation of a "non-wine-growing" area (2001- 2005)

While Argentina was going through a context of economic and social crisis, in 2001, Bodega Chañarmuyo was born as a winemaking project promoted by a businessman with wide experience and contacts in the productive and business environment of La Rioja. The Provincial Law of Industrial Promotion No. 22,021, applicable in the province of La Rioja, greatly encouraged productive investment (CIECTI, 2020; D'Alessandro et al., 2021; Starobinsky, 2016). In the case of Bodega Chañarmuyo, tax deferrals represented approximately 45% of the initial investment. No less important has been the capacity and financial support of the owner of the winery, which allowed the experimentation process to be continued.

Although there were no technical studies to support the businessman's decision to invest in winemaking, the tax incentive, the recommendation of a Chilean winemaker, the popular belief that Chañarmuyo could produce good wines, and the founder's willingness and financial capacity to tolerate risks prevailed in order to move forward with the business project. Thus, the first challenge to overcome for Bodega Chañarmuyo was to prove that vines could grow in a valley characterized by rocky soils and water scarcity. Thus, among the first actions carried out was the search for data on climate, soil and rainfall, although there were no records at INTA. Then, soil analysis, temperature measurements, rainfall measurements, determination of the green index⁶ and fertilization analysis were carried out.

Regarding the characteristics of the valley, the current winemaking manager of Bodega Chañarmuyo points out:

"...as a main characteristic it has very poor soils, of crushed granites... that makes the plants express themselves in this or that way... But with a very important fact which is the altitude. That altitude means that there are very cold nights and very warm days. That thermal amplitude generates very good natural acidity for the wines... An important characteristic that Chañarmuyo has is that they are very long-lived wines, wines with a long life, because they have low pH and a good amount of natural antioxidants".

The local personnel, who had no experience in the wine industry, also had to develop skills and abilities to work with the vines. In this sense, since the area is rural and relatively isolated, it was not easy to find qualified profiles from outside the area willing to move to Chañarmuyo. Finally, the company sought the advice of oenologists and professionals from Mendoza, who were in charge of training and educating the local personnel, defining the grape varieties to be grown, initially the white Viognier and the red Tannat, and the technification of its vineyards through a trellis training system, anti-hail netting and drip irrigation. It should be noted that, since its beginnings, Bodega Chañarmuyo differentiated itself in terms of primary technification, contrary to most of the Rioja wine farms, which due to the age of the vineyards and the high investment costs did not have -and do not have- this type of infrastructure (CIECTI, 2020; INV, 2021; Mazzola, 2014).

Thus, even subject to adjustments and improvements, in the first years of experimentation it was possible to prove that the Chañarmuyo Valley could produce grapes with the potential to be transformed into wine. It is also worth mentioning that, despite the difficulties and initial uncertainty, the geographical location of Chañarmuyo would later give rise to an important differentiation within the industry: the remoteness from the main wine regions of La Rioja would allow Bodega Chañarmuyo to individualize itself in relation to the competition, as the Winemaking Manager points out:

"...An important factor that Chañarmuyo has is that it is like a drop in the desert... we do not have vineyards relatively close or large estates. So, you have a very important influence of all the native flora. The jarilla, there is a bit of thyme, there is a lot of native flora that begins to influence the flavors of the wine and gives them a certain personality".

In 2004, after verifying that they could obtain grapes, they started to build a winery with a capacity of 2,300,000 liters, with machinery for processing, filtration and centrifugation of French origin and cement tanks lined with epoxy with a capacity of 14,500 liters, as well as stainless steel tanks with a capacity of up to 30,000 liters. The first winemaking processes were conducted by winemakers from Mendoza, while machinery was rented from Mendoza for the bottling process. It should also be noted that, due to the ownership of the land, Bodega Chañarmuyo has the right to use the water from the Chañarmuyo dam, part of which is used for the irrigation system. Given the water shortage,

irrigation is made more efficient through a Scholander chamber that measures the exact water needs of the plant. At the same time, a guesthouse is being built to house the owner and the company's technical team.

3.2.2) *Second stage: Experimentation and strategies for commercial expansion (2006-2015)*

With wine making underway, in 2006 the challenge of commercial insertion was assumed. It was decided to change the initial label of the winery, "Chañarmuyo⁷", for "Paimán⁸". In 2007, the winery began to enter the provincial market -La Rioja, Capital- and, in a small volume, abroad -Brazil-; as a commercial strategy, the guest house was set up to receive customers and importers. At the same time, learning and training efforts continue in the improvement and definition of the product.

The productive and commercial growth, besides being complex, was slow: between 2001 and 2015, production increased by only 10,000 bottles. From the commercial point of view, although between 2006 and 2007 national and international markets were opened slowly and in a small portion, the process of defining the style of the wines took time. It was not until 2010 that the oenological characteristics required by market trends were achieved, as well as the international validation of the quality of the wines through participation in international competitions in which they were scored by renowned critics of the world wine industry⁹. This represented an important commercial leap: at the domestic level, marketing expanded to the markets of Córdoba, Rosario and Buenos Aires, and at the external level, the company entered the U.S., mainly with Malbec wines.

In this new context, commercial strategies were mainly oriented towards defining prices to cover costs and rationalizing markets according to their sales capacity. As regards prices, and since these were high-end wines, challenges arose in relation to the preferences and the ability to pay of consumers, mainly at the provincial level, who had incorporated the choice of table wine.

In this regard, the Commercial Manager recalls:

"The problem was that the wine was sold in La Rioja at a price that could not be remarketed in Buenos Aires. First, because of the ability to pay of the person who was going to buy from the winery [Chañarmuyo]. They were local people who wanted to buy a wine a little better than the one they were used to buying, but they were not willing to pay three times as much for that wine. So, well, there was a need to unite a little on the issue of prices".

Although, during the initial years, both the production consultancy and the training and education of local personnel had been led by professionals from Mendoza, in 2012 an agronomist engineer from Bolivia, based in Chilecito, joined the project and changed the management of the estate according to the

specific climatic and geographical conditions of the area, different from those of Mendoza. The Production Manager reflects:

"...an important milestone for the company was the incorporation of an engineer from Chilecito, who changed our vision of the farm, he explained to us that the insolation is different... he managed to go to the specifics, he started to make measurements, controls".

Additionally, with respect to industrial production, an own fractioning line is installed, due to the problems of availability of rented machinery and its high cost.

Between 2013 and 2014, with the intention of exploiting Chañarmuyo's tourism potential, the wine business was expanded through the implementation of wine tourism strategies. Enotourism or wine tourism is one of the main activities of the wine industry that has gained relevance since the beginning of the 21st century accompanying the new direction taken by global viticulture. "Making known the place where everything is born" not only allows linking the consumer with the landscape, culture and history of a town, but also generates an important flow of tourist occupation and economic impact (Argentine Wine Tourism Observatory, 2021).

The Hotel "Casa de Huéspedes" was reoriented to provide lodging services to tourists. This required not only infrastructure modifications, but also the hiring and internal training in tourism of new employees, all of them from the Chañarmuyo Valley and nearby towns such as Pituil and Campanas. In addition to lodging in front of the vineyards, other wine tourism activities are also promoted that add value to the terroir¹⁰, history and culture of the people who produce. These include guided tours of the vineyards and winery - accompanied by the story of the history and beliefs of the town-, tasting of its wine lines and regional cuisine in the restaurant. Also, since 2014, the Geographical Identification "Valle de Chañarmuyo" has been registered with the National Institute of Viticulture¹¹ and the winery is part of the circuit of the project "La Ruta del Torrontés Riojano" promoted by the Government of the province.

3.2.3) Third stage: returning to the terroir to differentiate and scale (2016-present).

As of 2016, new winemaking, commercial and marketing strategies were added to the primary production strategies with the entry of professionals from Buenos Aires and Mendoza. First, the winery retakes the initial label "Chañarmuyo", as the idea now was to deepen the value of the terroir and its history. Then, the concept of "high-end wines" -high-end wines of higher commercial value- began to be used, which sought to make a difference with Riojan wineries that catered to the traditional Riojan wine consumption -table wines in large volume-. Thus, a brand recognition and differentiation work was developed, which achieved the Estate Grown certification, which implies that

the grapes used to produce the wine were grown by the winery itself. In fact, in the case of Bodega Chañarmuyo, the vineyards are located on the winery's own property, so that the quick transfer of the grapes also contributes to the quality of the wine.

A key aspect for the commercial insertion of the winery was to consolidate an official commercialization channel through a distributor, which has commercial centers in Buenos Aires, Misiones (Argentina) and, abroad, in Miami, U.S.A. Previously, at domestic level, it was only marketed through sommeliers in stores in Córdoba and Rosario; with the exclusive distribution, sales increased strongly in the markets of Córdoba, Rosario, Buenos Aires and La Rioja, Capital. On the export side, international quality validation, participation in international fairs and contacts with importers through visits to the winery led to a successful customer acquisition process. The role of the official distributor, which reached exclusive agreements with the US -in Texas, California and New York- has been fundamental. -In Texas, California and New York, as well as in Brazil.

The winemaking manager reflects on the evolution of this stage:

"...I think the secret, in the last few years, was that we have had enough exposure... It was to start showing what [the Chañarmuyo Valley] is and not trying to copy models.... So, we stopped making a commodity product and started to make a Malbec really from Chañarmuyo-La Rioja, which was also done before, but trying to copy or emulate other areas".

However, the market share was still small and the limit imposed by the slow growth in bottles made it difficult to enter other markets, such as Asia. In this context, in order to increase the volume of production, since 2017 it ventured into the provision of grape sales and processing services to third parties, particularly to Mendoza wineries, thus initiating the trade of bulk wine. Likewise, in order to reduce costs, mainly freight of inputs and finished products, Bodega Chañarmuyo begins to fraction its wines through a Mendoza winery, and also has a warehouse in Mendoza, from where it directs the production to the export ports. Thus, the greater integration with the Mendoza winery contributed to achieve a better balance between profitability levels and production volume.

Regarding the relationship with the Mendoza winery, the winemaking manager adds:

"...I think they see [Bodega] Chañarmuyo as a strategic producer that gave them the opportunity to explore in La Rioja... it is a working relationship, which is very good and is useful for both of us".

In terms of production and organization, during this last stage, a team of human resources with different skills in the administrative, winemaking,

industrial production and marketing areas is being structured to work together with the owner of the winery in decision making. Also, although the management of the different areas is in charge of professional personnel from Corrientes, Mendoza, Buenos Aires and Bolivia, which shows the need to incorporate resources from other regions, a process of hiring and training local personnel has been carried out. The production capacity to develop quality raw materials and wines that meet the requirements of important Mendoza wineries to which they provide services, the winemaker's ability to achieve new styles of premium wines such as "Viña Providencia" and "5 Hileras", and the Commercial Manager's ability to work on the distribution strategy stand out.

The production of high-end wines, "of height", with an outstanding price-quality ratio, guides the team to select grape varieties different from those traditionally grown in La Rioja, mainly in relation to the Torrontés Riojano grape variety (Pizarro Levi et al., 2022). Of the total varieties grown, 95% correspond to red grapes -following the national cultivation pattern- and the remaining 5% correspond to white and rosé grapes, within which the star white variety is Chardonnay. In addition, following consumer trends and preferences, varieties such as Chenin Blanc, a neutral white variety with a higher production, Viognier white and Syrah red are adopted, which are combined with Chardonnay to produce sparkling wines, or are combined together to produce rosé wines. These productions are considered innovations by the winery's team, in terms of new products that are new for the company and the market.

At present, Bodega Chañarmuyo markets around 350,000 bottles and has four wine lines, being the "Classic" line the predominant in terms of production and annual sales, while the premium wine lines together represent 10% of annual sales. In addition, they produce and market "Chamas Honnorat" sparkling wines (Table 1). As for the varieties marketed, 70% are the well-known red Malbec, 15% Cabernet Sauvignon and Franc, and the remaining 15% correspond to other varieties, including whites and rosés. Bottled sales are equally divided between the domestic and foreign markets (mainly the US and Brazil, although there have been incursions into countries such as Spain, Germany, Switzerland and Japan).

Table 1*Annual sales by line. Year 2022 (Share in total volume - Percentage)*

<i>Line</i>	<i>Cut</i>	<i>Participation in sales</i>
<i>Clásica</i>	Pool	50%
<i>Gran Vino</i>	Pool/barrel	30%
<i>Viña Providencia</i>	Barrel - high range	5%
<i>5 hileras</i>	Barrel - high range	5%
<i>Chamas Honnorat</i>	Sparkling	10%

Source: own elaboration.

Looking into the future, Bodega Chañarmuyo has investment projects in the pipeline for the extension of the winemaking capacity by 250,000 liters and the expansion of a French and American oak barrel room. It also intends to grow, over a period of 5 years, in the marketing of 750 cc bottles to reach 500,000 units and to launch a new production line of 500 cc bottles. In addition, taking advantage of the altitude of the area and in line with market trends, they plan to advance in the cultivation of walnut trees: they currently have a 20-hectare plantation, with plans to extend it to 150 hectares more. Finally, they are working on a project to implement solar energy for irrigation through a new partnership with the national government.

3.3 Articulations and challenges from La Rioja's periphery

Bodega Chañarmuyo has developed and has been favored by different links and relationships that have helped them to face the challenges of a peripheral context (ECLAC, 2021; CIECTI, 2020; D'Alessandro et al., 2021; Starobinsky et al., 2020a; 2020b). Since its beginnings, the winery has achieved the transfer of viticulture knowledge through the articulation with winemaking and business actors in Mendoza. This linkage allows the capture and application of new knowledge and productive innovations developed in the R&D and Quality Departments of different Mendoza wineries, as well as the use of laboratories for nutrient and yeast analysis. It is also possible to point out specific articulations with Chilean companies that provide advice and perform fertilization analyses.

There are also relations with the national and provincial governments. The Argentine Technological Fund (FONTAR) provided a loan for technological innovation through which the high-end lines "Viña Providencia" and "5 Hileras" -trials and changes in plantation frames- were developed and new barrels and stainless steel tanks were incorporated. A project for the development of solar energy was also submitted to the National Ministry of Science and Technology. At the provincial level, the link with the government was decisive for the

location of the winery in Chañarmuyo Valley and currently the winery receives subsidies for electricity for primary production (which is extended to all producers in La Rioja). In the last year, participation in international wine fairs has been encouraged by the management and coordination of the Federal Investment Council (CFI) and the Ministry of Production of the Province of La Rioja.

Also noteworthy are the agreements signed with the National University of Chilecito (UNdeC), through which internships are carried out in the laboratory of Bodega Chañarmuyo and internships for students of the Bachelor's Degree in Oenology and University Sommelier. Another national agency that stands out is the National Institute of Viticulture (INV), particularly for administrative and technical processes. Relations with the local business network are also identified through the Chamber of Winemakers of La Rioja, which is chaired by the winery's Production Manager. From this position, there is coordination with the State and the business sector to achieve communication and agreements on policy needs for the wine sector.

In relation to the structural limitations of La Rioja, regarding water scarcity and transportation costs, due to the acquisition of the land itself, the winery has the right to use water from the Chañarmuyo Dam. Among other challenges, emphasis is placed on the design of policies favorable to international trade, since the tariff barriers faced by the wine industry make costs more expensive. As regards the provincial wine industry, there is a need to carry out communication and promotion actions for the industry, in order to publicize the province's winemaking capabilities and attractiveness. The articulation with the Secretariat of Tourism of the province to carry out projects such as "La Ruta del Torrontés Riojano" and "La Ruta del Vino" are oriented in this direction.

4. OVERALL ANALYSIS AND FINAL REFLECTIONS

This paper has presented the business evolution of Bodega Chañarmuyo. It is an untold case, which contributes to document and analyze business trajectories and the development of knowledge and productive networks in one of the less developed regions of Argentina.

Since its beginnings, the winery has made productive efforts to transform the Chañarmuyo Valley into a wine-growing area, and commercial efforts to define their wine segment. This was possible thanks to the financial capacity of its owner and the creation of a management team in the different areas of the company. Thus, in line with Penrose (1959), the company's evolutionary path is based on the natural resources offered by the Chañarmuyo Valley, the financial resources of the winery owner and the managerial team in order to exploit wine productive opportunities. Indeed, tax deferrals have also functioned as a productive opportunity.

The development of capabilities and competencies has been decisive in the creation of competitive advantages, differentiation within the provincial and national wine industry and the adaptation and response to the demands and trends of national and international markets (Nelson and Winter, 1982; Nelson, 1991). The development of technical, organizational and economic routines at Bodega Chañarmuyo has been of key relevance to the production, adoption and transfer of knowledge within the company. The management team has managed to develop capabilities and new ways of combining resources to change the vision and management of the company in productive and commercial terms, through differentiation and brand recognition, new styles of wines, new forms of marketing, provision of productive services and the promotion of wine tourism (Gonzalo, 2021; López, 1998; Lundvall and Johnson, 1994; Nelson and Winter, 1982).

In terms of links with the regional innovation system, technological support and investment relationships have been identified with the governmental, particularly with the provincial government and with some national agencies such as FONTAR, MinCyT and CFI, and with the academic (UNdeC). Business links have also been developed through the Chamber of Winemakers of La Rioja and interaction with local, national and international companies. The business link with Mendoza, a leading province in the national wine industry, is particularly relevant. The transfer of knowledge, the use of modern technologies, and the bottling and labeling of bottles in the wineries of Mendoza have made it possible to face the productive challenges of the peripheral innovation system in which the province of La Rioja is inserted. It is also worth highlighting the contribution of the links established with qualified human resources from other Argentine provinces, which have responded to the problem of shortage and retention of qualified human resources in the province (ECLAC, 2021; CIECTI, 2020; D'Alessandro et al., 2021; Gonzalo et al., 2022; Pizarro Levi et al., 2022; Starobinsky et al., 2020a; 2020b).

In general terms, the case of Bodega Chañarmuyo can be described as a successful case given its present expansion. Based on the owner's financial capacity, the development of a management team and the exploitation of the resources of the Chañarmuyo Valley, the winery has been able to face the obstacles and limitations present in a peripheral innovation system, and even position itself as a differentiated player within the provincial and national wine sector. However, although the winery is currently profitable, there are new growth objectives to be achieved together with questions about the strategies to be followed: Should Chañarmuyo winery deepen its bulk production? Should it, instead, make efforts to continue with the differentiation in high-end wines with its own label? Or should it find a balance between bulk, classic and premium lines? Is it possible to grow in the bulk trade outside the alliance with the Mendoza winery? Are there relevant strategies as opposed to a greater

integration with Mendoza wineries? Should the expansion prioritize the domestic market or international markets?

The wine frontiers are growing worldwide and the province of La Rioja, Argentina, is no exception. The presence of a young winery that has managed to survive in the domestic industry and enter international markets with quality validations denotes the existence of business and wine resources and capabilities, despite being a peripheral region. In view of this, in the future, it remains to investigate the steps to be taken by the Rioja wine industry to multiply and scale successful cases: Is it possible to replicate and scale trajectories such as that of Bodega Chañarmuyo with other premium wines? In addition to the public support detected, should more in-depth interventions be developed?

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Notes

¹ In 2021, Mendoza's share of national wine production reached 78.4%, San Juan 15% and La Rioja 3.1% (INV, 2022).

² Central-western region of the Province of La Rioja, comprising the Departments of Chilecito and Famatina

³ <https://chanarmuyo.com/chanarmuyo/bodega/quienes-somos/>

⁴ Chañarmuyo is a town in the Department of Famatina with around 300 inhabitants that has been subject to the exodus of settlers who leave in search of job opportunities

⁵ <https://www.argentina.gob.ar/inv/vinos/estadisticas/superficie/anuarios>

⁶ It is an indicator that indicates the greenness, density and health of vegetation in each pixel of a satellite image. At <https://www.auravant.com/blog/agricultura-de-precision/indices-de-vegetacion-y-como-interpretarlos/>

⁷ The name change also had to do with the intention of entering international markets in the future, thus facilitating the pronunciation of the brand

⁸ Sierras del Paimán, the name given to the mountain range that surrounds the area.

⁹ Tim Athkin (UK), James Suckling (USA), Robert Parker (USA), Patricia Tapia (Brazil)

¹⁰ Terroir is defined as the mix of natural factors: soil, climate and topography of a particular agricultural unit and the interaction between all of them. Human intervention is also a factor considered in this concept. On <https://www.infowine.com/intranet/libretti/libretto6662-01-1.pdf>

¹¹ Res. INV N° C.28/2014

Experiences of emerging black woman farmers in the digital agricultural era

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Abstract

The purpose of this study was to investigate the challenges and opportunities experienced by emerging black woman farmers in using technologies in their farming operations. The study was situated within the interpretivism paradigm and employed the qualitative approach and an exploratory design. Data was collected using in-depth, semi-structured interviews using the purposive, snowballing sampling technique with emerging black woman farmers in three provinces in South Africa. The data was analysed thematically. The findings indicate that emerging black woman farmers face several challenges with acquiring and using technologies in their farming operations. Additionally, the women acknowledged and understood the opportunities available in farming when technologies are adopted. The paper proposes initiatives and programmes that will accelerate rural development, ensure economic growth, and promote sustainable development.

Keywords: emerging farmers, black woman farmers, digital technologies, policy

1. Introduction

Food security is a growing problem worldwide. Much focus should therefore be placed on the agricultural sector with a view of equipping the sector for increased food production capabilities. The transformation of the agricultural sector is one of Africa's difficult and urgent priorities to be addressed. If Sub-Saharan Africa is to stave off food and nutrition insecurity, and meet the continental food demands, it needs to increase the current levels of agricultural productivity (Tsan, Totapally, Hailu & Addom, 2019). The South African National Development Plan (2011) [NDP] highlights the key challenges for rural development such as, lack of economic participation in rural areas, lack of access to resources (land and water), high unemployment and lack of government services. These challenges necessitated the transformation of the agricultural sector to facilitate access to land, farming skills and clean water to the rural communities. The NDP views the agricultural sector as one of the key drivers for the significant growth of the country's economy and job creation.

The agricultural sector recorded the most substantial contribution to GDP growth by 33.6% which includes contribution from the small, medium, and micro enterprises (seasonally adjusted and annualised) during the second quarter of 2017 when compared to other industries (Department of Agriculture, Forestry and Fisheries, 2017, p.14). This economic contribution assisted South Africa (SA) in recovering from a recession during that period and showed the significant role played by the agricultural sector in contributing to the gross domestic product of the country. The agricultural sector showcased its potential of being the backbone of the country's GDP growth and major contributor in achieving the aim of the NDP. The NDP aims to eliminate poverty and reduce inequality as per the UN 2030 Agenda in sustainable development goals [SDG's] (NPC, 2011). The relationship between small, medium, and micro enterprises (SMMEs) and a country's gross domestic product (GDP) is strongly interconnected. The presence of a robust and thriving GDP indicates the significant role played by SMEs in contributing to the overall economy of a nation, as highlighted by Pandya (2012)

The use of the digital technologies in agriculture can be a tipping point in fast-tracking the transformation of the agricultural sector in Africa (Tsan et al., 2019). According to Jakku, Taylor, Fleming, Mason and Thorburn (2016), digital technologies can potentially deliver a step-change in productivity and/or profitability across the value chain. The adoption of digital agriculture not only facilitates information dissemination and market access for farmers but also enhances their bargaining power within the agricultural sector (Kariuki, 2015). This is exemplified by the utilization of mobile applications, which furnish farmers with valuable insights into market prices, weather patterns, and optimal crop cultivation techniques. Moreover, online marketplaces serve as direct conduits linking farmers with potential buyers, thereby diminishing the

reliance on intermediaries and empowering farmers to engage in fair price negotiations (Mkentane, 2019). Consequently, for woman farmers to attain a competitive edge, it becomes imperative to embrace digital agricultural strategies within their enterprises. Such measures enable farmers to leverage the benefits of enhanced information access, expanded market opportunities, and strengthened bargaining positions.

The integration of technologies in agricultural practices not only mitigates the adverse environmental impact associated with farming but also fosters the advancement of sustainable development. By leveraging digital technologies, the agricultural sector stands to undergo a profound transformation characterized by heightened operational efficiency, diminished wastage, and augmented decision-making capabilities (FAO, 2019). Such technological interventions hold significant promise for promoting environmentally conscious and economically viable agricultural practices in pursuit of sustainable development goals. The digital technologies used in agriculture include smart farming systems, sensor technology, internet of things, big data analytics, blockchain and drones, among others. The South African agricultural sector is lagging in the use of these technologies compared to other developing countries such as Brazil, Russia, India, and China (Jakku et al., 2016).

Sibanda and Simalenga (2010) suggests that South Africa still has a long way to go regarding digital agricultural technologies uptake and usage. Incorporating these technologies into every facet of agriculture in SA is critical, because of the sector's role in the economic development and sustainable development of the country. Senyolo, Long, Blok and Omta (2018) add that it is important for SA to invest in digital agricultural technologies, particularly in climate-smart technologies, because the country is faced with severe droughts and water shortages. These technologies will mitigate climate change challenges, for example, when a climate control system is used in vertical farming, it helps in minimising water, land, and nutrient usage. Furthermore, the digital technologies will help increase agricultural productivity, improve efficiencies in the value chain, increase economic growth and contribute to achieving the SDG's. Agricultural rural development can be accelerated by supporting the rural farmers in the adoption of the digital technologies in their farming businesses.

The agricultural development in South Africa has, historically, been discriminatory based on gender and race (Sebola, 2018). Even after democracy, farming in South Africa remains dominated by the white community, with the role of the black community limited to being the labour surplus and unsuccessful subsistence farmers (Sebola, 2018). However, in the last few decades, women's participation in the economy, access to resources and their role in decision-making in agriculture have been the focus areas of research globally (Khatri-Chhetri, Pant, Aggarwal, Vasireddy & Yadav, 2019). Black women in SA are one of the key marginalised groups to be brought into the fold within the agricultural sector. During apartheid, black women were regarded as

minors and, therefore, could not own land or property, thus, could not participate in commercial farming (United Nations Centre Against Apartheid, 1978).

Evidence suggests that empowering women can have economic benefits for women themselves, as well as their households and communities. Sub-Saharan Africa experiences an annual cost of around 95 billion USD due to gender inequality, as estimated by the 2016 Africa Human Development Report. Additionally, a study by the McKinsey Global Institute in 2015 indicates that achieving gender parity in economic outcomes, where women achieve similar levels as men, could potentially add a substantial 12–28 trillion USD to the global economy. However, there is a scarcity of research focused on examining the specific impacts of women's empowerment in agricultural settings (Klasen, 2018; Anderson, Reynolds, Biscaye, Patwardhan, & Schmidt, 2021).

In South Africa, commercial farming is a sophisticated and highly complex business. Considering the technological revolution taking place in farming, emerging farmers are now forced to be well-equipped to become the commercial producers of the future. Various studies have been conducted on the challenges faced by emerging farmers that limit their ability to increase their produce. However, there is a gap in the scientific knowledge regarding the key challenges and opportunities that affect emerging black woman farmers' use of digital technologies in their operations (Khapayi & Celliers, 2016).

This paper investigated the challenges and opportunities, experienced by emerging black woman farmers, of using digital technologies in their farming operations. The study was guided by the question, "What are the experiences of emerging black woman farmers of using digital technologies in their farming businesses?"

There is no consensus on the definition of 'emerging farmer' in South Africa (Rother, Hall & London, 2008). According to Khapayi and Celliers (2016), the term 'emerging farmer' is used interchangeably with 'subsistence farmer'. Others such as Mohlatlole, Dzomba and Muchadeyi (2015), and Xaba and Dlamini (2015) define emerging farmers as beneficiaries of land reform. Grobler, Scholtz, Bester, Mamabolo, and Ramsay, (2008) combine both above definitions. Due to the lack of consensus on the definition, Zantsi, Greyling and Vink (2018) provide the following definition in a bid to contribute towards a common understanding of the term 'emerging farmer'. The authors define an emerging farmer as Black, making less than half a million-rand turnover per annum, selling more than the produce they use for their own consumption, at least 0.6 Commodity Chanel Index (CCI), given that they produce for the market and aspire to commercialise their farming fully. This definition by Zantsi et al. (2018) is adopted in this study.

The structure of this paper is as follows. The literature review provides a background of the South African agricultural sector, the role of emerging black

woman farmers in the sector, the challenges faced by emerging black woman farmers and the technologies that can enhance farming and opportunities brought by digital agriculture. This is followed by the research methodology used, after which, the findings in relation to the challenges and opportunities are discussed. Following the findings, is the discussion of the findings with regards to the literature. Lastly, the conclusion on the findings is provided.

2. An outline of the agricultural sector in South Africa

The agricultural sector can be divided into two major categories: subsistence and market- oriented farming. There are different farming scales within the broad umbrella of market- oriented agriculture, namely, small, medium-sized, and large-scale/mega-scale farming. This study is situated within the small-scale market-oriented farmers. The Department of Agriculture, Forestry and Fisheries (DAFF) draft National Policy on Comprehensive Producer Development Support is the guiding document for the agriculture, forestry, and fisheries sectors in the country. It standardise and direct government interventions for various categories of producers, such as land ownership, access to finance, access to markets and compliance with market standards (DAFF, 2018). The policy document distinguishes between four groups of farmers: household producers/subsistence farmers, smallholder producers/farmers, medium- sized producers/farmers, and large-scale commercial producers/farmers. These categorisations are similar to those used by industry players such as the Bureau for Food and Agricultural Policy, and the Land and Agricultural Development Bank (Mtombeni, Bove, Thibane & Makgabo, 2019).

In South Africa, the total agricultural land is about 46.4 million hectares, which represents 37.9% of the total land area. Large scale commercial agricultural farming utilises 7.6 million hectares of this land. On the other hand, small-scale emerging farmers use approximately 25 million hectares of land and produce lower levels of the country's primary produce. Approximately 38.8 million hectares of agricultural land is not productive (Statistics South Africa, 2020). The land usage shows the divide in the agricultural sector, inequality, and marginalisation of the rural emerging black woman farmers.

3. Importance of emerging black woman farmers in South Africa

The South African agricultural sector is gradually transforming after many years of discrimination against all black farmers during colonisation and the apartheid periods. During these periods, the South African agricultural sector was characterised by dualism. On one end, there was a large-scale, white-owned, technologically advanced commercial agricultural sector that was thriving. On the other end, was a small-scale sector in the former homelands and it remained largely subsistent on communal lands (Greyling, Vink & Mabaya, 2015). Considering this conundrum, the democratic government has introduced agricultural and land reform transformation policies to address the

injustices of the past (Bhorat et al., 2011). The aimed beneficiaries of these transformational policies included emerging black farmers (Greyling et al., 2015; Zantsi et al., 2018). The discussion on the role of emerging black farmers in South Africa now follows.

Job creation opportunities

The South African commercial agricultural sector has shown a growing trend of shedding jobs in recent decades. According to the Department of Agriculture, Forestry and Fisheries' (2010,12) report, there were 1.1 million people employed in the commercial agricultural sector in 1992. This number decreased to 914 000 in 1996, of which two-thirds were employed on a regular basis and the remainder were seasonal or casual workers. Simbi and Aliber (2000) identified a trend away from the employment of permanent, regular workers to casual labour. According to the authors, this was a concern because casual jobs were less secure and inconsistent, and this trend would exacerbate the problem of rural unemployment in the country. Several factors contributed to the job shedding, including the intensive use of machinery which reduced the need for unskilled labour (Sandrey, Punt, Jensen and Vink et al., 2011). Considering this trend, emerging black woman farmers can contribute towards job creation because they are more labour intensive than commercial farmers (Zantsi et al., 2018). As they expand their farming operations or engage in agribusiness ventures, they often require assistance in various aspects, such as farm labour, agri-input suppliers, equipment maintenance, and transportation. By doing so, they contribute to local job creation and income generation, particularly in rural areas where agriculture is a primary economic activity. This has been highlighted in the NDP, which has identified the agricultural sector as one of the sectors that has the greatest chance of creating jobs (National Planning Commission, 2011). The engagement of women in farming and job creation not only has economic implications but also contributes to their empowerment. Through their involvement in agriculture, women gain financial independence, decision-making power, and increased social status. These factors, in turn, have broader social and economic impacts by improving gender equality and promoting inclusive development.

Poverty reduction

Internationally, it has been proven that small-scale emerging rural farmers generate income opportunities and employment in rural areas. In most developing countries, agriculture and agriculture-related activities provide most of the employment in rural areas (Machethe, 2004). According to Diao, Hazell, Resnick and Thurlow (2007), agricultural-led growth played a key role in alleviating poverty and transforming the economies of many Latin American and Asian countries, but the same has not occurred in Africa. Literature provides studies that have investigated the relationship between agriculture and poverty in different countries. The studies include countries such as Zimbabwe (Mbiba, 1995), Malawi (Orr, 2000), Kenya (Kimenyi, 2002), Zambia

(Siegel & Alwang, 2005), Africa as a whole (Fan, Johnson, Saurkar & Makombe, 2008), selected African and non-African countries (Ellis & Freeman, 2004; Dewbre, Giner, Thompson & Von Lampe, 2008), and Southern Africa (Victor & Akadiri, 2019).

Engaging in agricultural activities allows women to generate income through various means such as selling agricultural produce, livestock, or value-added products. This additional income plays a significant role in uplifting households out of poverty and improving their overall economic well-being. Women farmers contribute to poverty reduction by focusing on enhancing food security and nutrition within their households and communities. According to Mabaso (2014), the challenge in South Africa is to eradicate the structural constraints that limit the growth of emerging farmers. In South Africa, many emerging farmers live in rural areas characterised by unemployment and poverty (Zantsi et al., 2018). There is a large rural population, poorly educated and largely unskilled workforce. Agriculture is a promising strategy to combat rural poverty because many poor people reside in rural regions and many are already involved in some type of farming activity (Mabaso, 2014; Machethe, 2004; Zantsi et al., 2018).

Contribution to economic growth

There is a connection between the agricultural and non-agricultural sectors. As such, the development growth of the agricultural sector has the potential to promote growth in the non- agricultural sectors, which will have a poverty-reduction effect. Hendricks (2002) posits that an increase in the income of rural households has the potential to increase consumer expenditure on non-tradable goods and, thus, lead to local economic development. Women actively engage in farming activities, which leads to the production of various agricultural goods. This, in turn, creates employment opportunities throughout the value chain, including processing, packaging, distribution, and marketing of agricultural products. Studies have highlighted the positive correlation between women's involvement in agriculture and overall economic development, including job creation. Agriculture has had a significant impact on rural development in nations where emerging farmers predominate. In this sense, improving emerging farmers' productivity would raise demand for agricultural inputs such as fertilisers, pesticides, and labour – if the constraints they face are alleviated and well-developed government support is provided (Zantsi et al., 2018). The cultivation of diverse crops by women farmers has several positive outcomes, which contribute to food security, nutrition, and ultimately poverty reduction. Women farmers ensure a consistent supply of nutritious food, leading to improved health outcomes, reduced healthcare costs, and increased productivity. In turn, this would reduce unemployment and increase the food supply, thus addressing the issue of rural food security, which is a major issue in SA rural areas. But, among other things, for this to happen, there is a need for emerging black woman farmers to be capacitated and supported, in adopting and effectively using the technological resources (Rosegrant & Hazell, 2000;

Mwangi & Kariuki, 2015). Having discussed the importance of emerging farmers in the South African economy, the following section discusses the challenges faced by these farmers.

4. Challenges faced by emerging black woman farmers

Access to finance

In South Africa, 75% of emerging black woman farmers have a turnover of less than R1 million; therefore, most farmers are unable to obtain digital technologies due to high costs and economies of scale (WCDoA and USB, 2018). Most black woman farmers do not have the necessary finances to fund their farming activities and cannot afford to access the necessary technologies and capacity to drive their farming into the digital era (Mkentane, 2019). Women farmers may face difficulties in accessing credit or loans due to factors such as lack of collateral, limited land ownership rights, and cultural biases. Financial institutions may have stringent requirements or discriminatory practices that restrict women's access to finance. Gender bias and discrimination can affect women farmers' ability to secure financial support. Traditional gender roles and stereotypes may result in unequal treatment, lower loan amounts, higher interest rates, or exclusion from financial services tailored to the specific needs of women farmers (Li, Ahmed & Qalati, 2019).

Limited financial literacy and knowledge of financial systems can pose challenges for women farmers. Understanding loan application processes, financial management, and the requirements of financial institutions may be a barrier. In some cases, women farmers rely on informal financial systems, such as rotating savings and credit associations or community-based lending, due to limited access to formal financial institutions. While these systems can provide some support, they may not offer the same level of financial stability or growth opportunities as formal financial channels. Black woman farmers lack the tools they need to make informed decisions about their business' financial management, such as cost and profit margins and profitability analyses. Furthermore, farmers do not have management systems for storing and analysing the farm-related data collected that would support decision-making in everyday farming activities and management (Paraforos et al., 2016). The technologies require investment; due to lack of financial support and access to finance, these farmers are unable to participate fully in the economy. Government support is needed to reduce the costs of the technologies, and this can be achieved through subsidies and financing schemes.

Access to information and training

Limited access to extension services poses significant challenges for women farmers in accessing valuable agricultural information and training. Factors such as distance to extension offices, lack of awareness about available services, and gender biases within extension systems contribute to the limited reach of extension services to women farmers (Kiptot & Franzel, 2012, Drewry, Shutske,

Trechter & Luck, 2022). Cultural norms, lack of representation, and limited decision-making power further restrict women's participation in agricultural training programs and hinder their ability to access relevant information. Additionally, women farmers may face socioeconomic constraints that limit their ability to access information and training. Household responsibilities, limited financial resources, and lower education levels make it challenging for women to participate in training programs or access information through formal channels. Language barriers and low literacy levels further compound the challenges faced by women farmers in accessing and understanding agricultural information. Lack of tailored training materials in local languages and the requirement of advanced literacy levels can further exclude women from accessing and benefiting from available resources (Ingutia, Sumelius, 2022). Black woman farmers are constrained by a lack of knowledge and education about the opportunities and benefits associated with agricultural technologies and innovations in the digital era. Stakeholders in the entire agricultural sector need to ensure that farmers are trained, developed, and are afforded support in technology adoption and usage (University of Stellenbosch, 2017). Advisory and mentorship initiatives are necessary to build farmers' capabilities to make use of the data-driven information, knowledge, and technologies.

Lack of technological skills and access to technologies

One significant challenge faced by black woman farmers, especially in rural areas, is the limited utilisation of digital technology due to low capacity. This is exacerbated by the absence of digital technology infrastructure, which hampers their ability to effectively employ digital tools and technologies in their agricultural activities. As a result, farmers are unable to fully leverage the potential benefits that digital advancements can offer to improve their agricultural practices. South African black women farmers face challenges in accessing stable internet connectivity and infrastructure, limiting their ability to leverage digital technologies for farming activities. The effective use of digital tools, such as data analytics that require internet access, is hindered by the lack of reliable internet connectivity. Due to poor infrastructure and the high cost of internet services, it becomes challenging for these farmers to collect and analyse data necessary for informed decision-making in their agricultural practices. The limited access to stable internet and infrastructure creates barriers to the adoption and utilisation of digital technologies, impeding the potential benefits they can bring to improve farming efficiency and productivity. There is also a lack of technical skills, among rural farmers, which is required to organise and integrate digital technologies in their farming activities to reap its full benefits (Freeman, Park & Middleton, 2020, Goedde, Katz, Ménard & Revellat, 2020).

5. Digital technologies that can enhance farming

Digital innovation is a significant driver in enhancing agricultural production and improving the value chain, including post-harvest processes, transport, and storage. It plays a crucial role in addressing various aspects of the agricultural sector. For instance, food traceability systems that utilize digital platforms have emerged as essential tools for managing risks related to food safety and ensuring consumer confidence. These systems enable the tracking and monitoring of food products throughout the supply chain, helping to contain safety issues and enhance transparency. Additionally, digital-enabled marketing strategies contribute to increasing the efficiency and competitiveness of companies within the agricultural market (Smidt, & Jokonya, 2022, Corallo, Latino, & Menegoli, 2018.) By leveraging digital technologies, companies can streamline their operations, improve intra-company efficiency, and gain a competitive edge.

These advancements in digital innovation have far-reaching implications for the agriculture industry, transforming various stages of the value chain and promoting sustainable and secure food systems. The digital technologies are also changing the scope of farming globally in terms of production and ecosystem. These tools are advancing farming, unlocking new innovations to improve farming, empowering farmers to be resilient against harsh weather conditions and enhancing efficiencies in production. Agricultural technologies include smart farming systems, sensor technology, internet of things, big data analytics, blockchain and drones.

Artificial intelligence (AI) is driving the development and implementation of various digital technologies in agriculture. AI involves the creation of computer systems capable of performing tasks that typically require human intelligence. In the realm of agriculture, AI is being utilized for tasks such as visual perception, speech recognition, decision-making, and language translation. For instance, AI enables the analysis of images to monitor crop and soil growth, improves communication between farmers and automated machines through speech recognition, and supports decision-making by analysing data on soil conditions and weather patterns. Additionally, AI's natural language processing capabilities allow for the extraction, classification, and machine translation of content from research studies and farming documents, providing up-to-date information on trends and practices in the agricultural sector. In agriculture, AI systems leverage historical trends and patterns to optimize irrigation scheduling, fertigation management, and cultivation planning (Lingireddy et al., 2023)

Sensor technology is used to detect changes from the field and send the information to other devices. When armed with data from the soil sensors, GPS-equipped tractors and external sources, such as local weather channels, enable farmers to better manage key resources including seed, fertilisers and pesticides, while increasing productivity. Farmers can monitor crop health and yield predictions, control smart irrigation and improve data management (Fresco & Ferrari, 2018). The use of sensors makes it possible to regulate water,

nutrients and temperature in the smart greenhouse, pinpoint which plants need which quantities, thus saving on costs and product use like fertiliser. Sensors can assist farmers to fertilise or irrigate crops in such a way that crops are not overwatered they can also provide crucial information regarding the availability, condition, location, performance, and product visibility (Ghoreishi, Happonen & Pynnönen, 2020).

Internet of things (IoT) is about ‘things’ which are capable of recognising, communicating, and cooperating with their surroundings. The IoT provides flexible control mechanisms for large fields and can send information to the farmer in real time, which allows the farmer to make changes accordingly to the produce (Fresco & Ferrari, 2018). It simplifies and streamlines the collection, inspection and distribution of farming materials and resources using on-site equipment. Additionally, the IoT affords the farmer the ability to remotely: monitor animal movement, control and schedule pesticide sprays, control and schedule fertigation systems, detect leaks and control large water flows, and automate pest counting. The use of IoT has improved productivity and efficiency, reduced water uses in irrigation and increased yields, while also reducing, energy consumption costs to produce clean energy for long-term sustainability (Ojha, Misra & Raghuwashi, 2015).

Big data analytics are the techniques that are applied to find valuable and meaningful insight from large data that has hidden or unknown correlations and patterns. Using the analysis of data, farmers can predict the amount of rainfall that might occur in a given season and even the incidence of flooding. Accurate predictions can assist the farmers in terms of planning and deciding what to grow and when to grow it. This will assist the farmers in terms of planning and deciding what to grow and when to grow it. With big data analytics, farmers can discover business trends and customer preferences, track supplies and increase yields. The availability of data affords farmers with information that will help in cost savings, enable the farmer to better manage risk, and increase production and efficiency (Kamble, Gunasekaran & Gawankar, 2019).

Blockchain is beneficial to farmers around data that relates to land and resource use records, fair pricing, overseeing farm inventory and financial flow across the entire value chain. Blockchain brings an opportunity for farmers that promotes data analytic capabilities. These capabilities will provide technology infrastructure for digitisation, tracking and automation. All of these will help in driving the farmers’ sustainable initiatives (Kamble et al., 2019). Blockchain can also improve farm security and product traceability. In a blockchain-driven ecosystem where the whole value chain for agricultural products is entrenched, traceability from farm to fork can occur across supply chain partners who work in their own technological systems and export information into a private and centralised blockchain capability for shared use, making it easy for customers to validate the quality and authenticity of the products they purchase if farmers comply (Aldag & Eker, 2018).

6. Methodology

A qualitative methodology within the interpretivism paradigm was used. The motivation for a qualitative study was that an in-depth study of a situated experience would provide a deeper understanding than gathering standardised quantitative data from a large sample of the population (Patton, 2002). The interpretive perspective enabled the researchers to enhance their understanding of the key issues related to the experiences of emerging black woman farmers' use of digital technologies in their farming operations. An exploratory research approach was chosen as it is particularly useful to employ because there was a need to gain an in-depth appreciation of the phenomenon of interest, in its natural real-life context (Crowe, Cresswell, Robertson, Huby, Avery & Sheikh, 2011). The individual emerging black woman farmers were regarded as individual participants. Telephonic in-depth interviews using the purposive, snowballing sampling technique were used.

The interview questions were derived from two pre-conceived themes that emerged from the literature review. These were (1) the benefits of using digital technologies in a farming business and (2) the challenges of using digital technology in a farming business. The participants were drawn from the North-West, Gauteng and Western Cape provinces of South Africa. Fifteen participants were sampled. However, only 12 participants ended up participating in the study. This number of participants was attributed to the COVID-19 lockdown that had negatively impacted the country and the potential participants' businesses. The sample of 12 woman farmers was considered sufficient because it was in line with the recommendations by Dworkin (2012) and Baker and Edward (2012). These participants met the inclusion criteria of being an emerging farmer in line with the definition of emerging farmer adopted in this study.

Thematic analysis was followed using the six-step framework by Braun and Clarke (2006). Therefore, recurring themes and patterns were identified, categorised, and explained (Owen, Arnold, Friedman & Sandman, 2016). To ensure trustworthiness, firstly, participants were requested to verify the credibility and accuracy of the transcribed documents. Secondly, the researchers coded the transcriptions independently and then developed a shared understanding of the emergent themes through critical discussions.

7. Findings

The two themes, namely, benefits of using technology and challenges of using technology, and the related sub-themes are now discussed.

Benefits of using digital technologies in farming operations

Most of the participants were not using any of digital technologies in their farming businesses. The technologies they did use included machinery, systems, and information and communication technology (ICT). The machinery

used were distilling machines, water meters, moisture readers, spray carts, automatic irrigation, heat pumps, soil mixing machines and potting machines. The systems used were fogging systems, tunnel cooling and heating systems, hydroponic systems, drip irrigation system, raised beds, growing towers. The ICT used included social media, printing machines, colour coders, computers and mobile phones.

The participants indicated that the benefits they gained from employing technology in their businesses included productivity relating to higher yield, better use of man-hours, reduced manual tasks, saving time and speeding up production. Product quality is linked to a higher standard of product. Profitability related to water cost savings and electricity/energy cost savings. Information and marketing related to business and product market visibility and research/information gathering.

"Higher productivity and yield, better use of workers' time, thus, more sustainable as a business, more value for money. Higher standard of product being delivered."

"The use of mobile phone has actually been of a good use to me because I am able to research about most of the things or cases that I come across with my line of work, be it of health related challenges, feed, and any other thing that I may need information about."

"I can do a lot of activities without manual hard labour of soil treatment. There has been water and electricity savings as we follow a watering schedule."

"We opened our shop doors to the public in 2012, but did not have a big clientele until we created a Facebook page in 2013. Then my business started gaining momentum. I do not spend money on marketing."

The one participant who was not using technology in her farming business indicated that she expected to gain benefits from using technology. She indicated that, "Farming involves a lot of work and, therefore, technology can assist in a big way, such as packaging technologies."

Challenges of using digital technologies in farming operations

The participants stated that knowledge and skills scarcity were the major challenges. This related to lack of skills in managing the technology and the lack of ICT literacy. They also mentioned financial constraints, relating to the costs of servicing and maintaining the technologies, costs of outsourcing installations and costs of outsourcing maintenance.

"Technical backup to service or programming of some of the technologies being used. Lack of higher skilled labour to understand and manage the type of technology. Financials to service and maintain the type of technologies used."

"Installation and maintenance is mainly outsourced from outside my area."

"Financial constraints at the moment. I do not want to be heavily indebted when I'm still trying to find my niche and my special space in the farming sector."

"No challenges, apart from the fact that I am not digitally literate and social media remains tricky. If I had been more savvy, we would have advanced faster and more."

To address the challenges they face regarding the use of technology in their businesses, the participants indicated that they were employing knowledge and skills development, and financial solutions. The related knowledge and skills development solutions included hiring of external consultants and building the capacity of staff to manage the type of technologies used. The financial solutions included fund raising, financial prudence in running the business and searching for affordable technologies.

"At the moment, raising the money from sales to develop and invest. As an emerging farmer, I am not ready for heavy indebtedness."

"Trying to overcome them by being more economic and sustainable in our business, building the capacity of staff to manage the type of technologies."

"Still searching for other affordable technologies that can also yield good results within the farm."

"Forge collaboration with the expertise in the same field. So far, we have a mutual agreement with a few companies for mentorship and coaching."

"Practice and paid other companies to create an online shop and website."

Mitigating the challenges of using digital technologies in farming operations

All the participants were positive about the use of technology in their farming businesses. They encouraged other farmers to explore and implement technology in their farming businesses.

They suggested that farmers need to evaluate their need for technology before adopting it and to also think outside the box in terms of marketing.

"Learn social media, learn web design, etc. Think outside the box in terms of apps and marketing."

"There is need to adopt and invest in technologies now more than ever before. This should be considered seriously."

"Make use of different technologies as you see fit. Do adapt to modern technologies. New technologies lead to higher productivity and better and sustainable income streams."

"If as a farmer you have the means and you are able to afford the technologies that are in the markets, they must go for it and be open minded about adopting to technology"

"Before adopting a technology, evaluate if it is indeed necessary for your case as they come in expensive, and explore more with other farmers and ask questions."

The suggestions that the participants had for the farming sector, included the need for government organisations and institutions to create awareness and promote farming technologies amongst farmers, providing skills development and financial support to farmers. Regarding the promotion and awareness of digital farming technologies amongst farmers, the participants indicated that there was a need to make information available about digital technologies, to create platforms to expose and encourage emerging farmers to use technologies in their businesses. Concerning skills development, the participants indicated the need for the stakeholders to sponsor short courses, to support emerging farmers with training and development, and to provide guidance and information in the country's indigenous languages. Finally, the participants suggested that emerging black farmers be provided with financial support to procure digital technologies to be used in their businesses and to correct the procurement policies as well as the biased access to markets.

"I would recommend investment in the farming sector and provision of support in finances and training and development. A drive for farming at a national level is important. It is sad that, with all the land and other key resources, Africa should be importing food. Farming conscious culture at every level and with whatever small to largest piece of land, from the apartment to the commercial farmer."

"To set the platform to introduce, maintain and sustain adequate new technologies over time in their farming operations. Make woman farmers more aware that change can be positive in a business. Financial backup."

"Stakeholders should make information available about technologies that can be adopted in farms and have alternative technologies in place for those who cannot afford. It is also important for them to encourage and expose emerging farmers, be it youth or women to try and adopt to the use of technology."

"The procurement policies as well as skewed access to the market should be reviewed. The form of training should not exclude what people already know (IKS) in agriculture because there is no one model fits all, many factors play a major role. Allow us to engage with these technologies using indigenous languages."

8. DISCUSSION

The purpose of this study was to investigate the experiences of emerging black woman farmers in using digital technologies in their farming operations. Black woman farmers understand the significance of accessing and utilising data related to crucial variables such as soil conditions, crop health, livestock management, and weather patterns to optimize their agricultural activities. However, the lack of advanced digital tools poses a challenge to their ability to efficiently analyse and derive valuable insights from this data. The limited availability of advanced connectivity and equipment restricts farmers' access to digital tools that have the potential to enhance decision-making and improve

productivity in agriculture. The findings show that regardless of the size of the farm, the women are generally aware of the need to use technology in their farming businesses and, from the sample interviewed, most are using a range of old methods and machinery which include moisture readers, spray carts, heat pumps, soil mixing machines and potting machines. In terms of farming methods, the farmers use fogging systems, tunnel cooling and heating systems, hydroponic systems, drip irrigation system, raised beds and growing towers. What is also clear, is the fact that the black woman farmers are also using technologies like social media, colour coders, computers and mobile phones in their day-to-day farming and management activities. This shows that there is an awareness of the importance of technology in making farming more efficacious. These findings are important at two levels. Firstly, the results show a dearth of digital technologies in farming. None of the respondents indicated that they used technologies like smart farming systems, UAV's big data analytics, drones, IoT, automated fertigation systems, automatic irrigation, sensors and blockchain. This points to limited access and knowledge about these technologies. This tallies with the findings of Njiro (2003) and Huyer (2016) that show that there is a gender bias in terms of technology access in agriculture, with men having better access to technology than women. This shows the social and economic structural issues faced by emerging black woman farmers that requires addressing (Manfre, Rubin & Nordehn, 2017).

The findings also show that women in agriculture have limited access to digital technologies, although there is general awareness of its importance. The participants highlighted that with the use of digital technologies, it is possible to increase productivity and maximise labour usage while at the same time reducing the number of manual tasks that need to be carried out on the farm. The women also highlighted that with the use of technology, it is possible for them to reduce the number of inputs and consumables that are used across the farm. The farmers pointed out that with the adoption of digital technologies, they will manage to reduce the amount of water as well as the amount of electricity that is consumed on the farm. All in all, the use of digital technologies will result in increased profitability.

The two key challenges that the participants faced with the use of digital technologies related to their skills deficiency in managing the use of technology, the lack of ICT literacy, as well as financial constraints. The finding is consistent with that by the Southern African Trust (2013) conducted in Malawi and Zimbabwe, which also found that the challenges facing women farmers include limited knowledge and use of farming technologies. It also confirms that woman farmers often do not have access to finance and credit (Sandhu, et al., 2012; Lynch & Njuki, 2017); therefore, they cannot afford the cutting-edge digital technologies that will enable them to compete and become commercial farmers. Additionally, it also supports the assertion by Mtombeni et al. (2019) that access to finance is key to the success of a farming business in South Africa.

It was not surprising that the participants pointed out that their lack of general understanding of ICTs and the skills to manage the technology, because the technologies are often developed outside the farming sector. For these technologies to be used efficaciously, the farmers must have the necessary knowledge (Mwangi & Kariuki, 2015). This means that the farmers must be trained and educated about the technologies, yet this is not often the case in developing countries. The integration of advanced digital technologies and connectivity in agriculture has the capacity to bring about a significant transformation by equipping farmers with valuable information and enhancing productivity. Nonetheless, it is crucial to address the digital divide and ensure widespread access to these technologies in less-developed regions to fully unlock their potential benefits for farmers on a global scale. By embracing and implementing advanced digital technologies, black woman farmers can gain access to real-time data and insights that enable informed decision-making and optimized agricultural practices. These technologies offer valuable tools for monitoring soil conditions, crop health, weather patterns, and other essential variables, contributing to improved productivity and resource management in farming. Furthermore, connectivity facilitates the exchange of knowledge and best practices among farmers, promoting collaboration and innovation in the agricultural sector.

The challenges voiced by the participants in this study have been acknowledged in the recent Draft National Policy on Comprehensive Producer Development Support (DAFF, 2018) policy document and effective strategies to address these challenges have been mentioned. For example, the policy draft document indicates that several vocational training courses in different aspects of agricultural, forestry and fisheries activities, including value addition and processing of agro-products, would be introduced, the mainstreaming of women into the sector and providing them with access to finance has been highlighted; on- and off-farming infrastructure including mechanisation; investment in agriculture, forestry and fisheries mechanisation and policy intervention on mechanisation. However, these strategies have not been implemented. It is also not clear on how the government will implement and monitor the abovementioned ideas. These strategies could go a long way in addressing the needs that the participants in this study have articulated, such as the need for short courses and access to finance to afford digital technologies. There is a need for government to support black woman farmers and play a role in promoting business growth, to the level where these black emerging woman farmers can farm commercially. It is important that the support that women receive from the industry stakeholders, such as government departments, need to use indigenous languages when sharing information.

The study provides the following recommendations: The South African government and other stakeholders in the agricultural sector such as institutions, big-scale farmers, incubators, etc., should look at introducing initiatives and programmes that will facilitate, capacitate, and support the black

woman farmers in adopting and embracing the digital technologies. This requires efforts to enhance infrastructure, expand internet connectivity, and provide training and support for farmers to effectively utilise digital technologies. By enabling equal access to digital tools and knowledge, the agricultural sector can experience a more inclusive and sustainable transformation that enhances productivity and livelihoods for farmers around the world. Furthermore, woman farmers would increase productivity, reduce farming costs, increase profitability, and add value in the value chain in a sustainable manner. The initiatives and programmes will accelerate rural development, ensure economic growth, and promote sustainable development. Government should also propel the engagements of all other stakeholders in the agricultural sector and create an agricultural value chain policy that aims in fostering the growth of rural emerging black woman farming businesses.

9. Conclusion

This study investigated the challenges experienced by emerging black woman farmers of using technologies in their farming operations with the specific focus on the South African agricultural environment. Emerging black woman farmers play an important role in the South African agricultural sector and face a number of challenges. The study highlighted the benefits of using digital technologies in farming operations, the challenges of using digital technologies in farming operations as well as the strategies for mitigating the challenges of using digital technologies in farming operations. This shows that emerging black woman farmers are aware of digital technologies and their benefits in farming, however, they are facing challenges in accessing and adopting these technologies. The findings suggest that some of the strategies mentioned in the draft National Policy on Comprehensive Producer Development Support are what is needed by emerging black woman farmers. Therefore, the effective implementation of the draft policy will be able to assist emerging black woman farmers to grow and transition into commercialised farming operations.

10. Limitations of the study and implications for future research

Although the study was conducted in three South African provinces, it only used a sample of five women farmers. This, and the fact that the study is qualitative, makes it difficult to generalise the findings. The sample cannot be considered representative of all the women farmers in South Africa in terms of background, education levels and other factors, and that makes the applicability of the study problematic. Further research is needed on the same topic using a quantitative methodology. There is still room for more research that can be undertaken around women, technology and agriculture which includes looking at aspects like urban farming, vertical farming, precision farming and smart farming, and their impact on small scale woman farmers, and farming from a gender or feminist perspective.

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Positioning firms along the capabilities ladder

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Abstract

A major challenge for strategy research is the measurement of capabilities. We develop and apply a novel methodology for quantifying the capability development of firms, where capabilities are measured in terms of expenditures on certain activities. These activities can be sorted in a hierarchy of increasing difficulty, and firms can be sorted according to their positions on the capabilities ladder. Our nestedness algorithm, inspired by biology and network science, defines an activity as complex if it is performed by only a few firms at the upper rungs of the ladder. We analyze balance sheet and innovation data of almost 45'000 Indian firms for the time period 2000-2020, and observe significant nestedness. Lower rungs of the capabilities ladder correspond to basic managerial and production activities. Mid-level rungs correspond to internationalization and acquiring absorptive capacity. Higher level rungs are more related to M&A and innovation. ICT capabilities seem to have become more fundamental lower-level rungs on the capabilities ladder in recent years. We find that capability ranking can explain future growth patterns and survival probability of firms, summing up in one number their future potential trajectories.

Key Words: Capabilities, Competences, Complexity, Balance sheet data, Resources

JEL codes: L2, D2, O12

1. Introduction

Strategy scholars have long emphasized that superior firm level performance refers to the competitive advantage that is conferred by firm specific capabilities and resources (Penrose, 1959; Barney, 1991). Naturally, this has led to interest in how firms can develop advanced capabilities (Teece et al., 1997; Dosi et al., 2000; Helfat and Peteraf, 2003; Ethiraj et al., 2005). While strategy scholars generally agree on the importance of the development of capabilities for superior performance, nevertheless progress in the area is being held back by difficulties in operationalizing the capabilities construct in empirical research. This is a pity, because empirical progress can be expected to lead to further theoretical refinement. This was emphasized in a recent survey of the strategic management literature on capabilities: "Organizational capability is a central construct in theories of competitive advantage, strategic choice, firm boundaries, learning and adaptation, and technological change. Yet, if organizational capabilities are to fulfill their potential to illuminate these phenomena, there is an urgent need to surmount the problems of identification and measurement that continue to impede empirical research." (Grant and Verona, 2015, p.72).

This article therefore seeks to contribute to the measurement of capabilities and the dynamic processes of capability development. Research into capability development and capability accumulation faces (at least) two major challenges, however. A first challenge relates to how capabilities are operationalized and linked to real world phenomena. The lack of precision and specificity with which capabilities are identified in some studies is a problem for knowledge accumulation and subsequent theory building (Grant and Verona, 2015, p.66). Failure to connect abstract constructs like "capabilities" and "resources" to real-world phenomena risks leading to tautological statements (Arend, 2006), for example if (unobserved) valuable capabilities are invoked to explain the performance of successful firms. We address this concern by complementing the existing literature with a new approach that uses objective data on firms' reported expenditures.

A second challenge relates to how these capabilities can be arranged (ideally, in quantitative terms) into a hierarchy, such that a distinction can be made between advanced and lower level capabilities. Positioning capabilities into a hierarchy or a ladder is useful for the purposes of making specific normative recommendations to firms regarding which steps to take next, i.e. the paths that should be taken by firms to upgrade their processes to progress to higher value markets and activities. In this way, we seek to contribute to our understanding of the dynamics of capability development. In the innovation literature, Cirera

and Maloney (2017) discuss the concept of a “capabilities escalator” according to which capabilities are in a tripartite hierarchy of basic production/management, technology adoption, and invention/innovation capabilities. We draw on this intuition to attempt to develop a hierarchy of capabilities based on company expenditures in 47 different dimensions, sorting these capabilities into a hierarchical order by applying network science algorithms (Tacchella et al., 2012).

We therefore contribute to the literature by proposing a new method for sorting activities (and hence firms) into a hierarchy based on the complexity of activities, that we refer to as the ‘capabilities ladder’. Our measure of capabilities has a number of advantages. While some previous research has made valuable contributions to the measurement of capabilities using subjectively reported indicators of capabilities (e.g. Bloom and Van Reenen, 2010; Danneels, 2016), nevertheless subjectively reported indicators are costly and may include biases (Grant and Verona, 2015). Our approach to measuring capabilities refers to concrete observations of firm level expenditures in various areas. While subjectively reported data carries the risk of ‘cheap talk’, our indicators of activity require the actual commitment of resources. Although some previous research sought to analyze detailed data on capabilities from specific industries (e.g. Ethiraj et al (2005) and Chatterjee (2017) for the software services industry; Pandza (2011) for a pharmaceutical firm), our approach is general in the sense that it refers to firm activities that are observed across sectors. Our approach requires detailed balance sheet data for firms, but this type of information is usually readily available across sectors and countries, therefore making our approach amenable to replication and extension in a large range of contexts.

Our analysis shows that the lower rungs of the capabilities ladder correspond to basic managerial and production activities, such as borrowing money, owning land and building assets, and expenses due to outsourcing professional jobs. Mid-level rungs correspond to internationalization and acquiring absorptive capacity. Higher level rungs in the capability ladder are less clearly ordered into a hierarchy. Overall, therefore, the path for capability development is more clearly defined at lower and mid-level rungs than at the top. Focusing on changes in the structure of the ladder over time, ICT capabilities have become more present at the fundamental lower-level rungs on the capabilities ladder in recent years. Our capabilities ranking is correlated with firm size for small firms but not for large firms, indicating that firm growth is associated with capability development in small firms but not for larger firms.

The paper unfolds as follows. Section 2 presents our background regarding the conceptualization and measurement of capabilities. Section 3 presents our methodology. Section 4 presents our data on 44,971 Indian firms for the period 2000-2020. Section 5 contains our analysis and results, first sorting the expenditure items into a hierarchy according to our algorithm, and then

investigating dynamics in the hierarchy of the ladder. Overall scores for capabilities are compared across broad industry groups and for firm-level variables (firm size and survival). Section 6 concludes.

2 Background

2.1 The measurement of capabilities

“The core problem of empirical research into organizational capability is that organizational capabilities are latent constructs that are inherently unobservable.” (Grant and Verona, 2015, p.61). The unobservable nature of capabilities is one of their core characteristics, because it is this tacit and ambiguous aspect of capabilities that allows firms to provide competitive advantage without being imitated by rivals (Hilliard and Goldstein, 2019). However, the unobservable nature of capabilities is a headache for empirical researchers. As a consequence, indirect approaches to measuring capabilities are required. A common approach in the previous literature involved the analysis of questionnaire or telephone survey responses from firms to obtain subjective assessments of their firms’ capabilities (e.g. Bartel et al., 2004; Bloom et al., 2013; Danneels, 2016; Costa et al., 2021). Surveys of firms can shed valuable light on phenomena that are not detectable using administrative sources only (e.g. Costa et al., 2021). Subjectively reported indicators of capabilities have drawbacks however. Grant and Verona (2015) identify three sources of error in self-reported assessments of capabilities: deliberate misreporting, perceptual and cognitive distortions (leading to unintended biases in responses), and a lack of information on the part of the respondent. These biases can be attenuated, for example by checking the background and expertise of individual respondents (Danneels, 2016), or by performing doubleblind interviews (Bloom and Van Reenen, 2010) but this is time consuming and costly. We do not seek to diminish the commendable achievements of previous research that obtains subjectively reported measurements of capabilities, but we seek to complement the existing literature with a new technique for the development of capabilities based on factual observations in company balance sheets.

This paper therefore measures capabilities using objective data, although (given the unobserved nature of capabilities) this is done in an indirect way. Our approach draws on a generally-accepted definition of a capability as the ability to perform an activity or function using a set of tangible resources (Amit and Schoemaker, 1993; Helfat and Peteraf, 2003; Danneels, 2016). An important point is that a capability has material as well as cognitive components (Danneels, 2016). While the “ability to perform” is fundamentally unobservable, nevertheless this ability can only manifest itself through the deployment of material resources. For example, a marketing capability may require a customer database, which serves as a contextual requisite for the organizational routines supporting this marketing capability (Dosi et al., 2000). The number of general

management and functional executives, to cite another example, was taken by Fortune and Mitchell (2012) to proxy for managerial and functional capabilities. As such, an organizational capability is only observed when it is performed through the application of a routine involving tangible resources (Grant and Verona, 2015).

An example of an (individual-level) capability is given in Grant and Verona (2015,p.61): playing¹ the violin. Such a capability is only observed when someone actually starts to play the violin, and the capability remains latent or dormant until a violin is physically involved. In our context, buying a violin would be taken as evidence of a capability for playing violin. Furthermore, we do not distinguish between the quantity and quality of violins being purchased, instead we analyze binary variables regarding objectively reported expenditures in various areas to deduce the state of a firms' set of capabilities. Continuing with the analogy, we are not concerned with whether some violinists are 'better' than others, because our main concern is whether an agent is able to carry out a specific activity (such as playing the violin) purposefully, repeatedly, reliably, and in a minimally satisfactory manner (Helfat and Winter, 2011; Danneels, 2016). In this way, firms' expenditures in various areas can be considered to leave a paper trail of the performance of tasks that would only be undertaken if firms have capabilities in certain areas that are (given the current competitive environment) considered to be sufficiently developed that they are consistent with an overall profit seeking strategy.

A similar approach has been taken in previous papers that took R&D expenditures as an indicator of (unobserved) technological capability (Helfat, 1997; Rothaermel and Hess, 2007). In these papers, the fact that firms consider it to be in their interests to invest in R&D is taken as a signal that these firms have sophisticated routines and management practices in place to undertake complex activities relating to R&D. Our paper extends this line of investigation, because the dimension of R&D investment is only one out of 47 areas of expenditure that are analyzed to assess a firm's position in capability space.

An influential stream of research in the measurement of capabilities has emerged from the World Management Survey (e.g. Bloom and Van Reenen, 2007, 2010; Bloom et al., 2012). Our approach is similar to theirs, in that we measure and quantitatively analyze capabilities in a variety of sectors and for a potentially large number of firms. A difference, however, is that our approach can be applied at low cost to a population of firms that report detailed balance sheet data. Furthermore, our focus is not on management capabilities but on capabilities across various functions, such as marketing, financial practices, human resource practices, IT strategy, internationalization and innovation. Importantly, these capabilities are reflected not in self-reported data but in how firms actually spend their money in various activities and areas. Another important difference is that analysis of the World Management Survey does not seek to arrange capabilities in a hierarchy (but instead calculate an aggregate

sum as an indicator of management capabilities, implicitly giving equal weight to each dimension of management capability). In contrast, our analysis yields a data-driven ordering of firms' activities and capabilities into a hierarchy, i.e. a map of which activities generally appear to be precursors or prerequisites for others. We then investigate how this data-driven ordering relates to actual firms' performance in terms of growth and survival.

2.2 Capabilities: inputs, intermediates, outputs, and processes

Strategy scholars generally consider that firms have heterogeneous capabilities which correspond to different ways of doing things. But how different? This subsection seeks to be more specific about the ways in which firms differ. We return to our analogy of capabilities for playing the violin, then look at the case of innovation capabilities such as R&D capabilities that has been studied in the capabilities literature (e.g. Helfat, 1997; Rothaermel and Hess, 2007).

Capabilities are organizational level competences for knowing how to do certain types of activities (Dosi et al., 2008). As such, capabilities are formed of routines as well as other inputs that can be considered to be 'contextual requisites' for the capability (Dosi et al., 2008, p. 1167). In our example, R&D capability is not just the intangible routines and competences for managing an R&D project, but necessarily involves the actual commitment of R&D funds in order to come to life, therefore it can be proxied by R&D investments. Investment in a capability, at the simplest level, is binary, although more complex levels could also be envisaged (e.g. a continuous variable corresponding to the logarithm of amount invested).

Table 1: Conceptual distinctions between input, intermediate, output, and process aspects of capabilities.

	Violin-playing capability	R&D capability
INPUT: Investment in a capability	Buy/rent a violin	Invest in R&D
INTERMEDIATE: An input for further activities, although it already indicates partial accomplishment	Paying for expedited delivery of a certificate that confirms passing a violin exam	Paying application fees for a Patent
OUTPUT: Overall success of the capability	Initial goals are met, e.g. audience is satisfied	Commercial success, satisfactory performance outcomes

Of course, "[t]aking a first cut at an activity does not constitute a capability" (Helfat and Peteraf, 2003, p. 999). Inputs correspond more closely to 'intentions' rather than actual capabilities per se, although it is considered here that an

initial purposive allocation of resources into capability development is a generally useful proxy for actual capabilities, even if the proxy is not valid in some exceptional cases. Furthermore, attempts at pushing forward the firms' technologically-feasible production set by moving in new types of complex activities, even if these attempts turn out to be commercially unsuccessful, are a signal of ambition and have been observed to confer performance benefits (Braguinsky et al., 2021). Other items maybe be considered to be intermediate. For the violin example, an inter- mediate capability for violin playing could be concretely measured in terms of payments specifically for dispatching a certificate after having passed a standardized exam such as ABRSM grade 8. Novice violinists would not be able to make such a payment. With re- gards to innovation capabilities, expenditures on patent applications can be considered as positioned partway between inputs and outputs (Griliches, 1990), because while spending on patent applications constitutes evidence that a firm believes that they have something worth patenting, nevertheless many patents are worthless and many patents require considerable expenditures on further development before being able to attain commercial success. Likewise, new product introductions can be considered to be proxies for "market pioneering" capabilities (Franco et al., 2009) that we might call 'intermediate' in the sense that the market introduction of new products shows that the firm is at least capable of producing a new product, although there is not yet any evidence of its market success (the 'output').

The outputs of capabilities can be considered following Dosi et al. (2008, p. 1175): "the ultimate test of validity for any capability theory of industrial performances resides in its capability to account for inter-firm differences in profitability and growth patterns." Out- puts therefore correspond to 'performance outcomes', and furthermore they may be difficult to measure. An R&D department's capabilities, for example, are difficult to evaluate independently of its links to, and the performance of, other departments in the firm. A firm is a combination of R&D capabilities, manufacturing capabilities, and marketing capabilities, and so on, and it may be difficult to know whether a firm's overall success is due to its R&D capabilities or (instead) its marketing capabilities or hiring capabilities. Nevertheless, at a conceptual level, it is worth distinguishing the outputs of a capability from the inputs, intermediates, and processes of the capability.

The process of capabilities refers to how they are implemented (i.e. details on the multidimensional mapping function from inputs to outputs). When firms are said to have different "ways of doing things", the reader's mind may tend to turn to differences in processes. Processes of capabilities may correspond more closely to more traditional discussions in the literature regarding concepts such as routines and interdependent team-working practices (Nelson and Winter, 1982). There will be a lot of variety in processes (e.g. degree of mechanization, allocation of tasks, establishment and use of communication

channels, procedures for documenting errors). Process aspects of capabilities are difficult to quantify for many reasons (e.g. because there are so many possible dimensions involved, and also because firms' processes are difficult to observe). The overall 'level' of capabilities may differ between firms in the same industry (e.g. production capabilities for Ch[^]ateau d'Yquem Premier Cru Sup[^]erieur vs Tavernello boxed wine). Furthermore, different 'versions' of a capability may combine different constellations of inputs to yield the same overall 'level' of capability (Helfat and Peteraf, 2003, p. 1003). Process aspects of capabilities may be less important if we do not particularly seek to know 'how the sausage is made' as long as it is made in a minimally satisfactory manner (Helfat and Peteraf, 2003; Helfat and Winter, 2011; Danneels, 2016).

Table 2 distinguishes between the inputs, intermediates, outputs, and processes of capabilities.² In this paper, we measure capabilities by essentially focusing on inputs.³

A related dimension for conceptualizing capabilities is that capabilities here correspond to deliberate actions rather than automatic and habitual practices. There is a debate in the dynamic capabilities literature regarding whether the development of new capabilities emerges from either routine-based learning or purposive deliberate learning (Arndt et al., 2018; Barreto, 2010). Routine-based learning occurs when the semi-automatic repeated enactment of organizational routines, and their possible mutations in the context of a dynamic environment, leads in an unintended way to the emergence of new capabilities. Deliberate learning, in contrast, relies on strategic decision-making and planning activities that involve deliberate actions and may use codified knowledge sources (Zollo and Winter, 2002). In our research, capabilities are measured in such a way that they correspond to intentional and purposive decisions regarding the allocation of resources. It seems reasonable to assume that firms will not spend resources in specific areas without being aware of the bills and fees they are paying. This does not mean, of course, that routine-based learning never occurs; it merely means that a quantitative analysis of routine-based learning is beyond the scope of the current paper. Our analysis considers that intentional and deliberate investments in capabilities relate to more purposive and strategic aspects of capability development (Zollo and Winter, 2002), while humbly recognizing that intentions and conscious purposes may be distant from actual observed instances of capability, which may involve activities and outcomes that are automatic and habitual in nature (Dosi et al., 2008).

3 Methodology

The biology literature introduced the concept of "nestedness" to explain that in many systems the capabilities required to deal with specific advanced ecological niches were nested in those required for more basic ones. Similarly, in economic systems, those countries that were able to export advanced products were also exporting basic ones (Bustos et al., 2012). This intuition can

be formalized through algorithms inspired by network science (Hidalgo and Hausmann, 2009; Tacchella et al., 2012) to provide a natural ranking of countries and products. Domínguez-García and Munoz (2015) shows that Tacchella et al. (2012)'s algorithm works best for recovering the rankings in nested biological systems.

Here, the same algorithm analyzes activities of around 45'000 Indian firms, to explore patterns in the following types of areas: Is a firm investing in R&D? Applying for patents? Using external know-how? Exporting? Each activity is the fingerprint of advanced production and technological capabilities, and the algorithm uses this data to simultaneously measure both the rankings of the most advanced activities, i.e. the activities that are not accessible to firms that are not high enough on the capability ladder, and the position of the firms in the ladder. This allows a quantitative definition of concepts that were previously either described qualitatively or measured by ad hoc case studies.

To illustrate: research has found that innovative firms are more dependent on external finance (Brown et al., 2017). How are these two capabilities (innovation and seeking external finance) arranged in the capabilities ladder? A simple approach would involve comparing the conditional probabilities of innovating if a firm has access to external finance, and vice versa. The algorithm we will use instead does not look at the two capabilities in a vacuum, but takes an ecosystemic approach by looking at all the activities of all firms to evaluate the relative positioning of the two activities. At the same time it defines the ladder i.e. the ranking of capabilities and the position on the ladder of the firms, by defining a firm as high up the ladder if it is able to perform complex activities, and defining a capability as complex if those firms that are at the lower rungs of the ladder are not observed to perform it. The algorithm is validated against a null model in which firms' activities are reshuffled between firms to show that nestedness is indeed a key force shaping firms' behavior. More details on the algorithm are reported in Appendix B

4 Data

Some influential empirical investigations of capabilities have previously focused on Indian firms (Ethiraj et al., 2005; Bloom et al., 2013). A drawback of these two previous studies, however, is that they focused on small sample sizes. We use PROWESS, from the Centre for Monitoring the Indian Economy (CMIE). Data comes from the annual reports of companies (both public-listed and unlisted), which include balance sheets and profit and loss accounts. PROWESS is the most comprehensive database available for Indian firms. The companies covered account for about 70% of industrial output, 75% of corporate taxes, and over 95% of excise taxes. We also merge with Patstat for patent data.

Our unbalanced panel includes 44,971 firms in the period 2000 to 2020, for a total of 441,207 observations. Table 2 shows some general characteristics of firms in our sample. Sales demonstrates considerable skew, and therefore we take the natural logarithm of sales as a measure of size, to avoid outliers in the regressions.

A binary variable, in our baseline analysis, indicates whether or not the firm is investing in any particular area. (Robustness analysis in Appendix D confirms that our results are not sensitive to alternative thresholds for dichotomization.)⁴ The amount of spending

Table 2: Mean, Standard Deviation, and 5th and 95th percentiles for the main descriptive variables in our sample.

Variable	Mean	St.Dev.	5th percentile	95th percentile
Sales (million rupees)	3717	45646	0.8	10093.9
Age	18.6	16.8	1	51
Growth Rate	0.08	0.84	-0.94	1.08

is therefore considered to be less important than whether or not a firm actually spends anything in this area (following e.g. Crépon et al., 1998; Bartz-Zuccala et al., 2018; Coad et al., 2020), because what matters is the binary variable of reaching a “rung” on the capabilities ladder, not the scale of activity on that particular rung. In this way, small firms that spend less on certain activities (e.g. R&D) receive the same ‘score’ regarding their capability in this area as large firms that spend larger amounts on the same activities, because both firms appear to possess the required capability.

We divide 47 firm activities (signalling underlying capabilities) into 7 groups: 1) Production Capabilities; 2) Technological Capabilities; 3) Innovation; 4) Basic Managerial & Organizational Capabilities; 5) Internationalization; 6) Environment and Social Amenities;

7) I.T. and Communication.⁵ Appendix A provides details on the activities. This binary dataset is the starting point of our analysis, represented in Figure 1 in matrix form for one year (2019): each row corresponds to a firm and each column corresponds to an activity. The different colors represent different groups of activities. At a first glance, we can observe that certain activities (eg. production colored by red, managerial activities colored by black) appear more often than others (eg. Technology adoption colored by green).



Figure 1: Matrix of activities by firm for year 2019. 28689 firms active in that year in our database are represented by rows and the 47 firms' activities are represented by columns. Colour online

5 Results

5.1 The capability ladder

Given the matrix of activities as in Figure 1, our algorithm then checks for nestedness, i.e. whether activities can be ranked to highlight that firms doing complex activities are also likely to do simpler ones. (Nestedness and the ranking algorithm are presented in Appendices B and C.) Put differently, our iterative algorithm rearranges rows (i.e. sorting activities according to their difficulty) and rearranges columns (i.e. sorting firms according to their 'fitness') to move from the raw data in Figure 1 to the results matrix in Figure 2, which displays clear nested behaviour. Indeed, rows and columns can be rearranged to cluster the present and absent values much better than in a random matrix with similar characteristics. Hence, it is meaningful to sort activities into a hierarchy. If Figure 2 appeared as a solid block-diagonal triangle wedged in the upper left corner, this would mean that firms at a particular rung engage in all the activities at lower rungs. If, however,

Figure 2 were a thin diagonal line, this would correspond to firms at a particular rung only engaging in a small number of activities at the rungs immediately preceding it. And of course, if Figure 2 were a solid square (with density = 100%, then all firms engage in all activities (at all rungs). Instead, the density of our matrix is 21.6% (i.e. firms perform on average 21.6% of the activities). Some firms at upper rungs engage simultaneously in many activities at lower rungs, but this is not always the case because there are many gaps in the upper triangle.

Figure 2 suggests that, as a first step, firms need basic managerial capabilities and production capabilities. Internet access and basic communication needs

arise at about the same time. At a second step, firms engage in internationalization and gaining absorptive capacity for future innovation. At a third step, firms have more idiosyncratic patterns of engaging in product innovation or patenting, merging, environmental policies, and so on.

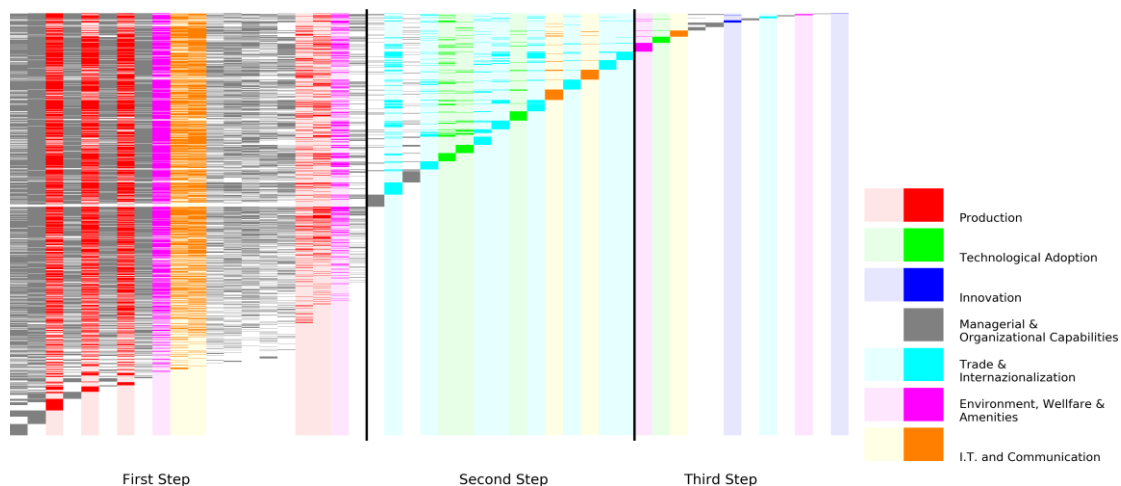


Figure 2: Matrix of activities by firm for year 2019. 28689 firms active in that year in our database are represented by rows and the 47 firms' activities are represented by columns. Same as Figure 1, but columns and rows are reordered to highlight nestedness. Colour online.

The optimal rearranging of columns and rows can be also considered as a natural ranking of activities and firms. In the next section we will look at the ranking of firms, and its significance in measuring firms' capabilities. Focusing now on the 47 activities, we see that the first three rungs of the ladder are the ability to borrow, to own land & building assets, and to outsource professional employment. The three most advanced are product development, patenting, and external specialist consultants.

Figure 3 shows the dynamics of the hierarchy of activities over the available time window (2001-2020). As expected, this hierarchy of activities is quite stable over this period. The main exceptions are ICT related capabilities and Environmental, Welfare & Amenities. Indeed, while ICT capabilities were the fingerprint of an advanced organization in the early 2000s (that is, it was a complex activity performed only by complex organizations), they became a standardized and necessary step for climbing the capabilities ladder already around 2005. It is instead only in 2015 that Environmental, Welfare & Amenities capabilities became a (slightly) more basic rung of the ladder, as Indian firms have to first give precedence to environmental activities with respect for example to Internationalization. In appendix A we show the evolution of the single activities during the time period of our analysis.

What is the probability of moving up or down the ladder from one year to the next? A transition matrix (Table 3) allows a further description of the dynamics of capabilities by shedding light on the transition probabilities for firms. Three interesting observations appear. First, around 90-95% of the probability refers to firms that either stay on the same quintile or move to the neighbouring quintile: not surprisingly, firms' capabilities are quite stable over time. Second, there are no steps that appear to be much more difficult to overcome than others, instead quintiles are similar. Third, upgrades are slightly more likely than downgrades in our data, which is also in line with expectations: firms tend to up- grade their capabilities over their lifetimes, and firms exits make the capability distribution stationary.

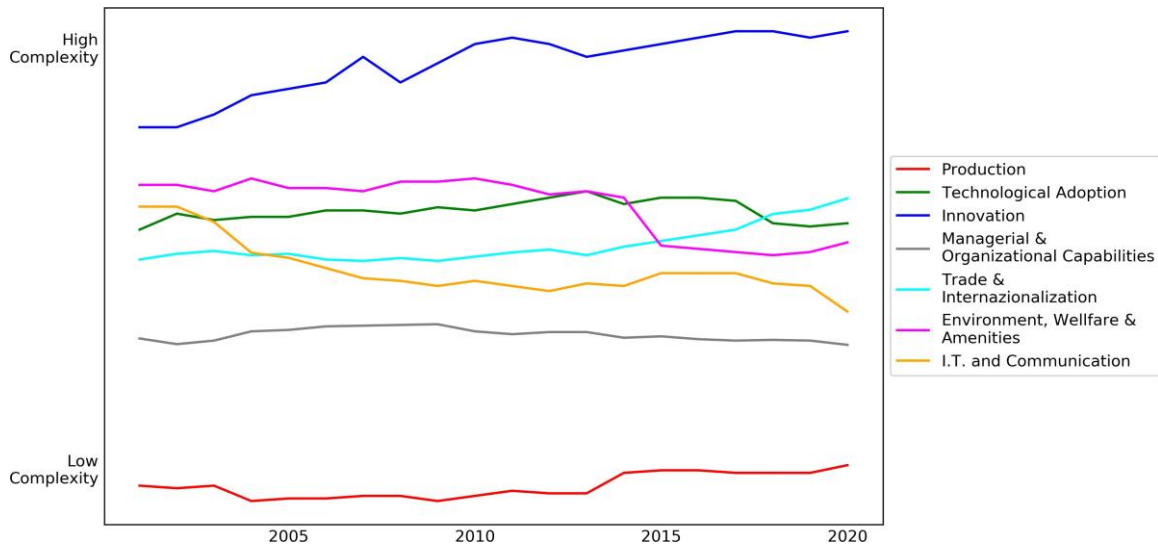


Figure 3: Dynamics of the hierarchy of activities over the period 2001-2020. Colour online.

Quintile	1	2	3	4	5	Total
1	79.19	13.24	2.95	1.97	2.65	100.00
2	11.26	64.90	14.92	4.36	4.57	100.00
3	1.94	12.44	63.33	14.40	7.89	100.00
4	1.21	4.07	12.45	65.35	16.92	100.00
5	1.53	3.98	6.97	16.15	71.38	100.00

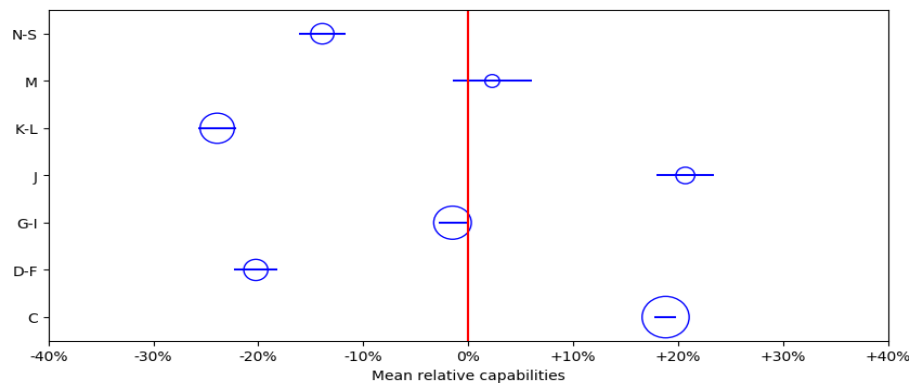
Table 3: Transition probability matrix for firms between quintiles of the capabilities ladder. Each cell represent the probability (as a percentage) of moving the next year in a specific quintile (columns) of the capabilities ladder depending on the starting quintile (rows).

5.2 Populating the ladder

In the previous section, we defined and described the ladder as it emerged from the algorithm. This process defined the landscape where firms coevolve.

We can now describe the firms present at different levels of the capabilities ladder. Indeed one could look at the rows of the matrix and look at the characteristics of the firms located at various rungs of the ladder. We first focus on the average firm's capabilities by industry. A first relevant point is that, at each rung, there is a mix of firms from different sectors. However, this mix is not random: firms in the financial and real estate (K-L), trade (G-I), professional scientific and technical sectors (M), as well as energy (D-F) and other services (N-S) tend to be present along all the spectrum of capabilities, while ICT service sectors and manufacturing firms are mostly located in the two highest steps. This is shown by the average position of firms in the global ranking by industry, as plotted in Figure 4.

Figure 4: Relative average position in the capabilities ladder with respect to the

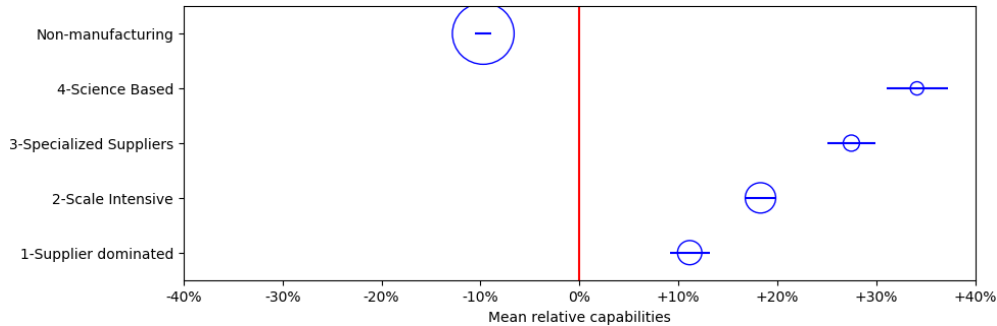


average of all Indian firms of the firms of a specific industry. Year 2019. Error bars represents 2 standard errors – i.e. $\approx$ 95% confidence interval. Size of the circle is proportional to the number of firms in the sector. Industries: C- Manufacturing; D-F: Energy, Water, Construction; G-I: Wholesale and retail trade, deposit and distribution, food and accommodation; J- In- formation and Communication; K-L- Financial and real estate; M- Professional, Scientific and Technical Activities; N-S: Other services (Administration, Health, Education, Other). Colour online

Figure 4: Relative average position in the capabilities ladder with respect to the average of all Indian firms of the firms of a specific industry. Year 2019. Error bars represents 2 standard errors – i.e. $\approx$ 95% confidence interval. Size of the circle is proportional to the number of firms in the sector. Industries: C- Manufacturing; D-F: Energy, Water, Construction; G-I: Wholesale and retail trade, deposit and distribution, food and accommodation; J- In- formation and Communication; K-L- Financial and real estate; M- Professional, Scientific and Technical Activities; N-S: Other services (Administration, Health, Education, Other). Colour online than service-sector firms, taxa characterized by more

reliance on technological capabilities (Specialized Suppliers and Science Based sectors) show a significantly higher position in the ranking, similar to ICT service firms.

Figure 5: Relative average position in the capabilities ladder of manufacturing



firms of a specific Pavitt taxum with respect to the average of all Indian firms. Year 2019. Error bars represents 2 standard errors – i.e. $\approx 95\%$ confidence interval. Size of the circle is proportional to the number of firms in the sector. Colour online.

5.3 Climbing the ladder

The firm growth process involves enlargement in quantitative terms (regarding indicators such as revenues, employees, assets, profits) as well as episodic reorganization and restructuring events (linked to the strategic development of capabilities) that are more qualitative in nature. Figure 6 shows that these two processes (firm size and capabilities) are indeed correlated. It shows a non-parametric Nadaraya Watson kernel regression between firm size (proxied by log of sales revenue) and the order of the firm in the capabilities ranking. Firms increase in size while climbing the capabilities ladder in a coevolving process between capability accumulation and firm size. Interestingly, however, the positive correlation fades in the upper half of the distribution, roughly corresponding to firms that passed the first step highlighted in section 4.1. While a certain size is necessary to support advanced capabilities, the relationship disappears above $\log(\text{sales}) \approx 6$, equivalent to sales of about 40 crore Indian rupees, or approximately 5 million US\$. Overall, the relationship arises from two different dynamics: the growth dynamics and the survival probability.

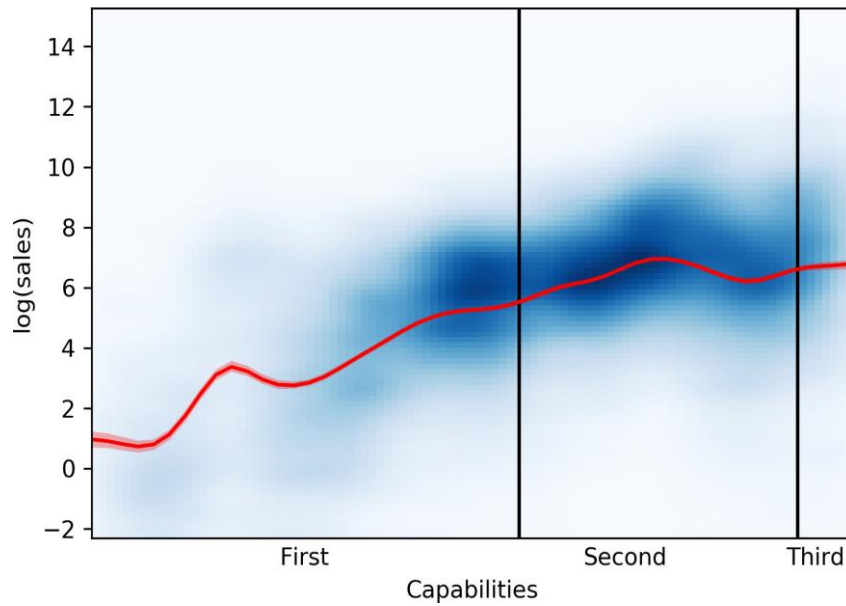


Figure 6: Color map representing firms' density with respect to size of the firms (in terms of the natural logarithm of sales) and its (inverse) position in the ranking, i.e. its capabilities, in 2019. The two vertical black lines separates the three steps. The red line is a non- parametric Nadaraya Watson kernel regression. Colour online.

In figure 7 we look at the relationship between age and capabilities. While there is an expected positive relation between capabilities and age, it is clearly much less striking than what we observed in the previous figure: while firm size strictly constraints firm capabilities, there are firms of any age at any level of capabilities. This is why we preferred the term "capabilities ladder" to "capabilities escalator": there is nothing automatic into the process of building capabilities. Firms can remain simple units for decades, and few firms can be at the edge of the frontier 3 or 4 years after the incorporation.

To better understand the dynamic coevolution of sales and capabilities, we now look at the growth and survival of firms depending on their capabilities and sales. In Figures 8 and 9 respectively, we look at the expected growth rates (relative to the growth rate of

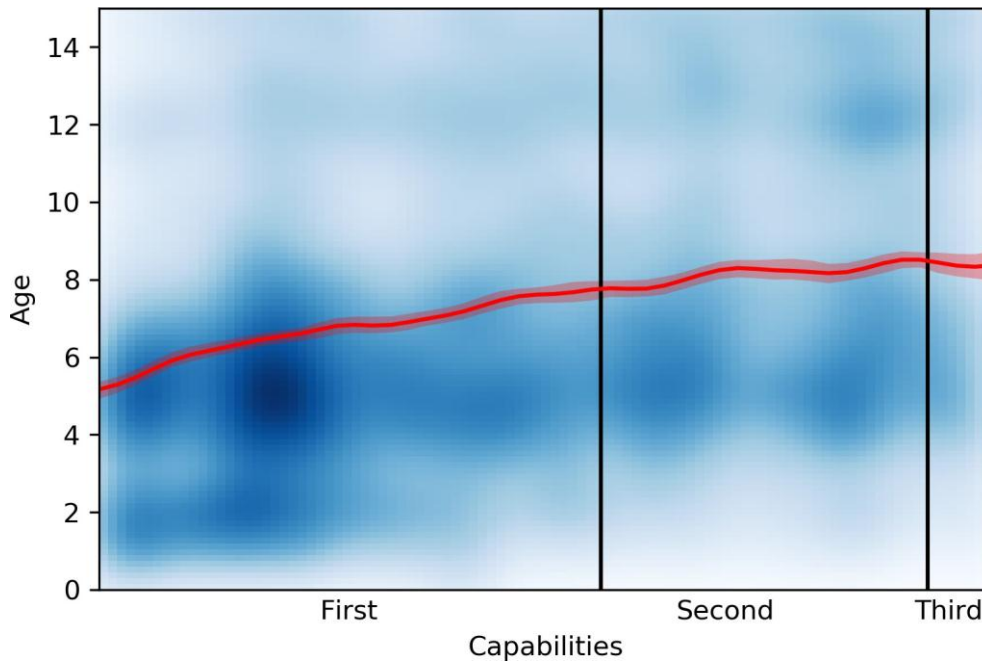


Figure 7: Color map representing firm' density with respect to age of the firms (up to 15 years old firms) and its (inverse) position in the ranking, i.e. its capabilities, in 2019. The two vertical black lines separates the three steps. The red line is a non-parametric Nadaraya-Watson kernel regression. Colour online.

that size class) and survival probability of firms after 7 years⁶ depending on their initial size and capability class. Firms are divided by size class in four quartiles (approximately less than 5.6 crores rupees, between 5.6 and 23.7 crores rupees, between 23.7 and 81.8 crores rupees, and over 81.8 crores rupees), and in terms of the capability ladder we split the firms in the first step (the most populated step) into two subclasses I.A and I.B, to get a total of four capability classes. Once we observe the two processes separately, we better understand the dynamics leading to Figure 6. First, the data points in Figure 8 shows a general trend from bottom-left to top-right, indicating that, for firms in every size class but the smallest ones, higher capabilities are associated with significantly higher average growth: in a 7 years period the average growth rate between at the step I.A and a firm at the III step has a difference of more than 1.2 in log scale, i.e. the sales of a firm with capabilities in the highest group are expected to end up 3.3 times larger at the end of a 7 years period than the sales of a firm with the same initial sales but in the lowest group with respect to its capabilities. Second, by looking at the survival rate (Figure 9), capability development improves survival outcomes from completing the activities at the first step of the ladder, although subsequent development of capabilities has no clear survival benefits for firms. A possible explanation is that higher positions in the capability ladder correspond to entering into more risky activities (exporting, patenting) and sustaining higher fixed costs.⁷ This is reminiscent of Arora and Nandkumar (2011), who observe that capable entrepreneurs with high opportunity costs will take more risks and place less value on the option of

survival. Another possible explanation is that some of these cases of non-survival correspond to lucrative exits via acquisition or trade sale. While firms in 'Size class 0' have maximum survival probability at step I.B, climbing up the ladder of production and managerial capabilities without engaging in R&D and exporting activities, firms in higher size classes have their maximum survival probability while remaining at step II of the ladder, avoiding only the riskiest activities (patenting, introduction of new products, etc).

Assuming a linear behavior for the relationship between growth and capabilities, we can add further controls to better understand the growth process by using parametric regressions. The relationship between firm size and capabilities is confirmed by looking at the future growth of the firms that are higher in capabilities than their size would indicate, i.e. firms that are below the red line in Figure 6. Table 4 shows the results of a Fixed Effects regression of firm growth for different sectors:

$$Growth_{i,t} = a + \beta_1 Size_{i,t-1} + \beta_2 Age_{i,t-1} + \beta_3 Capabilities_{i,t-1} + v_i + \gamma_t + \epsilon_{i,t} (1)$$

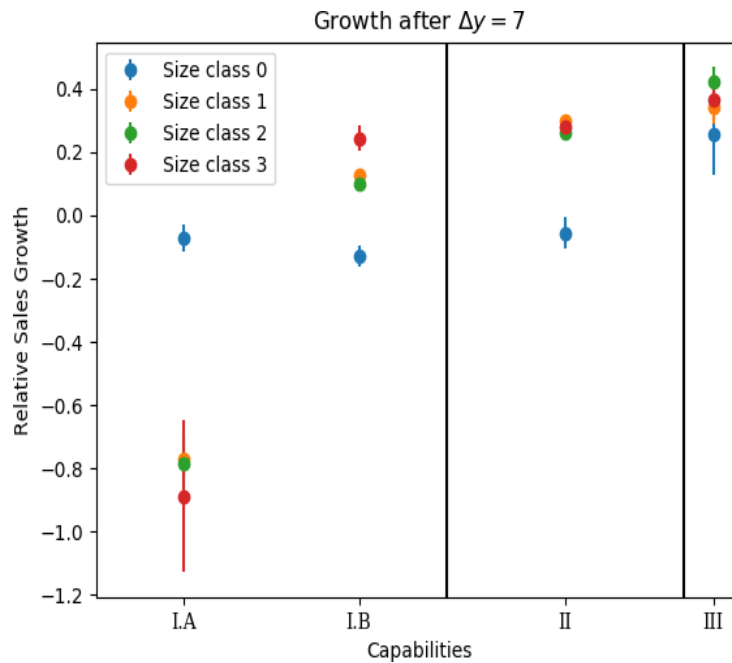


Figure 8: Average 7 years sales growth relative to the size class for different size and capability classes. Bars represent two standard errors, $\approx$ 95% confidence interval. Colour online.

where firm growth is defined in terms of log-differences of sales, i.e. $Growth(i,t) = \log(sales(i,t)) - \log(sales(i,t-1))$ for firm i in year t . The controls include size (measured by log sales), log of age of the firm, year dummies (γ_t) and two-digit sector dummies (v_i). Interestingly, there is a clear threshold effect: the larger the firm, the higher on the ladder it should be placed to be able to grow.

Notice that this effect is specific for firm growth: an alternative performance variable (i.e. profitability) is not affected by the spread of firms in different activities (see Appendix B). Indeed, a lean operation not involved in R&D or internationalization could well have a higher profitability than a large corporation could. An explanation could be that the gains from capability development are not clearly visible in the 'bottom line' of final profits,

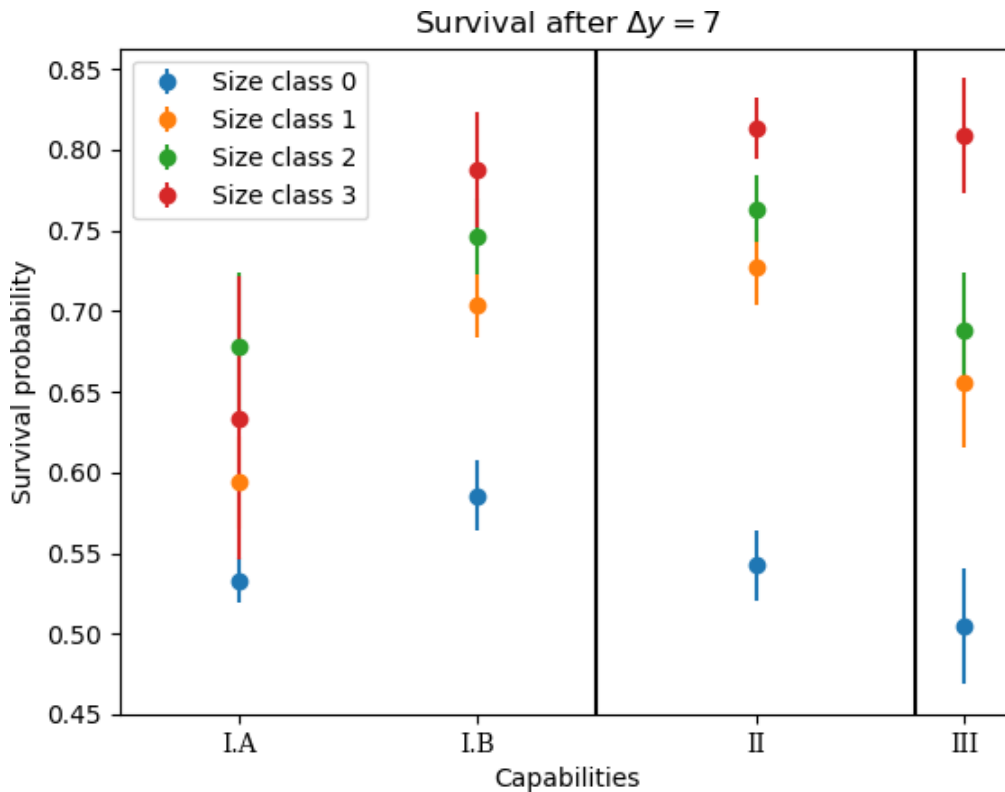


Figure 9: Survival probability after 7 years for different size and capability classes. Bars represents two standard errors, $\approx 95\%$ confidence interval. Colour online.

because they are shared with stakeholders such as skill-upgrading employees. Increasing the operational complexity of the firm only seems necessary for increasing the scale of operations, not for boosting profitability or enhancing survival.

6 Concluding Discussion

We contribute to the strategic management literature by introducing and applying a novel methodology for quantifying firms in terms of their capabilities, and putting these capabilities (and hence also the firms) in a hierarchy that we refer to as the capabilities ladder. These operational routines correspond to a variety of functional areas, such as marketing, financial practices, human resource practices, internationalization, and innovation. Our

Table 4: Fixed Effect regression of firm growth with respect to lagged size, age and the position in the ladder of the firm ('capabilities') normalized from 0 (beginning of the ladder) to 1 (top of the ladder). Column 1 and 2 involve manufacturing firms (industry C), columns 3 and 4 involves ICT firms (industry J), while columns 5 and 6 involves all firms in the sample.

	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.3003*** (0.0079)	-0.3118*** (0.0081)	-0.3403*** (0.0054)	-0.3512*** (0.0057)	-0.3256*** (0.0045)	-0.3371*** (0.0047)
Age	-0.2046*** (0.0165)	-0.2060*** (0.0171)	-0.2050*** (0.0179)	-0.2074*** (0.0181)	-0.2312*** (0.0124)	-0.2329*** (0.0127)
Capabilities		0.1643*** (0.0195)		0.2792*** (0.0235)		0.2462*** (0.0162)
Observations	121703	118231	155869	150569	277572	268800
R ²	0.201	0.205	0.199	0.200	0.196	0.198
Firm clusters	13359	13173	22523	22100	35882	35273

Notes: Standard errors in parentheses.

Key to significance stars: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

nestedness algorithm, inspired by biology and network science, defines a capability as complex if few firms at lower rungs of the ladder are observed to perform it. We analyse balance sheet and innovation data of almost 45'000 Indian firms 2000-2020, and observe significant nestedness, as compared to a random allocation of activities in firms. Lower rungs of the capabilities ladder correspond to basic managerial and production capabilities. Mid-level rungs correspond to internationalization and acquiring absorptive capacity. Higher-level rungs are less clearly ordered into a hierarchy. Higher-level rungs are more focused on one side with environmental and welfare, and the other side with innovation in terms of patenting and introducing new products. Further analysis showed some interesting changes in the ordering of the rungs over time. For example, ICT capabilities – once rare – have become more fundamental lower-level rungs on the capabilities ladder in recent years, as ICT capabilities have become more widely used and have permeated a wider range of processes. While the observation that ICT capabilities have become more commonplace in recent decades may seem obvious, it is here quantified precisely and we can see how ICT capabilities became fundamental steps in the early 2000s, while for example investments in the well-being of employees became a fundamental step only in the second half of the past decade.

Interestingly, we saw that firms with higher capabilities have higher growth rates, but when the firm is involved in too many advanced activities with respect to their size it has a lower survival probability. As a first step, firms

need to have basic managerial capabilities and production capabilities. Internet access and basic communication needs arise at about the same time. At a second step, firms engage in internationalization and gaining absorptive capacity for future innovation. Subsequent rungs of the capabilities ladder are less precisely arranged in a hierarchy (i.e. nestedness is weaker), as firms with adequate capabilities have more latitude to climb their own customized ladders. For lower capability firms, though, the capability ladder is set out quite clearly. These combined dynamics generate an equilibrium distribution where capabilities relate strongly with firm size for small firms with few capabilities, while for higher capability levels there is a different regime, likely depending on the firm sector, age, and some idiosyncratic firm's characteristics, breaking the observed relationship between size and capabilities. While this work assesses the strong relationship between the capability measure and firms' future performance (in terms of sales growth and survival), a further development of this line of research could take the shape of an advanced quantitative forecasting exercise to investigate how well the measure allows us to forecast firms' future performance, with the standard instruments of such evaluations. In practice this would be achieved by analyzing a subset of firms' data up to a certain year, and checking the accuracy of the predictions on that year's data regarding firms' survival and growth for the following years, compared with their real evolution. Similar methods have indeed been successful in forecasting the growth of countries (Tacchella et al., 2018). Some limitations of our work (and empirical work in this area more generally) can be mentioned. First, we use a dummy variable for capability, for reasons discussed in Section 2, which could be a limitation because this operationalization does not take into account how much a firm spends in a certain area, or how skilful the capability is (e.g. some violinists have better capabilities than others). Robustness analysis in Appendix D, however, confirms that our results are not sensitive to alternative thresholds for dichotomization. Second, and relatedly, we take an inputs-based indicator of capabilities, rather than an output-based indicator. A problem could be that inefficient and optimistic firms may lack the capabilities to effectively create value from expenditures in these areas (e.g. to benefit from R&D investment). Third, our statistical analysis focuses on conditional associations rather than applying a causal econometric framework. While intertemporal associations are useful for purposes of predictions and forecasting, nevertheless future work applying causal techniques would offer a deeper understanding of capability development.

Some policy implications can tentatively be discussed, drawing on our analysis. First, a number of policy initiatives seek to provide support to firms facing particular challenges, such as taking first steps into export markets. Our results help to better understand the precursors and prerequisites for certain types of activities, which could make policy targeting more effective if firms become eligible for policy support conditional on their existing capabilities. For example, publicly-funded export assistance could be made conditional on

having a website; or eligibility for R&D grants could be made conditional on patent applications or having certain technological search routines or skilled employees. There may be drawbacks to making policy support conditional on capabilities, however. Grazzi et al. (2021) argue that some firms might accelerate their movement up the capabilities ladder (e.g. prematurely enter export markets) in order to become eligible for export promotion policies, which leads to a misallocation of policy support towards ill-prepared firms. Another possible drawback of making policy support conditional on existing capabilities (according to our methodology) would be that firms could learn how to “game the system” and imitate high-capability firms by spending in areas where they have no capabilities, in an attempt to appear sophisticated.⁸

Another intriguing phenomenon is that some firms climb the capabilities ladder with remarkable speed, with of course the special case of potentially ‘born capable’ firms that possess advanced capabilities (e.g. internationalization, R&D investment) immediately after birth. Such awe-inspiring cases seem worthy of particular research focus. Somewhat relatedly, it could be worth investigating how severely firms are penalized (if at all) for moving up the rungs in an order that is different from the commonly-observed order of rungs.

To summarize, therefore, we present a novel methodology for the measurement and sorting of capabilities within firms, and hope that our methodology and results will help to improve our ability to measure capabilities as well as helping to refine the theory of capabilities and capability development.

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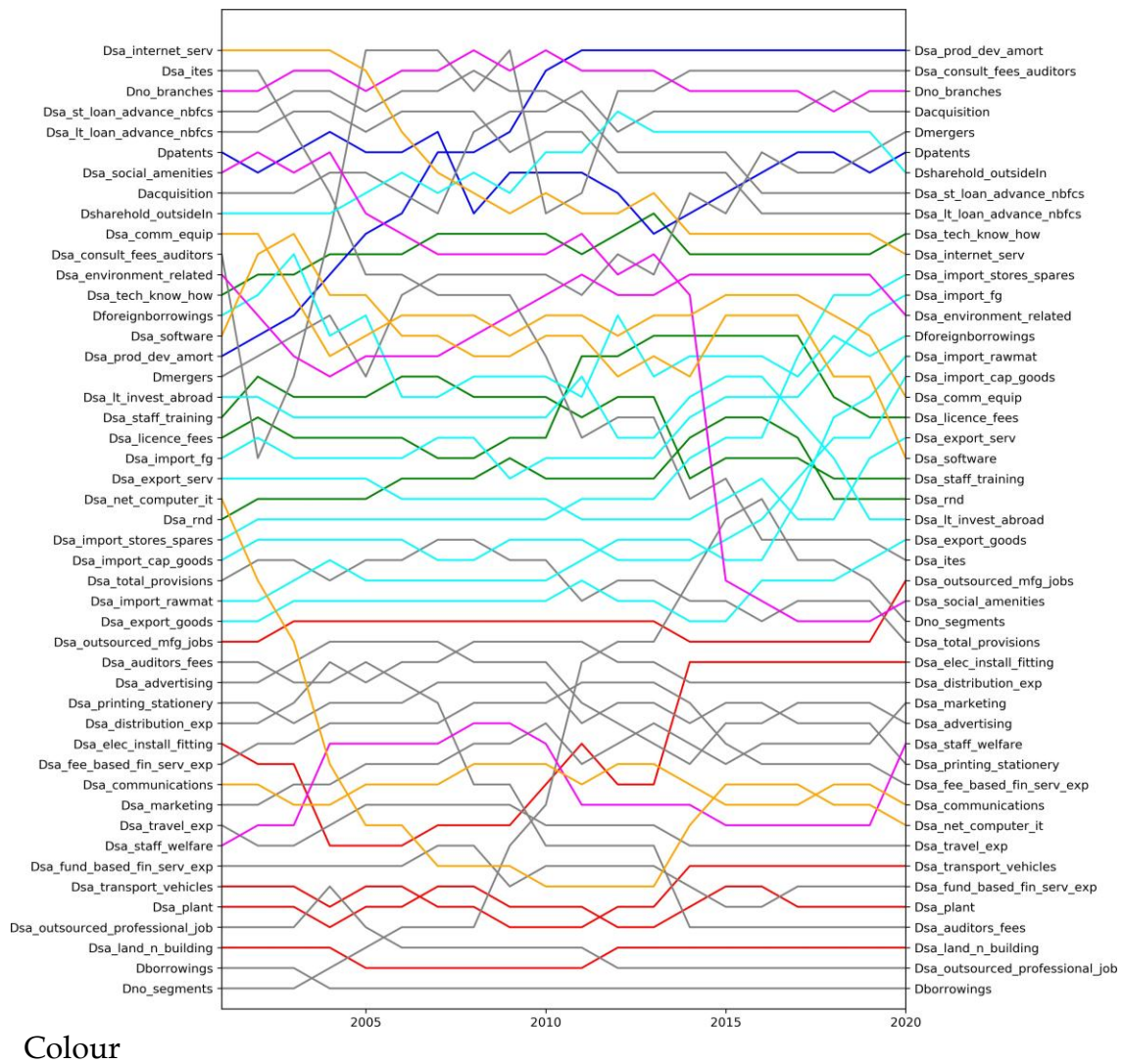
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A Ranking of the capability variables in time

In this appendix, we list the individual firm activities used in the analysis (Table A.1) and we show their individual evolution in time in terms of complexity (Figure A.1).

Figure A.1: Dynamics of the hierarchy of activities over the period 2001-2020.



B The ranking algorithm

In this type of analysis, the basic input is the matrix $M_{f,c}$ for a given year, whose entries take the value 1 if the firm f is active in the activity revealing the capability c and 0 otherwise. For example, the input matrix $M_{f,c}$ in our case for year 2019 is shown in Figure

1. From this starting input we try to infer at the same time the complexity of the activities and the “fitness” of the firms, i.e. their ability to perform complex activities. To task we use the Tacchella et al. (2012) algorithm, as it has been shown to be the best algorithm to highlight nestedness in biological systems (Domínguez-García and Munoz, 2015).

In particular, to calculate the fitness of firms and the complexity of the activities we iterate upon convergence the following set of non linear coupled equations:

$$\begin{aligned} \vec{F}_f^{(n)} &= \sum_c M_{fc} Q_c^{(n-1)} & \vec{F}_f^{(n)} &= \frac{F_f^{(n)}}{\langle F_f^{(n)} \rangle} \\ \vec{Q}_c^{(n)} &= \frac{1}{2} \frac{1}{\sum_f M_{fc} F_f^{(n-1)}} & \vec{Q}_c^{(n)} &= \frac{Q_c^{(n)}}{\langle Q_c^{(n)} \rangle} \end{aligned} \quad (B.1)$$

where n is the iteration index and the normalization of the intermediate tilded variables with the average ($\langle \rangle$) of $\vec{F}^{(n)}$ and $\vec{Q}^{(n)}$ is made as a second step to ensure that the final measures have average 1.

The top-left equation presents fitness (F_f) as a function of the set of activities c (proxies for capabilities) that a firm f has (M_{fc}) that is weighted by the complexity Q_c of these activities. In other words, firm-level fitness is calculated as the sum of activities undertaken by a firm weighted by complexity weights. This seems uncontroversial and in line with intuitions from the strategy literature. Firms engaging in just one simple activity would get a low score. Firms engaging in all possible activities would get the highest score. Firms engaging in a small number of the most “complex” activities (as reflected by the complexity weights Q_c) would get a relatively high score.

The bottom-left equation calculates the complexity at the level of activities (not at the level of firms). To a first approximation, the complexity of an activity is inversely proportional to the number of firms engaging in it. However, complexity depends not only on the raw number of firms, but on the fitness of these firms. The intuition is that complexity is strongly influenced by the lowest-fitness firm that is able to engage in this activity. If a high-fitness firm is

able to undertake an activity, this is given low weight for calculating an activity's complexity, because it is expected that high-fitness firms can easily fulfil low-complexity tasks. If an activity is undertaken by all firms, then the average fitness of the firms undertaking this activity would be relatively low, it would get a low score for complexity (Q_c). If an activity is undertaken by a small number of high-fitness firms, it would get a high score for complexity.

The set of non linear equations cannot be solved algebraically, and they are therefore solved numerically by iterating the coupled equations until a fixed point is reached. This allow us to rank firms and activities in a unique way. These rankings, as shown in Figure 2, allow reorganizing the matrix to highlight its nestedness. Indeed it has been shown in Domínguez-García and Munoz (2015) that equations B.1 are the best equations to find the ranking representing the importance of species in nested systems: once the species are ordered according to equations B.1, the nestedness of the system is the highest with respect to ordering of rows and columns based on different centrality measures. Equations B.1 will also be the rankings we use in our computations when referring to the complexity of capabilities (Q_c) or firms (F_f).

C Measuring nestedness

A crucial part of this work is assessing the nestedness of the matrix, i.e. the fact that firms able to perform activities classified as complex, are also able to perform simpler activities more than what we would expect if firms were selecting activities randomly. While this looks intuitively obvious, we first need to clarify two points: how are we going to measure the nestedness, and what "randomly" means in this context. First, as a measure of nestedness we use 'Nestedness as a measure of Overlap and Decreasing Fill' (NODF), (Almeida-Neto et al., 2008), a measure of the actual overlap between firms' activities. The measure gives a number between 0 (no overlap) and 1 (perfectly triangular matrix). According to this measure, our matrix for 2019 has a NODF of 0.742. To be able to compare this value with what we would expect from a random matrix, we have to clarify how a random assignation of activities to firms would occur.

The easiest process we can imagine is a process where each firm-activity link has the same probability. As the density of our matrix is 0.216 — firms perform on average 21.6% of the activities — if this is our null model each firm will have a probability 0.216 of being active in any given activity. The distribution of NODF for matrices produced by this null model is represented in Figure C.1. Clearly, the empirical NODF is much higher than the NODF measured in the matrices produced by this null model.

Of course, this does not seem particularly surprising: we know that there are firms more diversified in different activities, and that this is not the outcome of a random process but of different firm capabilities. We can therefore change our

null model, and assume now that each firm has the same expected diversification as in the empirical matrix, but with random selection regarding which specific activities it is doing. If a firm is empirically active in 50% of the activities, the corresponding random firm will have a 0.50 probability of being active in each activity. The distribution of NODF for matrices produced by this null model is represented in Figure C.2. Again, also this null model cannot produce matrices with a NODF as high as the empirical matrix.

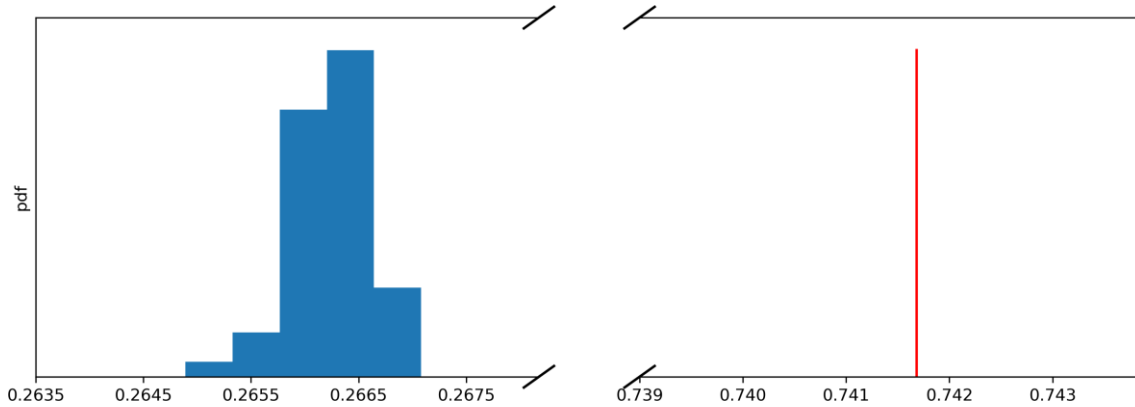


Figure C.1: Probability distribution of the NODF of matrices generated by a homogeneous null model (blue area), compared with the NODF of the empirical matrix (red line). Colour online.

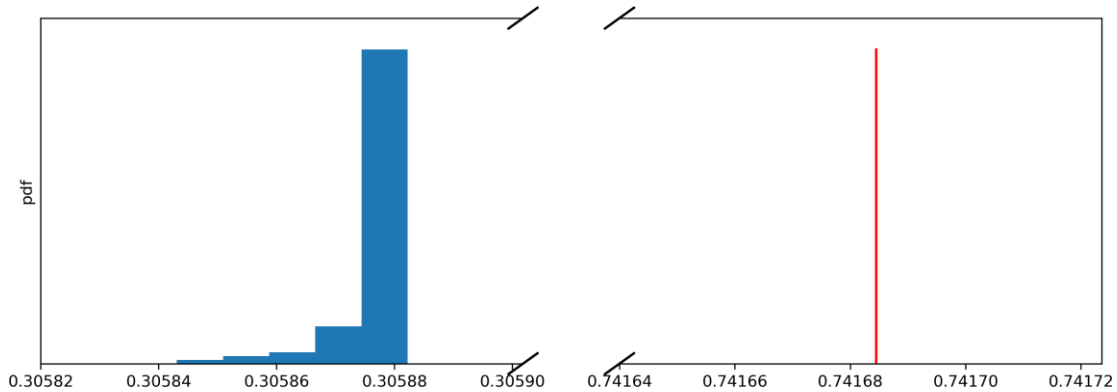
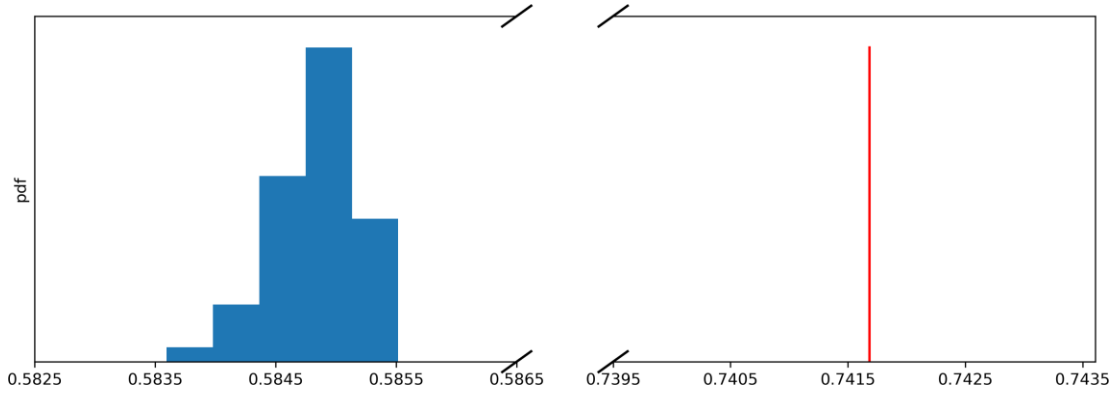


Figure C.2: Probability distribution of the NODF of matrices generated by a null model pre- serving heterogeneous expected firms diversification (blue area), compared with the NODF of the empirical matrix (red line). Colour online.

There is a further objection: we know that activities are not all the same and some activities are less ubiquitous than others. This is not the outcome of a random process but of higher capabilities required. We can propose therefore one more null model, and assume now that each activity has the same expected ubiquity as in the empirical matrix, but which specific firms are doing that activity is randomly selected. If an activity is performed by 30% of the firms, each firm will have 0.30 probability of being active in that activity. The

distribution of NODF for matrices produced by this null model is represented in Figure

C.3. Also this null model cannot produce matrices with a NODF as high as the empirical matrix.



serving heterogeneous expected activities ubiquities (blue area), compared with the NODF of the empirical matrix (red line). Colour online.

Finally, in the empirical matrix are present at the same time both the constraints tackled in the previous two paragraphs. Therefore, we want a null model representing random matrices such that both of the following are satisfied: each firm has its expected diversification and each activity has its expected ubiquity. To solve both constraints at the same time we need to solve a system of equations numerically with techniques inspired by the maximization of entropy (Saracco et al., 2015). The distribution of NODF for matrices produced by this last null model is represented in Figure C.4. Even this last null model cannot produce matrices with a NODF as high as the empirical matrix.

In table C.1 we show the statistics of the distribution of NODF for matrices generated with the four models, and the Z-score of the empirically observed values of NODF for the matrix assuming the four different null hypotheses. An interesting result is that, even if no null model approaches the empirical value (0.742), we can see how the heterogeneous ubiquity of activities is a crucial ingredient to generate a nested matrix, more than the diversification of firms.

Overall, the comparison between the nestedness of an empirical matrix with a random matrix is not a trivial task, as it is not clear which constraints are actually to be discounted and which are into the definition of nestedness itself (Bruno et al., 2020). In our case

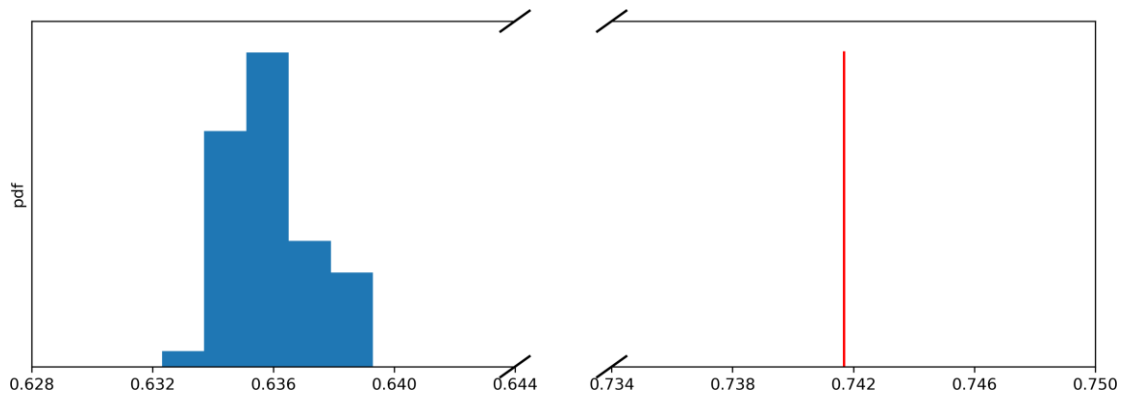


Figure C.4: Probability distribution of the NODF of matrices generated by a null model preserving heterogeneous expected activities ubiquities and expected firms diversifications (blue area), compared with the NODF of the empirical matrix (red line). Colour online.

however, the nestedness observed, measured as NODF, is above the random case even discounting every possible constraint. To perform advanced activities, a firm has to climb the ladder.

Notice that the large values of the Z-score in table C.1 should not surprise the reader: having many firms in our sample, even small signals are highly statistically significant. As a comparison, it is instructive to look at the case of survey data. Applying the same computations to data from the World Management Survey⁹ (employed by several studies, among others, Bloom et al. (2012)), we can define firm capabilities from managers' answers to the survey questions. For instance, to the question "Can you describe the production process for me?", a manager could answer with different scores, where score 1 would imply the introduction of few modern manufacturing techniques in an ad-hoc manner, score 3 would imply introduction of modern manufacturing techniques in an informal or isolated manner and score 5 would imply that all major aspects of lean manufacturing have been introduced formally. The observed nestedness in the empirical matrix of capabilities extracted by this survey data, as measured by NODF, is 0.299. While it is statistically significantly different from the strict null model, with a Z-score of ≈ 10 from the null model average of 0.253, it is not economically significantly different. As NODF spans from 0 to 1, the signal with respect to random noise is just 4.5% more. More striking, even with the looser null model devoid of any constraint, a complete random rendition of a matrix of a certain density, the null model average is 0.218.

D Varying the threshold for dichotomization

Are even small amount of expenses signals of firms capabilities? According to our methodology so far, a firm that spends 1 rupee on R&D would be classified as having R&D capabilities. A reasonable objection to the idea of dichotomization is that it could mix signal and noise: as we consider a firm as

having the proper capabilities for an activity if they have any expense in said activity, very small and inconsequential amounts of expenses gets conflated with important expenses. Furthermore, the threshold could be in absolute terms (assuming for example that expenses less than the wage of two researchers is not a signal of a working R&D department) or in relative terms (a big multisegment firm paying two researchers does not reflect the same focus as a small startup with the same expenses), or even have a different threshold for different sectors (to perform R&D activities in two sectors could have a very different cost).

Indeed in the exercise presented in this paper we define a firm-activity link to be “True” if there is any expense. This could be problematic, as any noise could obfuscate the signal. For example this is what happens when applying the same algorithms employed in this paper to countries and products, the original context in which these algorithms were devised: as small amounts of trade in a sector are often random and not representing capabilities, the signal is maximum when small amounts are cleaned off. This is typically done by considering a link as true when the country shows “Revealed Comparative Advantage” (Balassa, 1986). Therefore, in this appendix we look at the dichotomization process considering that small amounts of activities could be just noise. We will look at two different algorithms as possible candidates to clean the potential noise.

The first algorithm uses an absolute threshold for each activity. We first choose a percentile (N), and later for each firm’s activity we compute the N-th percentile of the expenses (among the non-zeros value). We assign a “True” value to the binary matrix for a firm-activity link if the firm’s expenses in that activity are greater or equal than the N-th percentile for that variable, instead of just greater than 0. If N is equal to 0, the exercise is the same as the one proposed in the article: all the expense thresholds are equal to minimum for that variable, and we have therefore a “True” value in the link between a firm and an activity if the expenses of the firm in that activity are different from zero. When N increases, we stop considering “True” the bottom percentiles of the expenses, so that small amounts of expenses in one activity are not considered as revealing firm’s capabilities in that field. This algorithm goes toward the first kind of objection, the idea that a small enough R&D department is not an R&D department.

The second algorithm we tried to use to clean our matrix is using a relative measure. The procedure is the same as the previous algorithm, with a threshold set for each activity depending on a specific percentile. However, we now use a relative matrix as the starting data: instead of activities expenses, we look at activities expenses divided by total firms’ sales. In this way, when we remove the bottom percentile, we are removing firms not highly involved in a specific activity with respect to their size. For example, according to this algorithm, a big multisector firm with two researchers would not be considered as involved

with R&D, while a small startup with the same setup could be considered a firm performing R&D. Of course, also in this case, when the percentile N is equal to zero we have the same exercise of the baseline proposed in the article.

To evaluate the best cleaning strategy, we look at the excess nestedness, i.e. if the system looks less random when we clean the small values: this is what is expected if there was no information in small values. The results are shown in figure D.5. For each case, as in the previous appendix we compute the empirical nestedness as NODF and we also run a Bilateral configuration model to produce null models for the random case. We measure excess nestedness as the ratio between the empirical NODF and the average NODF for the null models. For both algorithms, it looks like even small amounts of expenses in one

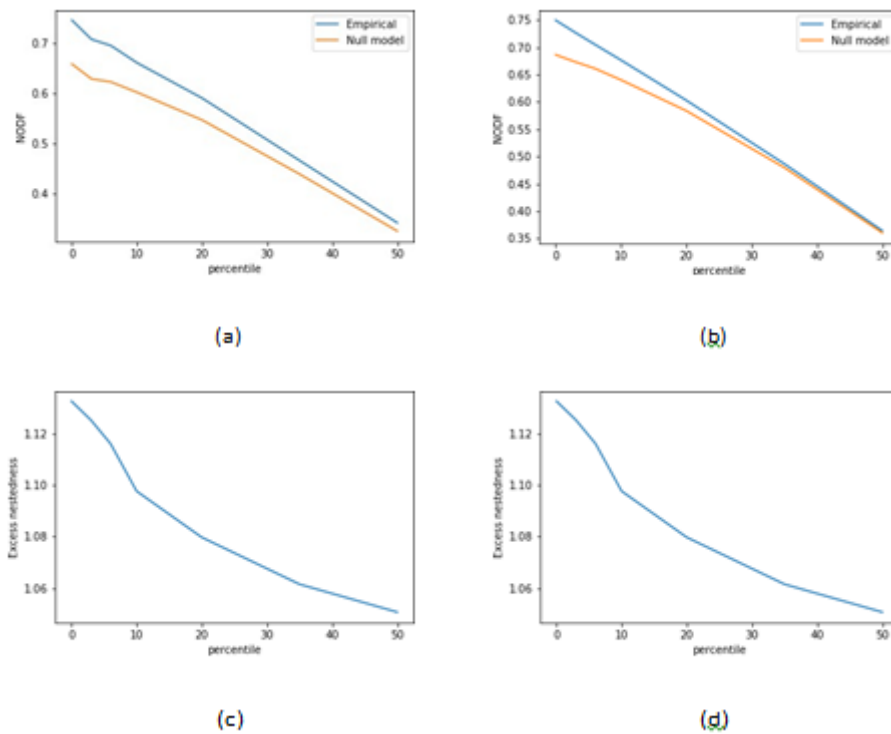


Figure D.5: Nestedness (NODF) (a and b) and excess nestedness, computed as empirical NODF divided by the mean NODF obtained with a Bilateral configuration model, (c and d) setting a different threshold depending on the absolute value (a and c) or relative value (b and d) of expenses.

category are more likely to represent a small signal than noise. The higher the threshold the less signal remains. Not surprising, when we move to a threshold of 50%, we lose any excess nestedness: if to be considered active in a field you

have to have more than the median value of expenses, firms will be considered specializing in different activities, instead of diversifying and increasing their capabilities portfolio.

Table A.1: Definition of variables

Variable name	Set	Definition
~~Opaloots~~	Innovation	Patents
~~Opalprod_dev_expens~~	~~INNOVATION~~	Product Development Expenses
~~Opalconsult_fees_auditors~~	Managerial & Organizational	~~Expenses~~ : Consultancy fees to auditors
~~Opalbranches~~	Environment, Welfare & Amenities	No of branches
~~Opalsegments~~	Managerial & Organizational	No of segments or business units
~~Opallt_loan_advance_oblig~~	Managerial & Organizational	Long term loans and advances
~~Opalst_loan_advance_oblig~~	Managerial & Organizational	Short term loans and advances
~~Opaltech_knowhow~~	Technological Adoption	Technical knowhow fees paid to external parties
~~Opalinternet_serv~~	I.T. and Communication	Expenses on internet services
~~Opalmergers~~	Managerial & Organizational	Merged with another company
~~Opalenvironment_related~~	Environment, Welfare & Amenities	Environment and pollution control related expenses
~~Opalleased_in_assets~~	Managerial & Organizational	Leased in assets
~~Opallicense_fees~~	Technological Adoption	License fees (for use of intellectual property) paid
~~Opalcomm Equip~~	I.T. and Communication	Assets – communication equipment
~~Opalshareholders_outsidein~~	Internationalization	Shareholders outside India
~~OpalITES~~	Managerial & Organizational	Expenses – Outsourced IT enabled services and other professional jobs
~~Opalstaff training~~	Technological Adoption	Staff Training Expenses
~~Opalimport_fg~~	Internationalization	Import of finished goods
~~Opalr&d~~	Technological Adoption	R&D expenses
~~Opallt_invest_abroad~~	Internationalization	Long-term investment abroad
~~Opalexport_serv~~	~~Internationalization~~	Export of Services
~~Opalforeigncurrencyborrowings~~	~~Internationalization~~	Foreign currency borrowings
~~Opalacquirer~~	Managerial & Organizational	Acquirer
~~Opalimport_ofstora_and_spara~~	Internationalization	Import of stores and spares
~~Opalimport_cap_goods~~	~~Internationalization~~	Import of capital goods
~~Opalimport_rawmat~~	~~Internationalization~~	Import of raw materials
~~Opalexport_goods~~	~~Internationalization~~	Export of goods
~~Opaloutsourced_mfg_jobs~~	Production Capabilities	Expenses: Outsourced manufacturing jobs
~~Opaltotal_provisions~~	Managerial & Organizational	Provisions for i) bad and doubtful advances, ii) debts & debtors, ~~disposals~~ in investments and iii) ~~unspecified~~ contingencies
~~Opaldistribution_exp~~	Managerial & Organizational	Distribution expenses
~~Opalelec_install_fitting~~	Production Capabilities	Assets – Electrical installations
~~Opalsoftware~~	I.T. and Communication	Assets - Software
~~Opalmarketing~~	Managerial & Organizational	Expenses on market research, branding, product designing ~~for targeted markets~~
~~Opalprinting_stationery~~	Managerial & Organizational	Printing and Stationery Expenses
~~Opalstaff_welfare~~	Environment, Welfare & Amenities	~~Expenses~~ on staff welfare
~~Opaladvertising~~	Managerial & Organizational	Advertising expenses (Media campaign etc)
~~Opalcommunications~~	I.T. and Communication	Communication expenses (Telephone, postage etc)
~~Opalnet_computer_it~~	I.T. and Communication	Assets - Computers and IT systems
~~Opalfee_based_fin_serv_exp~~	Managerial & Organizational	Fee based financial services expenses (Bank charges etc)
~~Opaltravel_exp~~	Managerial & Organizational	Travel expenses
~~Opaltransport_vehicles~~	Production Capabilities	Assets – transport vehicles
~~Opalplant~~	Production Capabilities	Assets – plant and machinery
~~Opalfund_based_fin_serv_exp~~	Managerial & Organizational	Fund based financial services expenses (interest paid on loans)
~~Opalauditor_fees~~	Managerial & Organizational	Fees paid to auditor associated with the company (internal)
~~Opaloutsourced_professional_job~~	Managerial & Organizational	Expenses: Outsourced professional jobs
~~Opalland_building~~	Production Capabilities	Assets – land and building
~~Opalborrowings~~	Managerial & Organizational	Borrowings

Null model	Mean	St.Dev.	Zscore
Homogeneous probability - C.1	0.266	3.7810^{-4}	1260.83
Heterogeneous firms diversification - C.2	0.306	6.4510^{-6}	67612.9
Heterogeneous activities ubiquity - C.3	0.585	3.4610^{-4}	453.6
Bilateral configuration model - C.4	0.636	1.3610^{-3}	78.1

Table C.1: Mean and Standard deviation of the NODF for matrices generated with different null model, and T-statistics of the empirical value (0.710). All the corresponding p-values are below machine precision

E Relative Profitability (ONLINE SUPPLEMENTARY MATERIALS)

Profitability can be taken as an alternative dependent variable (besides sales growth and survival) for investigating the link between capabilities and firm performance. This appendix shows the results of running a regression looking at the relative profitability of the firm compared to other firms in its 4-digits sector. Time-invariant firm specific effects, as well as some basic controls (lagged values of the logarithms of firm size and firm age) are controlled for. The main takeaway is that capabilities are far from being statistically significantly associated with relative profitability.

	(1)	(2)
Size	1.7688 (1.8228)	1.4923 (1.9284)
Age	-2.1014 (2.1622)	-2.0956 (2.2747)
Capabilities		8.5995 (6.6688)
Observations	277559	268800
Firm clusters	35881	35273

Table E.1: Capabilities and firm profitability: Fixed effects estimation

F Geographical characterization of firms (ONLINE SUPPLEMENTARY MATERIALS)

We can look at the position of firms in the ladder from a development angle, by looking at the average capabilities of firms in different Indian states, analyzing the vast heterogeneity in terms of industrial capabilities of Indian states. Notice that these results are suggestive, but they do not allow for a clear causal interpretation. On the one hand, here we do not take into account the potentially confounding role of variables such as urban density, sectoral specialization, firm size, regional infrastructure, and so on. On the other hand, the average capability of the firms in the state should not to be seen as a measure of excellence: a state with many young and active start-ups would have low average firm capabilities. With these caveats, in Figure F.1 we show

the average capabilities per state. Haryana and Kerala firms have on average the most developed capabilities, while West Bengal and NCT of Delhi have the least developed capabilities. In Figure F.2 we show, for the four states with the most firms in our sample, the distribution of firms at different steps of the ladder

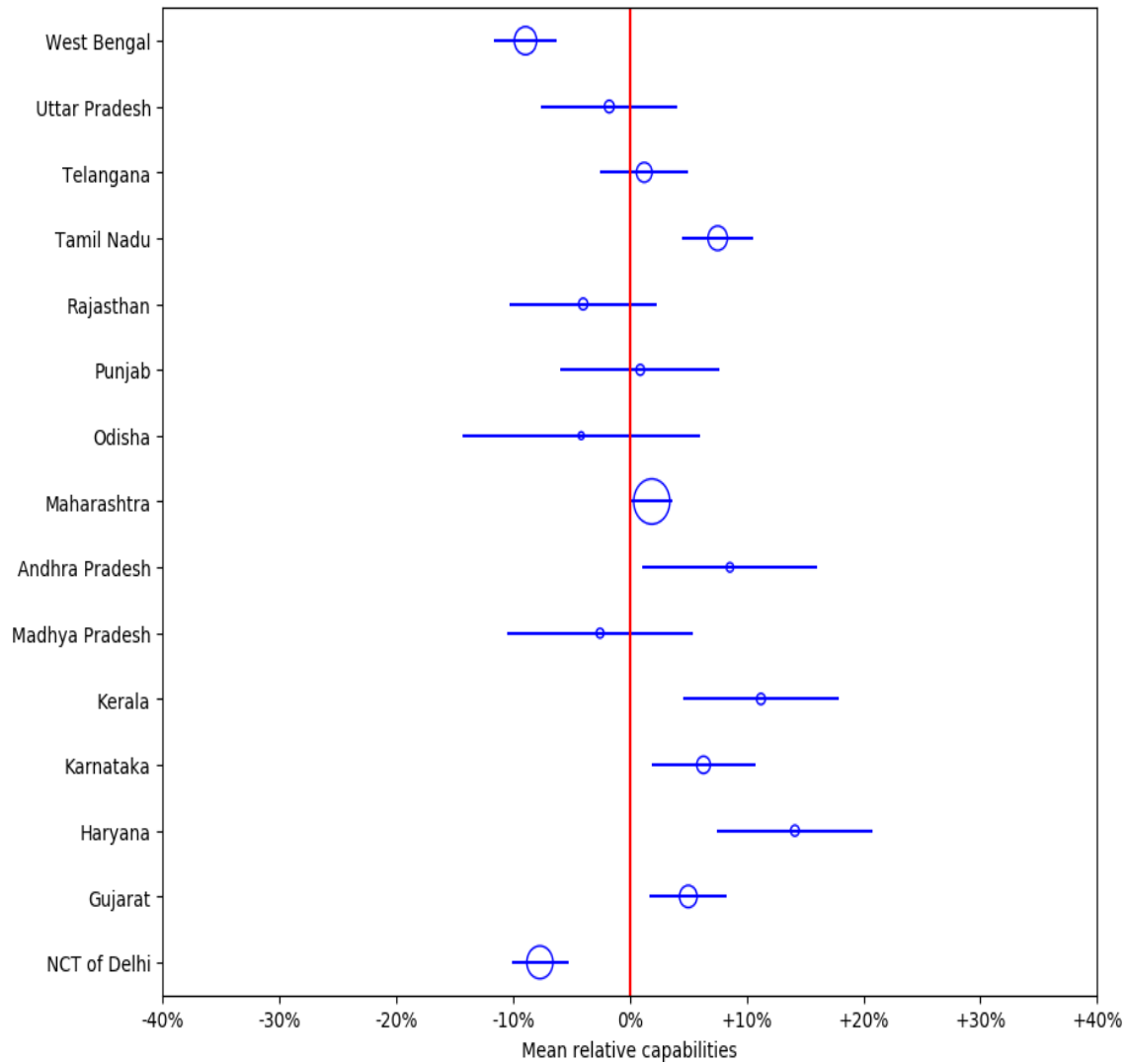


Figure F.1: Relative average position in the capabilities ladder of firms in different Indian states with respect to the average of all Indian firms, Year 2019. Error bars represents 2 standard errors – i.e. $\approx 95\%$ confidence interval. Size of

the circle is proportional to the number of firms in the sector. Colour online.

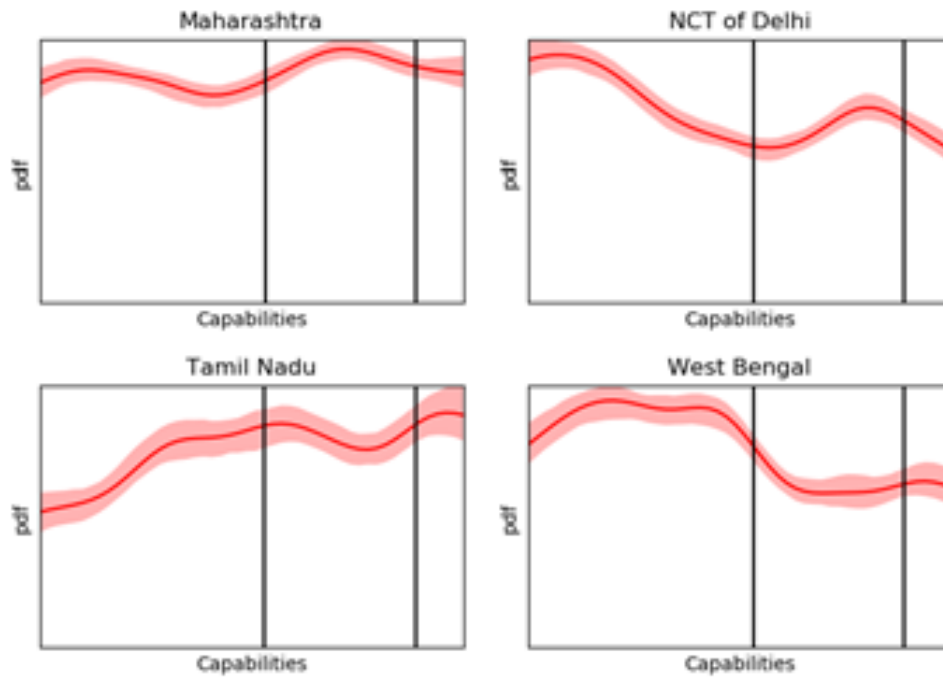


Figure F.2: Probability distribution of firms of the state by capability (inverse) ranking among Indian firms, for the four states with the most firms in our database. The two vertical black lines divide the three steps. Colour online.

Notes

¹ A violin analogy also appears in the discussion of capabilities in Costa et al. (2021, p.5).

² Our distinction between inputs, intermediates, and outputs does not closely correspond to the distinction in Helfat and Peteraf (2003) between the founding, development, and maturity of capabilities, because all of our dimensions (inputs, intermediates, outputs, and also processes) apply at all stages of Helfat and Peteraf (2003)'s lifecycle (founding, development, maturity), while the reverse does not hold.

³ Not all our measured activities are inputs, however. Patent expenditures, for example, would be inter- mediate activities rather than inputs (Griliches, 1990).

⁴ ment science teach us that to set any expense as the firm having that capability could be naïve: a certain amount of resources is needed to have an R&D department, and by considering any expense as the finger- print of firms' capabilities could add more noise than signal. Appendix D checks that our main results hold for alternative thresholds.

⁵ Previous research into capabilities has distinguish between client-specific capabilities and project man- agement capabilities (Ethiraj et al., 2005), or between technological and R&D capabilities, and customer and marketing capabilities (Danneels, 2016).

⁶ The general pattern for different delta years is similar. The same figures for different delta years are provided upon request by the authors.

⁷ This result contrasts with Bloom et al. (2019, Figure 2, Panel C, p.1659), who observe higher survival rates for firms with higher-scoring management capabilities. This is presumably because of the differences in the operationalizations of 'capabilities' across the two studies, given that the capabilities indicators in Bloom et al. (2019) correspond to relatively low-risk activities such as frequency of tracking performance indicators and procedures for setting production targets. This underscores the distinct and complementary contribution of our approach.

⁸ This drawback could be attenuated if the threshold for dichotomization (capability or not) is not fixed at zero, but at a small yet non-negligible positive value

ICT Adoption and Gender Productivity Gap in Sub-Saharan Africa

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Abstract

Despite rapid adoption of ICTs over the past two decades in sub-Saharan Africa, it remains widely recognized that women benefit less from these technologies compared to their male counterparts. However, there is still very little empirical evidence of the contribution of ICTs to the gender productivity gap. Thus, this research aims to examine the effect of ICT adoption on the gender productivity gap in sub-Saharan Africa. Specifically, we analyze whether women-led businesses are less productive than male-led businesses on the one hand, and whether ICT adoption in these SMEs hinders or narrows gender gaps in labor productivity. The paper uses World Bank Business Survey data from fifteen sub-Saharan African countries for the years 2013-2018. ICT is captured here by three key variables, including: Email; the Website; and finally, mobile money. After MCOs estimate the determinants of productivity, the results show that email and website variables have a positive effect on the productivity of SMEs, while mobile money has a negative effect. These results are confirmed when we correct endogeneity bias with IVs. The breakdown of productivity by the Blinder-Oaxaca method shows a productivity gap of 44.7% to the disadvantage of women managers. The results are confirmed with the RIF decomposition which shows us a more pronounced gap in the 75th and 95th quantiles of productivity. These differences are mainly due to staffing factors, namely mobile money, and the number of years of experience of managers. Based on these results, we recommend that women managers increase their level of ICT adoption on the one hand and fill their low number of years of experience with training and retraining programs that can improve their managerial capacity.

Key Words: : ICT; gender gap; Productivity; SME; IV; OLS ; RIF ; Oaxaca-Blinder.

1. Introduction

Small and medium-sized enterprises (SMEs) are very often defined based on two different criteria: employment, turnover or investment (Mausumi & Naveen, 2016). In this research, we define SMEs according to the employment-based approach, which states that SMEs are "any firm with between 5 and 99 employees" (Beck & al, 2005). The critical role of SMEs in achieving the SDGs¹(SDG 1²; SDG2³; SDG3⁴ and SDG5⁵) has made it a priority area and a key policy instrument for achieving structural transformation in developing countries (Gries & Naude, 2010; Dias and McDermott, 2006). Although an important and significant lever for economic development, SMEs very often face many challenges and constraints (Baig & al, 2020; Espinoza-Mendez and Correa, 2022). Among these challenges we can mention the capacity to adapt and absorb new technologies (in this case Information and Communication Technologies-ICT).

Indeed, under the conditions of the new economy, ICT development has become one of the most important sources for increasing the productivity of enterprises (productivity being understood as the relationship between inputs and outputs in the production process). ICT refers to any tools for storing, sharing, and transforming information (Taylor, 2019). There is extensive literature on the socio-economic role of this technology. Among other things, ICTs allow the various actors in economic and social life to have quick and easy access to information and knowledge (Sepehrdoust, 2018). They also allow access to new markets with lower investment costs thanks to the increased efficiency of the functioning of markets, they reduce regional disparities in income and productivity, allow access to human capital via telegrid (Pradhan & al, 2018); the use of ICTs, especially internet access, can promote sustainable development, entrepreneurship of small and micro-enterprises as it reduces the difficulty of obtaining finance by mitigating information asymmetry and reducing agency costs (Chen & al, 2018).

A study by McKinsey, conducted in 2014, indicates that companies that succeed in their digital transformation have a potential gross increase in their operating income of 40% while those that do not run the risk of seeing their operating profit fall by 20% (World Bank, 2016). Recently, the AUC/OECD report (2021), based on company data, argued that the existence of a website within a structure can increase annual sales by: 37 to 38%; 22 to 23% sales per worker; from 12% to 14% the number of full-time workers and 5.5% the share of direct exports in business sales.

From a theoretical point of view, the leapfrogging theory proposed by Brezis & al, (1993) highlighted the role of technological revolutions in stimulating a

reversal of fortunes between nations on a global scale. This theory states that, in the context of major technological change, an "advanced" country's dependence on old technologies can make a new technology unattractive in the short term, as it is less profitable, thus delaying its adoption. On the other hand, countries lagging in old technology, which are less wealthy and have lower wage levels, have a much stronger incentive to abandon the old technology and adopt the new technology in a catch-up perspective of advanced countries (Cariolle & Carroll, 2020), which is much more cost-effective from their perspective. The adoption of new technologies by lagging countries leads to increased productivity, employment and output in sectors using the new technology. Countries that were previously lagging then take the lead in technology-intensive sectors.

Thus, based on the catching-up theory described above, the future of economic progress on the African continent will undoubtedly depend on the diffusion of digital technologies (Aker & Mbiti, 2010; Schuman & Kende, 2013). While the continent has particularly distinguished itself in terms of the adoption of mobile technologies over the past decade (which has facilitated the proliferation of internet-based innovations), this dynamic has quickly been confronted with the problem of the digital divide. In 2015, Internet penetration rates in African countries did not exceed 60% of the population, with some countries such as Niger, Sierra Leone or Guinea-Bissau having penetration rates below 5% of the population (Cariolle & Carroll, 2020).

According to the IMF (2020), 20 million jobs are expected to be created per year in sub-Saharan Africa to absorb the subcontinent's demographic dividend. Yet, in the formal sector, less than 50% of SMEs in the formal sector have a website compared to 87% of large enterprises (AUC/OECD, 2021). This has a direct impact on job creation because, today, in Africa, only 17% of start-up entrepreneurs hope to create at least six jobs, the lowest percentage in the world (Up Cit.). In addition to technological capacity, the literature also identifies the role of the principal manager as a determinant of SME productivity (Forbes & Milliken, 1999; Daily & Dalton, 2003).

Starting from the "upper echelon" theory (Hambrick & Mason, 1984; Hambrick, 2007) and resource-based-view (RBV) theory, which state that it is the combination of the CEO's personal traits and a firm's productive capabilities that lead to a sustainable competitive advantage (Barney, 1991; Madhani, 2010), several authors have pointed out in their work that strategic decisions made by the company's top executive would have a direct impact on the company's performance (Lee & al, 2018; Saeed & Ziaalhaq, 2018). To this end, the literature has increasingly focused on determining whether the demographic characteristics (in this case the gender-specific character) of the CEO of the firm could explain the differences in productivity between SMEs (Flabbi & al, 2019; El-Shal & Morsy, 2020; Novita & Ariani, 2022).

In fact, the gender performance gap within firms is a key topic in female entrepreneurship that has received considerable attention over the past decade (Barasa, 2020). While the efforts of economic development programs through their implementation (notably SDG5) tend to try to address gender inequalities, the problem remains as intense as ever. Indeed, there is still an imbalance between the role of men and women as actors and beneficiaries of development results within companies (Novita & Ariani, 2022). In their leadership role, women often face constraints ranging from discrimination of any kind to access to human and technological capital (Sabarwal & al, 2009). This is very important in the African context where women are very often marginalized from CEO positions (Up Cit.).

Many studies have examined the effect of CEO gender on firm performance indicators (Kiefer & al, 2022). These studies have attempted, through various methodologies, to highlight the existence of a gap between women's and men-led businesses. While several of them report that firms with women senior managers have lower sales and profits compared to male-managed firms, (Coleman, 2007; Fernando & al, 2020; Islam and Amin, 2023). Other studies find no difference in firm performance by gender (Kepler & Shane, 2011; Watson, 2002). Still others even find that female-owned and/or female-owned firms perform better in terms of sales and profits than firms that are owned and/or managed by men (Hashimzade & Rodionova, 2013; Vershinina & al, 2020).

Although the literature on the gender productivity gap seems voluminous, it is important to note that most existing work concerns SMEs in advanced economies and Asian countries, evidence on middle-income economies in this case SSA is scarce (if one excludes of course the gender productivity gap in the agricultural sector which has received sufficient attention). Moreover, despite the proliferation of ICTs around the world, few studies have looked at their impact on the gender disparities of the company's senior manager. Thus, in view of all the above, this research attempts to answer the following question: What is the effect of ICT adoption on the productivity gap of SMEs according to the gender character of the leader in sub-Saharan Africa? To answer this question :

- We first examine the existence of the gender productivity gap;
- Then we determine the gender productivity gap;
- Finally, we analyze the contribution of ICT to this productivity gap.

To answer these questions, we opt for a quantitative methodological approach. Our data comes from the World Bank's Enterprise Surveys for the period 2016-2018. Companies run by women are defined as companies where the top manager is a woman, and, conversely, companies run by men are defined as companies where the top manager is a man. Business surveys are nationally representative and use the same questionnaire and methodology across countries. This characteristic is important given that most studies on gender

and labor productivity gaps are either country-specific (especially in agriculture) or region-specific (Islam & al, 2020). ICTs are captured here by three variables: the use of e-mail to communicate; The website and mobile money.

Our contribution to the economic literature is threefold. As a first step, we document and develop a theoretical framework highlighting the channels of transmission and potential interaction between ICTs, women leaders and SME productivity.

Our second contribution is to decompose the observed gender productivity gaps by going beyond traditional decomposition methods. Indeed, a widely used approach to decomposing the sources of gender productivity gaps was to attribute the average deviation to differences in observable characteristics (staffing effect) and differences in performance of these same observable attributes (structure effect). This approach, derived from Oaxaca (1973) and Blinder (1973), thus called the Oaxaca-Blinder decomposition, has been widely applied in previous studies. However, more recently, it has been argued in the gender gap literature that the observed gap is a very complex phenomenon that can only be aggravated by average comparison analysis and can also vary across the productivity distribution. The productivity potentials of women at the top or bottom of the distribution may be significantly different. It would therefore be misleading to assume a constant productivity gap throughout the productivity distribution. To account for the possibility that covariates have marginal effects that are not constant and vary according to the position of the firm in the productivity distribution, we rely on unconditional quantile regressions that decompose gender gaps across the distribution. The fundamental advantage of the quantile decomposition approach over the traditional mean-based approach such as the Oaxaca-Blinder method is that it allows the possibility that individual characteristics may have differential returns at different points in the distribution (Mukasa & al, 2015).

Finally, our final contribution is to estimate the potential productivity gains that would be achieved if we gradually or completely reduced the differences in ICT adoption between male and female managers. We are thus carrying out a forecasting study where the reduction of the gender productivity gap would be the result of a more than proportional increase in access to and use of ICTs in women-owned enterprises but also of the complementary framework that makes the use of ICT effective for a company.

The rest of this work is organized in three main sections: the first relating the essence of the economic literature on our question; The methodology is then presented in the second section and finally our last section concludes our research while elaborating the economic policy recommendations.

1. Lessons from the economic literature on the ICT-gender labour productivity gap

This section is divided into two subsections: the first highlights the theoretical and empirical framework related to gender differences in productivity (1.1). This first subsection is very important because the magnitude of the effects of ICT adoption on the productivity gap between male- and female-led firms will depend heavily on how the main channels of ICT transmission on labor productivity could affect the gender of the leader. And our second subsection looks at the effect of ICT on productivity (1.2). In this second part, we focus on the mechanisms by which ICT affects factor productivity.

1.1. Gender productivity gap

Despite the increase in women's economic participation in most countries, gender wage inequalities, occupational segregation and the underrepresentation of women in leadership positions in both the private and public sectors persist. Similarly, more recent research has highlighted gender differences in labour productivity (Campos & Gassier, 2017; Nagler & Naudé, 2017; Islam & al, 2020; Tsou & al, 2019; Tahir & al, 2021; Islam & Amin, 2022). The theoretical basis of this research on gender and labour productivity within firms very often comes from two main theories: social role theory and resource theory.

Social role theory suggests that women will underperform because of institutionalized and systematic discrimination against women that deprives them of access to essential resources that can be called endowment factors (Fischer & al, 1993). Thus, this theory assumes that higher economic development and gender equality will break down gender roles, thereby reducing or eliminating gender differences in preferences and performance (Falke & Hermle, 2018). In other words, if there are gender differences in performance, there must be some segregation in access to productive resources by female CEOs (Allison & al, 2023).

While the second theoretical current, resource theory, holds that men and women have inherently unique characteristics that can explain differences in productivity (Cirera & Qadim, 2014). This argument is based on the precondition that self-expression contributes to the satisfaction of basic resource needs (Haushofer & Fehr, 2014). This expression counterintuitively leads to more pronounced gender differences because women and men have sufficient resources to independently increase and express their respective preferences. So, starting from these two theoretical currents, the purpose of this subsection will be to review the constraining factors that influence the choices of women managers and therefore these strategic choices have an impact on the performance of the company in a broad way. For this purpose, we classify these factors into two main categories: staffing factors and preference factors.

1.1.1 Endowment factors and gender gap

It is well recognized in the literature that production depends on several factors that significantly impact the performance of companies, whether turnover or productivity. Therefore, differences in endowments may help explain the gender gap in business development (Campos & Gassier, 2017). Specifically, we analyze three main staffing factors here: (a) access to finance; (b) access to human capital and skills and (c) adoption of new technologies and innovation.

(a) Access to finance :

Financial capital is undoubtedly one of the most essential resources for the success of any business (Beck & al, 2005). However, many research studies indicate that women employ lower levels of debt and/or equity than men (Coleman & Robb, 2018; Bui & al, 2019; Babalola & al, 2021). Indeed, it is well established in the literature that women are more risk-averse than men (Powell & Ansic, 1997; Jianakoplos & Bernasek, 1998). Since this risk hesitancy is precisely related to financial barriers and investment portfolios, women CEOs become less likely to be granted outstanding loans, use business credit cards, or borrow using trade credit (Robb & Wolken, 2002; Zalata & al, 2019; Dadanlar & Abebe, 2020). To this extent, women-led businesses tend to be smaller, less internationalized, and grow more slowly than those run by men (Allison & al, 2023). As a result, difficulties in obtaining financing are often cited as a key reason for their low returns. Empirical evidence partially supports the fact that female CEOs tend to be less solicited for credit than their male counterparts. For example, Demiguc-Kunt and Klapper (2014), based on global financial inclusion data and show that only 6% of women in Africa compared to 7% of men had obtained a loan from a financial institution in 2013. In addition, the authors also find that in terms of savings, 33% of men and 25% of women in sub-Saharan Africa had an account in a formal institution. And that 13% of men versus only 10% of women had mobile money accounts. However, other authors, such as Aterido & al. (2011), find no evidence that women are disadvantaged in terms of access to finance provided they can control the characteristics of the firm and entrepreneur.

(b) Access to human capital and skills:

To achieve their factor productivity targets, firms need to invest appropriately in labor and human capital. Employers may view overqualified workers as an "insurance package" against productivity losses in difficult times (Allison & al, 2023). For example, women CEOs may think that hiring a more educated and skilled workforce will generate better performance results to boost productivity in times of uncertainty or downturn. However, overqualified workers are also characterized by higher turnover rates (Verhaest & Omey 2009) compared to workers whose skills and education match their jobs appropriately. Staff turnover and dissatisfaction lead to a decrease in the productivity of existing

employees, which contributes to an overall negative corporate culture. Thus, the implication is that companies should hire to match skill and education levels to the actual requirements of the task associated with a given job. But the acquisition of an over-skilled workforce leads to disgruntled and uncommitted workers and increases the costs of recruitment, integration, and training.

All these factors are in addition to the fact that female CEOs are more likely to focus on social value goals than male CEOs (Hechavarria & al, 2012; Hechavarria & al, 2017). In addition, they may consider that improving employee well-being (for example, providing employees with a living wage and a permanent contract) is just as important, if not much more important, than maximizing the company's profits. These practices will drive up labor costs for women-led businesses and will once again create a productivity gap.

(c) Adoption of new technologies and innovation

Economic literature widely argues that the adoption of new technologies and innovation as well as access to finance are substantial for a firm's growth, survival and TFP (Ahudja & Thatcher, 2005; Aiello & Ricotta, 2016; Makarius & al, 2020). Overall, the adoption and conversion of new technologies into innovative processes and applications is fundamental to underpinning a company's long-term competitive position. However, a company's decisions to adopt or not adopt a technology or undertake innovative activities depend heavily on a few factors, such as the skills of the workforce and the strategic decision-making that very often falls to the company's CEO. These decisions, in turn, depend on factors related to the business environment (which is, as discussed above, hostile depending on the gender of the CEO) that influence incentives and risk-return considerations. For example, when it comes to ICTs, internet adoption rates have spread unevenly, becoming a likely source of productivity difference between female and male CEOs (Orser & al, 2018; Voss & al, 2021; Alam & al, 2022).

Although the literature on SME adoption of new technologies and gender diversity has grown rapidly in recent years, few studies attempt to explain gender disparities in management decisions regarding innovation and technology adoption, and the evidence provided to determine whether women-led firms are more or less likely than male-led firms to undertake activities. innovative are mixed. For example, focusing on the case of Vietnamese SMEs, Hoang & al, (2021) analyze whether women-led enterprises are innovative than those run by men and whether this affects their respective productivity. The authors find that although female managers innovate less than their male counterparts, they are not less productive if and only if the role of innovation in the firm is controlled by other variables. However, they also find that overall, innovative firms are nevertheless 23% more productive than non-innovators. This gap was mainly due to the fact that innovative firms adopted new technologies more than less innovative ones. On the contrary, Wu & al, (2021),

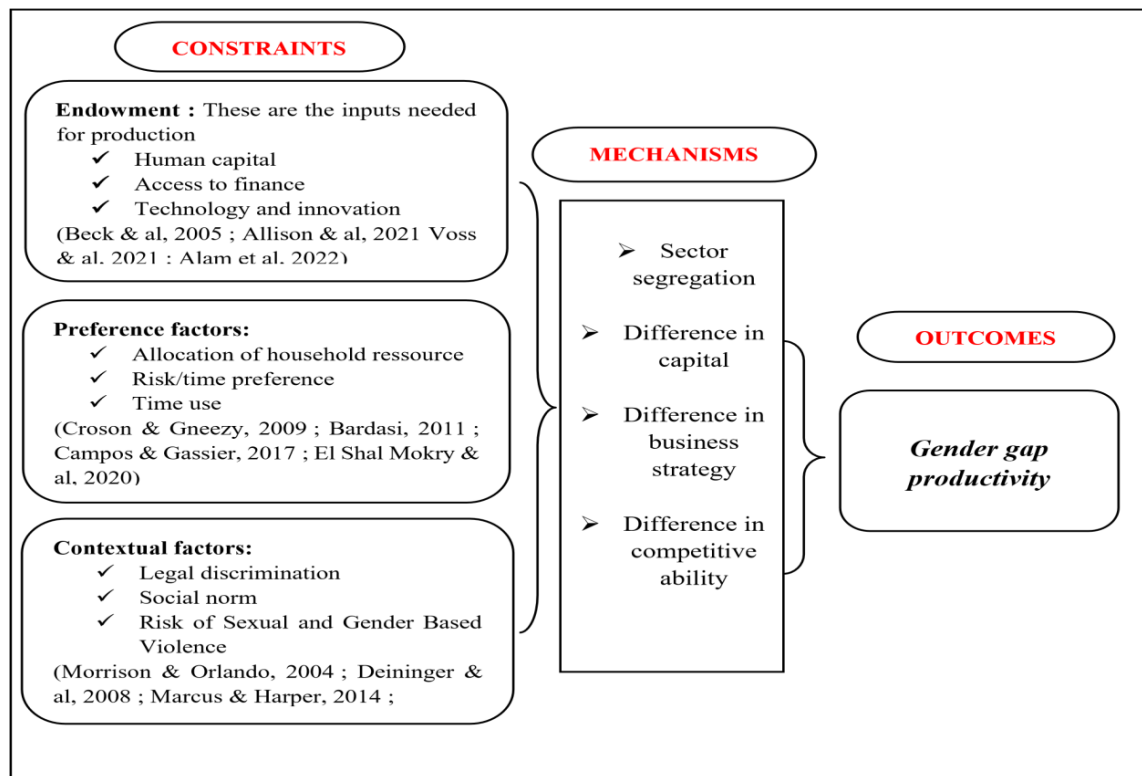
in examining the impact of women CTO (Chief Technology Officers) on innovation within Chinese companies, find that companies whose director is a woman are more innovative (in terms of patents and patent citations) than those therefore the CTO is a man. Moreover, they argue that this effect is much more pronounced for SMEs with a favorable environment for innovation (strong diffusion of new technologies in particular) and for those whose CEO was also a woman.

1.1.2 The role of preference factors

Not only can labor productivity in women-led firms be limited by staffing factors, but also CEO preferences and social responsibilities (within the household to be precise) can also lead to a gender productivity gap (Campos & Gassier, 2017; El-Shal & Morsy, 2020). Indeed, in a world without market failures, standard economic theory would predict that business leaders and entrepreneurs would separate the maximization of business profits from other decisions in their lives. Subsequently, the individual earnings of their business would provide income to their household, with household decisions and business decisions remaining separate.

But when market failures exist and managers, for example, face staffing constraints (rigidity in access to credit, limited access to highly skilled labor), their decisions are influenced by their personal preferences (Campos & Gassier, 2017; Croson & Gneezy, 2009). This occurs with market failures that are not necessarily gender-specific (for example, in the absence of properly functioning credit markets, business owners must make decisions about consumption versus household or business investment) within the limits of the limited resources available. Therefore, in contexts where there are market failures – the norm in African countries – business choices will be limited and shaped by the preferences of the entrepreneur herself and other members of her household. Here we examine the importance of three types of preferences (a) biases in household resource allocation, (b) women's prioritization of domestic spending and its relationship to time and risk preferences, and (c) gender differences in time use and market activities. In conclusion, the following diagram can allow us to describe how different factors of constraint between the sexes can lead to differences in performance.

Figure 1: ICT adoption in SMEs in sub-Saharan Africa, by gender of CEO



Source : Campos & Gassier, (2017)

1.2. Effects of ICT on labour productivity

A wide range of economic literature has assessed the ICT-productivity relationship by trying very often to answer one of two questions: 1) what is the effect of ICT on productivity? 2) How can ICTs contribute to productivity growth? The two questions being closely linked, we will go around the answers by studying the transmission channels of ICT on productivity. Thus, first we address the spillover effect of ICT on productivity (1.2.1), then we then deal with the complementary effect of ICT on human capital (1.2.2).

1.2.1 Spillover effects: ICT a General-Purpose Technology (GPT)

The spillover effect of ICT assumes that ICT is a general-purpose technology (GPT) that can lead to indirect positive or negative consequences on the economy through the diffusion of digital technologies and digital knowledge outside the enterprise (Lipsey & al, 2005; Cariolle & Carroll, 2020). Indeed, considering ICT as GPT arises from the fact that it is part of the goods or services currently produced (e.g. smartphones; computers) and technological improvement and productivity growth in ICT-producing sectors have a direct effect on overall productivity that is proportional to the size of the ICT sector (Jorgenson & al, 2002; Gordon, 2012 Van Ark & al, 2008). But, as they play a substantial role in the treatment; storage; The transmission of information and

in reducing market failures related to information asymmetries, ICTs also affect productivity in the sectors that use them but indirectly. Specifically, ICTs are catalysts for product, process, and organizational innovation in user sectors, which, according to Bresnahan & Trajtenberg (1995), refers to them as general-purpose technologies (GPTs) ubiquitous technologies, i.e., technologies applicable for multiple purposes, leading to continuous improvement and experimentation and while facilitating innovation (through co-inventions). For example, the use of commercial platforms and even social networks nowadays have direct effects on the turnover of SMEs today. In general, these indirect externalities can occur at three levels.

First, the spillover effect of ICTs can result from "network effects", induced by a greater diffusion of digital technologies among firms, contributing to multiplying and accelerating interactions between adopters of these technologies (Stiroh, 2002; Van Reenen & al, 2010). For example, Leeuwen & Van der Weil (2003) find a positive spillover effect of ICT use and significant spillover effect on labour productivity and TFP growth for Dutch firms in the service sector for the period 1994-1998. Other authors find that this effect can only be important if they sufficiently shift their digital technological frontier (Crémer & al, 2000; Goldfarb & Tucker, 2019).

Second, the positive externalities of ICT result from the knowledge economy. This is the impact of improved information flow (e.g., when upstream and downstream firms share ideas, practices, and production processes) within industries induced by the use of ICT infrastructure (Harrison & al, 1999; Paunov & Rollo, 2016). While the first type of externalities has received sufficient attention, this second group, however, has not been sufficiently documented empirically.

Finally, the spillover effect of ICT can be negative if intensive use of ICT by other firms results in increased competition, which in turn may result in a loss of revenue for firms with limited technological absorptive capacity such as SMEs in most cases (Görg & Greenaway, 2004; Marsh & al, 2017). In fact, faster adoption, and more efficient use of ICT by large companies can reduce the market share of other companies or even cause them to exit foreign or domestic markets altogether. This limited adoption is often explained by the cost of the new technology; adaptability difficulties often related to the digital literacy problem (Orser & al, 2019). The latter justified the emergence of another current in the literature on the link between ICT and productivity: the complementarity effect between ICT and human capital.

1.2.2 Complementary effect of ICTs on human capital

In general, the hypothesis of complementarity dating back to Milgrom and Roberts (1990) states that the use of the full potential of new technologies, in this case ICT, requires complementary changes (investments in human capital

or infrastructure) both at the micro level (work organization, investment in employees' skills, introduction changes in business processes) and at the macro level (increase in the capital stock). human, introduction of institutional changes favoring the flexibility of markets and thus the diffusion of new technologies). A list of these complementary effects of ICTs was presented by (Brynjolfsson & Brown, 2005). The authors identified seven pillars of the digital organization that improve a company's productivity and market value: moving from analog to digital; open access to information; employee empowerment; use of merit-based incentives; invest in the cultural company; recruit the right people; and investing in human capital.

Although it has emerged over the past two decades, several authors have nevertheless been interested in empirically verifying this hypothesis of ICT complementarity. To achieve this, they determine the combined effect of human capital (level of education; specific skills such as digital) and ICT tools (internet, smartphones, computers, software) on productivity. Bresnahan & al, (2001) examined the conditions for ICT investment to become productive within US firms (in terms of organizational adaptations). The authors find that in the short term, the introduction of ICT may involve layoffs of employees and low or even negative productivity gains, while in the medium to long term, the deep adoption of ICT requires a reorganization of the internal workplace and high skills to generate productivity gains.

Recently, Baker & al (2020) looked at the effect of the use of the internet mediator to human capital on labor productivity in 65 developing countries for the period 2000-2014. After estimating a fixed-effects panel, the results revealed a mediation effect of 24.20% of the internet on the total effect of human capital on total labor productivity, and 27% on labor productivity in services and 23% in industry. Mediation has been inconsistent in the agriculture sector. On the other hand, several studies in other contexts have shown that the expansion of ICT poses a risk to the labor market. For example, recent studies in industrialized countries (Akerman & al, 2015; Acemoglu & Restrepo, 2016) hypothesize that the introduction and penetration of digital technologies contributes to the polarization of the labor market by increasing the demand for skilled and educated workers at the expense of lower-skilled workers.

In conclusion, the literature provides conclusive evidence on gender constraints and firm performance on the one hand and the effects of ICT on productivity growth on the other. However, the issues of spillover related to the management of companies in relation to the effective use of ICT remain mostly unexplored. In addition, there is also a neglect of women's participation in work on the effect of ICT on productivity. And yet addressing this aspect could provide solutions to the reduction of gender inequalities, particularly within SMEs. Moreover, most of the work has focused on developed economies rather than low-income countries such as SSA. It is with this in mind that this research attempts to improve the existing literature. To our knowledge, this is the first

assessment of the effect of ICT adoption on gender gaps in labor productivity among SMEs. The use of productivity decomposition techniques makes it possible to disentangle the various factors that explain the gender gap in labor productivity. The analysis in this paper complements other recent analyses that have investigated the gender productivity gap using cross-national firm-level data (Islam et al, 2020; Allison & al, 2023; El-Shal & Morsy, 2020).

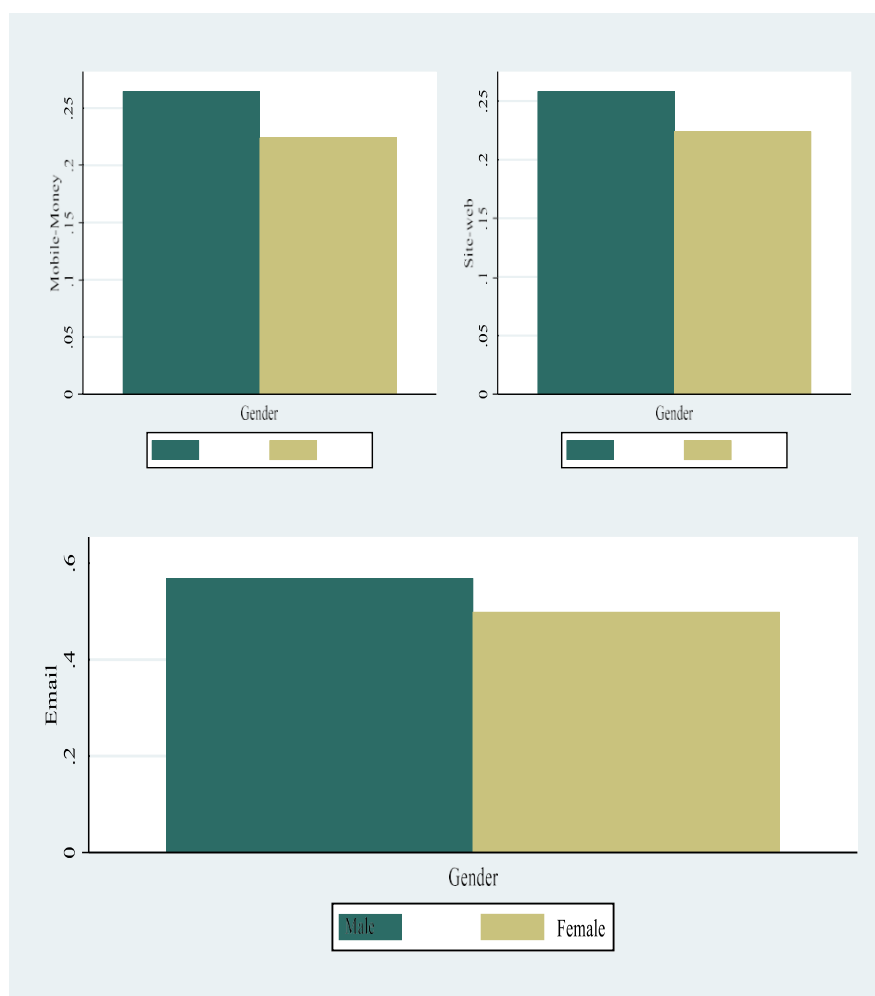
2. ICT Adoption and SME Labor Productivity in SSA: Stylized Facts

The objective of this section is to provide descriptive evidence on ICT adoption among African SMEs by focusing on gender differences. Three main ICT measures are discussed here: use of e-mail; Website and financial technology or mobile money. On the other hand, we also graphically analyze the correlation between the adoption of these technologies and labour productivity within SMEs. These stylized facts focus on 15 SSA countries over the period 2013- 2018 using standard data from Enterprise Surveys.

2.1. ICT adoption in SMEs by gender of manager

This subsection deals with the dissemination of ICTs (Email; website and mobile money). First, we compare the level of use of mobile money in the various financial transactions within the company according to the gender of the CEO. We observe that on average 27% of male-led SMEs use mobile money in their various financial transactions compared to 22% of SMEs with a female CEO. Similarly, when we look at the graph of website availability, we see that 25% of SMEs run by a man say they have a website compared to 22% of SMEs run by women. Similarly, the email usage graph shows us that on average 57% of male-led companies regularly communicate with email compared to only 50% of female CEOs. Overall, these figures reflect striking differences in ICT diffusion by CEO gender. This could certainly influence the productivity of the company and therefore widen gender inequalities.

Figure 2: ICT adoption in SMEs in sub-Saharan Africa, by gender of CEO



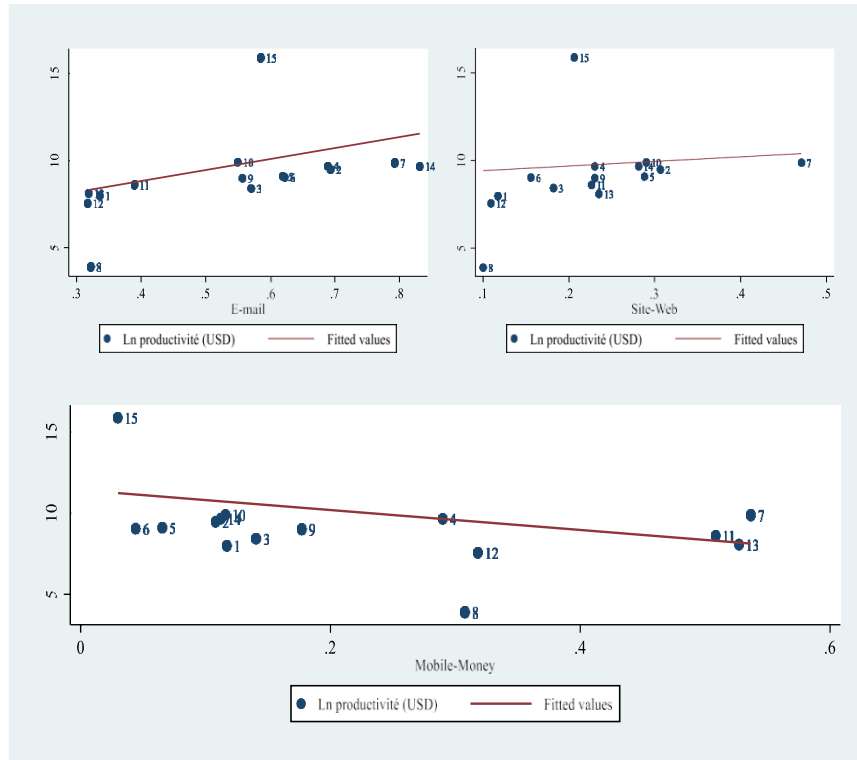
Source : Author

2.2. Effect of ICT adoption on SME labour productivity

Figure 3 illustrates the correlations between the impact of ICT adoption (email, website and mobile) on firm productivity at the year level and the country averages of our sample and the variables considered. Based on this simple graphical correlation, we make two major observations. On the one hand, there is a positive relationship between labor productivity and e-mail and the website. And on the other hand, there is a negative relationship between the use of mobile money and labor productivity. This is not surprising given the relatively low percentage of companies using this technology. This graph

therefore suggests a mixed effect of ICT adoption on labor productivity because depending on the indicator it can be positive or negative.

Figure 3: Correlation between ICT adoption and SME productivity, by country



3. Econometric evaluation of the effect of ICT adoption on gender gap productivity in SSA

Following the work of Essers & al, (2021) we assume a production function that takes the form of the standard Cobb-Douglas specification:

$$y_i = A L_i^{\beta_1} K_i^{\beta_2} \quad \text{with } \beta_1 \text{ et } \beta_2 > 0 \quad (1)$$

Where Y , L , K represent production, labour inputs and capital respectively within firm i . A is the Hicks neutral efficiency level, which captures total factor productivity or unincorporated technical change (Hsieh & Goel, 2019). Here it is approximated by the stock of R&D as in the work of Essers & al, (2021). A logarithmic transformation of the above equation allows us to introduce linear modeling as follows:

$$y_i = \beta_0 + \beta_1 l_i + \beta_2 k_i + \varepsilon_i \quad (2)$$

With β_0 captures the average efficiency between firms over time and ε_i is the error term has two components. Based on the work of Nkama, (2014) and Kim & al., (2021), we now assume that the overall capital stock K can be adjusted in such a way that it can be divided into ICT and non-ICT capital as follows:

$$y_i = \beta_0 + \beta_1 l_i + \beta_2 ICT_i + \beta_3 NICT_i + \beta_4 Z_i + \varepsilon_i \quad (3)$$

With Z the vector of our control variables. This model is estimated to meet the first objective of this research work, namely, to examine the determinants of labor productivity in SSA SMEs.

Model 3 above is estimated based on fixed-effect OLMs because the temporal dimension is not available as in the panel data. This equation is estimated in two subregions (North and Central Asia and South-South-West Asia) because of their well-balanced country representation, and for each country covered by this study. However, given that the MCO method is not the most efficient estimation method in econometrics, and that the economic literature highlights the existence of endogeneity bias (Cette & al, 2021; Vaumi & al, 2022) due to a bidirectional causality between ICT and productivity, we perform a robustness analysis of our results using the Instrumental Variables (IV) method.

On the other hand, one of the questions that arises is whether the productivity gap is pervasive in all sectors of activity, or whether it is a function of the size of the firm or the geographical area. The possibility that the productivity gap is limited to one sector or firm size group cannot be excluded, as men and women tend to be separated by sector and by firms of different types (Amin & Islam, 2014; Goldin 2014). A productivity gap that is limited to one sector or firm size group has very different policy implications than those that are pervasive across all sectors and firm sizes. Thus, we check the productivity gap for each sector, group of companies, according to the size and gender of the CEO.

3.1. Method of decomposition of labour productivity

After Aterido & al, (2013); Kilic & al, (2015) and Islam & al, (2020), an Oaxaca-Blinder decomposition approach (OB, 1973) is first applied to examine the various factors contributing to productivity gaps between female-led and male-led firms. As a result, we first run a model of the determinants of labor

productivity for each country and sex group by including the same set of control variables, including ICT.

Consider y as the natural logarithm of labor productivity, g as the sex of the firm's chief executive, and X as a vector of $K+1$ dimension comprising all observable factors as well as the use and intensity of labor, non-work-related and ICT inputs that encompass firm-level characteristics and elements of the business environment that can determine whether relationships are causal. The determinants of labor productivity can then be modelled using the following production function:

$$y = \beta_g + \sum_{j=1}^k \alpha_j X_j + \varepsilon \quad (1)$$

Where α_j and β are unknown parameters to estimate and ε is the error term. This model is first estimated for all the countries in the sample. Then, the existence of a productivity gap is assessed by testing the size of the β in our equation (1). If the estimated coefficient is negative and significant, this indicates the presence of a productivity differential to the detriment of women-led enterprises and a contrary conclusion will be drawn if it is not. We also estimated equation (1) separately according to the gender of the company director to identify any significant differences in the impact of ICT on labor productivity.

The advantage of this approach is that it isolates the impact of the gender of the firm manager on the level of labor productivity after controlling for differences in the other variables observed. However, given the inability of this model to identify the root causes that trigger productivity differences between male and female managers, the Oaxaca-Blinder (1973) decomposition procedure is necessary. This allows us to understand whether the estimated productivity differences are due to differences in levels of observable characteristics, particularly ICT endowment, between male and female managers (staffing effect), or to differences in the returns of these characteristics between the two groups (structural effect), or even to differences in the levels and returns of these observable characteristics (interaction effect). The decomposition begins with equation (1) which is estimated for the pooled sample as well as the sex of the entrepreneur as follows:

$$y_g = \beta_g + \sum_{j=1}^k \alpha_{gj} X_{gj} + \varepsilon_g \quad (2)$$

With $g=\{m,f\}$; and ε_g is now the gender-specific random error term. The rationale for the Oaxaca and Blinder decomposition approach is therefore to show how much of the difference in average productivity, $G=E(y_m) + E(y_f)$, et $E(y_m)$ et $E(y_f)$ designating the expected values of labor productivity by male and female managers, is explained by gender differences in the levels and

returns of variables in vector X .

According to Daymont and Andrisani (1984) and Jann (2008), the productivity gap between gender G can also be written as follows:

So it G l'écart of gender productivity:

$$E(y_m) - E(y_f) = [E(X_m) - E(X_f)] Q_f + E(X_m)'(Q_m - Q_f) + [E(X_m) - E(X_f)]'(Q_m - Q_f)$$

Endowment effect Structural effect Interaction effect

From the previous equation it follows that the gender productivity gap can be explained by three distinct factors:

- (i) *Endowment effect*: this is the difference between male and female managers due to the attributes or influence of certain factors as explained on the productivity of the firm's work. A positive effect of any of these factors implies that male managers have a staffing advantage over female managers with respect to the variable in question, while a negative effect suggests the opposite. The same reasoning applies to all other components ;
- (ii) *Structural effect*: structural effects refer to the role of output factors or attributes of firms that lead to the widening or narrowing of the labor productivity gap between women's and men's enterprises;
- (iii) *Interaction effect*: captures the share of the productivity gap from simultaneous differences in predictors and their coefficient.

3.2. Data and choice of variables

The data source for our analysis is based on World Bank Business Surveys (GEs). The dataset covers a representative sample of approximately 3238 enterprises for 15 SSA countries studied between 2013 and 2018 (list of countries in the sample is presented in Table 1). The ES database are nationally representative surveys of formal enterprises (micro, small, medium, and large). These surveys cover manufacturing and service enterprises, excluding mining and quarrying and agriculture. The survey is implemented using stratified random sampling with location (in the country), sector and size as strata. Survey respondents are mostly business owners or senior executives. The use of a standardized survey instrument and methodology allows for the comparison of savings. The surveys cover several topics, including corruption, access to finance, infrastructure, competition, crime, labour, barriers to the business environment and business performance. We focus on the main manager, rather than the owner(s) of the company, because this is a well-defined concept, even for companies with multiple owners or shareholders, and because, as we mentioned above, strategic decision-making in the company strongly influences the performance of companies. A detailed analysis of the variables (dependent

and independent) of the model is presented in the following paragraphs.

(i) ***k Dependent variable:*** Following previous work, as a measure of labour productivity we opt for the log of total firm sales divided by the total number of workers (Nkama, 2014; Wu & Cheng, 2016; Black, 2019; Islam & al, 2020, 2023). It is particularly suitable for a comparative analysis of productivity within firms because it allows for the heterogeneity of firms (Essers & al, 2021). All local currency values are converted to USD. Since many companies do not give an answer to the question about shares held by women, we use as a measure of gender a dummy that takes one if the CEO is a woman and 0 if not. This measure is widely used in the literature on the gender productivity gap (Islam & Amin, 2015; El-Shal & Morsy, 2020; Gang & al, 2021).

(ii) ***Independent variables:*** Following the literature review developed in Section 1, our initial model of the determinants of labour productivity takes into account a number of factors that describe behaviour at the firm level and that may affect productivity. These factors are divided into three categories: staffing factors; contextual factors and control variables. We do not take preference factors into account in the present given the difficulty of measuring this.

➤ **Endowment Factors:**

Technology adoption and innovation: As we mentioned in our literature review, the adoption of new technologies is a very important factor for firm productivity, especially in view of its impact on the firm's innovation capacity (Wu & al, 2021; Tahir & al, 2021; Hoang & al, 2021). In the context of gender inequality analysis, this indicator becomes crucial since women are very often identified as being on the margins of technological progress (Orser & al, 2018; Alam &, 2022). As the objective of this work is to analyze the effect of ICT adoption on the gender productivity gap, we particularly opt for key measures of technology, namely: e-mail; The website and mobile money. However, since the literature defends that for an effectiveness of ICT on labor productivity it is necessary to consider certain factors that will be complementary to the use of ICTs such as innovation (Gaglio & al, 2022; Barasa & al, 2019).

Human capital: in the literature, the availability of a highly qualified workforce improves the company's performance. In addition, the authors mention that, to have a significant impact of ICT on the productivity of the firm it is necessary that the workforce can use the new technology effectively (Orser & al, 2018; Voss & al, 2021; Alam & al, 2022). Therefore, we measure human capital here by two variables: the percentage of employees with a secondary education and the number of full-time employees within the company. Although there is a consensus in the literature on the positive effect of human capital on productivity, Barro (2001) shows in a study of 100 countries that the quality of education of men is significantly related to economic growth but not for women. A plausible explanation is that the labor market was still largely

discriminatory at that time, and therefore the proportion of male workers was much higher than that of women.

Physical capital: The literature supports a positive effect of physical infrastructure on labor productivity, for example (Islam & al, 2020). However, we must specify that everything depends on the indicator considered. For example, Falentina & Rososudarmo (2019) show through a study of Indonesian companies that power outages reduce the average labor productivity of these companies and that the resulting losses amounted to about USD 4.91 million. Therefore, the authors advocate improving the reliability of electricity supply in developing countries. To do this, in this work we use the number of power outages as a measure of physical capital, which is a significant barrier in SSA countries that are still largely under-electrified (Chimbo, 2019; Houghbonon & al, 2021). This constraint imposes direct (operating and production) and indirect costs on the performance of firms that limit the firm's prospects of reaching full productivity potential.

Access to finance: An infinite number of authors indicate that financial constraints are associated with changes in productivity levels between firms and industries (Bopkin & al, 2017; Fowowe, 2017). For this purpose, several indicators are used in literature. But in this work, we focus on access to finance, which is very often discriminatory for women entrepreneurs and CEOs (Allison & al, 2023; Flabbi & al, 2019). This is a dummy that takes 1 when access to financing is an obstacle for the company and 0 if not. We expect this variable to be negatively correlated with labor productivity.

➤ **Contextual factors:**

Institutional constraints: there is ample empirical evidence on the importance of quality governance for firm performance (Bardasi & al, 2011; Mattina & al, 2018). To this end, we include two measures of the perception of the regulations in force to capture institutional constraints. The first is the tax which is a dummy that takes 1 if the tax rate in force constitutes an obstacle to the activities of the company and 0 otherwise. The second variable is corruption, which takes 1 if corruption is an obstacle to the company's activities and 0 if not.

➤ **Control variables**

As part of our analysis, we consider two control variables. The first is the number of years of experience of the CEO. The second concerns the variable woman owner, which is a variable that takes 1 if within the company of women hold shares and 0 otherwise.

3.3. Descriptive analysis

Table1 : Descriptive statistics

Variable	All		Female Managers		Male Managers		Difference
	Obs	Mean	Obs	Mean	Obs	Mean	
Productivity	32389,831	455	9,994	2783	9,804	-0,191	
Email	32380,559	455	0,499	2783	0,569	0,07***	
Website	32380,254	455	0,224	2783	0,258	0,034	
Mobile money	32380,259	455	0,224	2783	0,265	0,041*	
Women owners	32380,304	455	0,842	2783	0,216	-0,626***	
CEO Experience	3238 16,347	455	14,725	2783	16,612	1,887***	
Education	3238 49,092	455	48,354	2783	49,212	0,859	
Taxes	32380,827	455	0,8	2783	0,831	0,032	
Corruption	32380,745	455	0,721	2783	0,749	0,028	
Access to finance	32380,832	455	0,829	2783	0,833	0,005	
Innovation	32380,406	455	0,398	2783	0,408	0,01	
Size	32382,559	455	2,36	2783	2,592	0,233***	
Electricity	26919,299	382	10,191	2309	9,152	-1,04	
R&D	32380,184	455	0,187	2783	0,184	-0,003	

Source : Auteur

The table above shows the percentage of companies run by women in the countries in our sample is much lower than that of men, 455 versus 2783. However, when we look at the different variables.

Table 1 shows that the percentage of enterprises run by women in the countries in our sample is much lower than that of men, 175 versus 1135. However, when we look at the different variables we find a difference, but not always quite profound, between male- and female-led businesses.

Table 2 shows the correlation matrix. We observe no correlation coefficient greater than 0.50 between two independent variables

Table 2 : Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) Productivity	1,000													
(2) Email	0,212	1,000												
(3) Website	0,116	0,421	1,000											
(4) Mobile money	-0,178	0,004	0,055	1,000										
(5) Women owners	0,102	0,111	0,093	0,013	1,000									
(6) CEO experience	-0,009	0,118	0,027	-0,026	0,035	1,000								
(7) Education	0,276	0,266	0,219	0,029	0,099	-0,057	1,000							
(8) Taxes	-0,070	0,022	0,017	0,026	-0,035	0,009	0,002	1,000						
(9) Corruption	-0,151	0,032	-0,019	0,078	-0,026	0,068	-0,054	0,262	1,000					
(10) Access to finance	-0,044	-0,057	-0,059	0,009	-0,039	-0,020	-0,022	0,209	0,154	1,000				
(11) Innovation	0,066	0,121	0,180	0,123	0,088	-0,028	0,164	0,015	-0,002	0,024	1,000			
(12) Size	0,120	0,384	0,361	-0,072	0,017	0,116	0,131	0,047	0,039	-0,072	0,117	1,000		
(13) Electricity	-0,067	-0,024	0,015	0,026	0,022	0,049	-0,068	0,009	-0,001	-0,004	-0,025	-0,044	1,000	
(14) R&D	0,105	0,170	0,193	0,052	0,074	-0,007	0,138	0,019	-0,014	0,018	0,244	0,174	0,023	1,000

Source: Author

4. Empirical results and discussions

This section is divided into two parts: the first concerns the results of regressions of the determinants of labour productivity within SMEs, and the second refers to the decomposition of labour productivity to deduce the productivity gap and the role of ICT.

4.1. Determinants of SME labor productivity

Regression results for the effect of ICT adoption on labor productivity are presented in column 2 of Table 3. The results of the determinants of labor productivity for the entire sample are presented in column 5. But first, the sample was divided according to the size of the enterprise (Small or Medium).

Regarding the effect of ICT on labor productivity: the email and website variables are positively associated with labor productivity in all our regressions and are significant at 1%. Specifically, SMEs that use email to communicate have 89.1% higher productivity than SMEs that do not use email. Similarly, SMEs that have a website have a productivity 7.6% higher than that of companies that do not. These results corroborate those obtained by Islam & al, 2020; Islam & al, 2023 Allison & al, 2023. The use of mobile money has a negative effect in all our regressions. However, this variable is only significant when we do not control for the other explanatory variables (see column 2). This negative effect can be explained by the weak financial culture of companies. And the majority of the companies in the sample being surveyed in 2013, it is important to specify that at that time Mobile Banking did not have the same magnitude as we observe today. The manager's gender has a negative but not significant effect in all our regressions. In addition, women-led enterprises achieve lower productivity than those run by men. This indicates the potential existence of a gender productivity gap in SSA. However, the manager's

experience is positively correlated with labor productivity and is statistically significant in all our regressions. This testifies to the importance of the specific characteristics of the eater in relation to the performance of the manager (Novita & Ariani, 2022). Education is also positively associated with labor productivity and is significant at 1%. Access to finance is negatively associated with labor productivity and is significant at 10%. This implies that the tax base constitutes an obstacle to the activities of SMEs in SSA. Power cuts are also negatively correlated with labor productivity. However, this variable is not significant in all our regressions.

Table 3 : Determinants of labour productivity

	Model 1	Model 2	Model 3	Model 4
VARIABLES	Productivity	Productivity	Productivity	Productivity
Email	1,235*** (0,120)	0,857*** (0,0950)	0,857*** (0,0950)	0,891*** (0,0758)
Website	0,295** (0,127)	0,352*** (0,130)	0,352*** (0,130)	0,368*** (0,0845)
Mobile money	-1,126*** (0,0941)	-0,0282 (0,106)	-0,0282 (0,106)	-0,123 (0,0753)
Gender of CEO	0,255 (0,157)	-0,131 (0,133)	-0,131 (0,133)	-0,0510 (0,106)
Women owners		0,250** (0,106)	0,250** (0,106)	0,139* (0,0787)
CEO Experience		0,0173*** (0,00418)	0,0173*** (0,00418)	0,0128*** (0,00311)
Education		0,00817*** (0,00108)	0,00817*** (0,00108)	0,00678*** (0,000835)
Taxes		-0,118 (0,116)	-0,118 (0,116)	-0,114 (0,0882)
Corruption		0,0548 (0,0946)	0,0548 (0,0946)	-0,0125 (0,0740)
Access to finance		-0,218* (0,129)	-0,218* (0,129)	-0,218** (0,0923)
Innovation		-0,0176 (0,0847)	-0,0176 (0,0847)	-0,0814 (0,0646)
Size		-0,111 (0,0891)	-0,111 (0,0891)	0,0525 (0,0445)
Electricity		-0,00117 (0,00220)	-0,00117 (0,00220)	-0,000584 (0,00122)
R&D		0,209* (0,115)	0,209* (0,115)	0,231*** (0,0825)
Constant	9,762*** (0,0989)	8,036*** (0,249)	8,036*** (0,249)	8,040*** (0,167)
Individual	Yes	Yes	Yes	Yes

effects

Observations	3,238	1,691	1,691	2,691
R-squared	0,235	0,728	0,728	0,732

Source: Author; Note: Robust standard errors in parentheses ***p < 0,01, **p < 0,05, *p < 0,1.

Heterogeneity

One of the concerns with SME data is whether the productivity gap is pervasive when controlling for the gender of the manager or the type of industry. The possibility that the gender of the CEO may have a different effect on the productivity of the company cannot be excluded because, as mentioned in the literature, the constraints related to the activities of SMEs most often affect women-owned or women-owned businesses to a greater extent. Moreover, the

probability that the productivity gap will be limited to one sector of activity cannot be excluded because men and women tend to be separated by sector of activity (Goldin, 2014; Amin & Islam, 2014). A productivity gap that is limited to sector of activity with different repercussions at the level of economic policy recommendations. Thus, Annexes 3 and 4 respectively present the determinants of productivity according to the sex of the manager and according to the type of sector of activity. The following important points emerge from the analysis of these results.

First, for the determinants of productivity by gender of the manager (see Appendix 3), column 2 gives the regression results of the determinants of productivity for all firms with a female CEO. And column 3 gives us the results for companies where the CEO is a man. Overall, email and website variables are positively correlated with labor productivity. However, the website is significant at 5% for female CEOs and 1% for men. Emails are 1% significant for both sets. When we look closely at the coefficients, we see that the impacts of the use of ICT adoption are relatively less important in women-led firms compared to those of their male counterparts. This may indicate a digital divide from a gender perspective due to low digital literacy on the part of women (Orser & al, 2018). The mobile money variable is not significant but has a mixed effect (because positive for women and negative for men). The manager's experience is positively correlated with productivity and is significant for both of our regressions.

Deuxièmement, quand nous contrôlons le type de secteur d'activité (manufacturier et service), nos résultats tendent toujours à corroborer notre premier tableau de résultats en termes de l'effet de l'adoption des TIC sur la productivité du travail. Autrement dit les variables email et site web ont un effet positif sur la productivité du travail et sont significatives respectivement à 1% et à 5%, tandis que la variable mobile money demeure avec un effet négatif.

Les variables éducation et expérience du manager ont aussi un effet positif sur la productivité du travail dans les différents secteurs d'activité et sont significatives à 1%.

4.2. Oaxaca-Blinder decomposition of labor productivity results

So far we have analyzed correlational regressions to identify the determinants of SME labor productivity. In this subsection, we first determine the gender productivity gap. And second, we try to distinguish which of these determinants contribute to the gender gap and more specifically what role ICT adoption plays in this phenomenon.

Table 4: Decomposition of the gender productivity gap

VARIABLES	overall	endowments	Structural	interaction
Group_1	9,941*** (0,0628)			
Group_2	10,39*** (0,178)			
Difference	-0,447** (0,188)			
Endowment	0,218 (0,292)			
Coefficients	-0,135 (0,198)			
Interaction	-0,530* (0,298)			
Email		0,0230 (0,0222)	0,281 (0,224)	0,0241 (0,0235)
Website		0,0359 (0,0274)	-0,265** (0,114)	-0,0437 (0,0317)
Mobile money		-0,112** (0,0510)	0,156* (0,0920)	0,0418 (0,0296)
Women owners		0,382 (0,278)	0,922** (0,402)	-0,667** (0,291)
CEO Experience		-0,0109 (0,0290)	0,108 (0,291)	0,0112 (0,0304)
Education		-0,00531 (0,0237)	0,287 (0,242)	-0,00274 (0,0124)
Taxes		-0,0137 (0,0183)	0,0262 (0,382)	0,00120 (0,0175)
Corruption		-0,0264 (0,0228)	-0,00808 (0,292)	-0,000391 (0,0141)
Access to finance		0,0116 (0,0159)	-0,663* (0,370)	-0,0146 (0,0194)
Innovation		-0,00632	0,0834	0,00597

	(0,0120)	(0,153)	(0,0123)
Size	-0,0994*	1,171**	0,125**
	(0,0573)	(0,536)	(0,0617)
Electricity	0,00387	-0,0377	0,00385
	(0,00828)	(0,0710)	(0,00893)
RD	-0,000131	0,0812	0,00164
	(0,00187)	(0,0900)	(0,00950)
Constant		-2,404***	
		(0,926)	
Individual effects YES	YES	YES	YES
Comments	2,691	2,691	2,691

Source: Author; Note: Robust standard errors in parentheses ***p < 0,01, **p < 0,05, *p < 0,1.

Thus Table 4 presents the analyses of the productivity decomposition with the Oaxaca-Blinder method. The first observation is the following, the labor productivity of women-led companies is on average 44.7% lower than that of male CEOs as indicated in column 2 of the table above. Using the Blinder-Oaxaca decomposition method, this productivity gap is broken down into three factors experienced by the company: staffing factors; structural factors and interacting factors.

4.2.1. Endowment effects

Staffing effects refer to the impact of the difference in staffing level of the explanatory variables in our model. Regarding the role of ICTs in the gender productivity gap, column 3 shows us that only the level of mobile adoption widens the gender gap by 11.2%, which is in line with the results obtained by Islam et al, 2020. This can be explained by the fact that few female executives adopt this technology more than men. This indicates the existence of a digital gender divide specific to mobile money adoption.

4.2.2. Structural effect

This is the share of the gender gap attributable to the performance of staffing factors. We find that the website's performance widens the gender gap by 26.5%, which is at odds with previous findings in the literature. However, this low productivity performance in website use can be explained by the low level of digital literacy that women managers generally suffer. On the other hand, the return of mobile money brings the gender productivity gap down by 15.6%.

4.2.3. Interaction effect

The interaction effect captures the share of the gender productivity gap resulting from simultaneous differences in staffing level and performance of observable variables. None of the ICT adoption indicators considered in this work appear to have an interaction effect on the gender productivity gap.

5. Robustness

The results presented above could be influenced by different biases from which our data may suffer, endogeneity bias (Bertschek & Niebel, 2016). Moreover, despite the extensive use of the mean decomposition based on the standard Oaxaca-Blinder regression, it is important to note that, although very informative, this approach leaves out the possibility of heterogeneous behavior of company leaders at different points of distribution of productivity. And this can potentially mask large differences in staffing and structural factors in the productivity distribution (Backiny-Yetna & McGee, 2015). For this purpose, as a robustness we use the instrumental variables first to solve the potential endogeneity bias, then we resume the decomposition of productivity using the method of the refocused influence function (RIF) of Firpo & al (2011) and recently applied by Kilic & al (2015), El-shal & Morsy, (2020); Ackah & al, (2021).

5.1. Instrumental variables

The results obtained from the MCO estimation technique presented in Table 3 above so far assume that firms with female CEOs have lower productivity levels than their male counterparts (see Model 2; 3 and 4). However, it should be noted that the CEO gender variable is not significant in any of our estimated models, which could call into question the results obtained. In addition, estimates based on OLS could potentially conceal endogeneity bias (due to possible reverse causality between labor productivity and ICT adoption) on the one hand and/or omissions of relevant variables observed at the firm level (Bertschek & Niebel, 2016; Vaumi & al, 2022).

Indeed, we argue that different types of ICT use can be distinguished by their potential endogeneity. On the one hand, productivity and the use of ICT tools can be determined simultaneously since firms choose their inputs based on the output they plan to achieve and vice versa (Bertschek & al, 2016; Cette & al, 2020). On the other hand, ICT is also likely to be correlated with the error term, as omitted variables can influence both labor productivity and ICT. Therefore, he concludes that the possibility of reverse causality as a source of endogeneity bias is not negligible.

To correct for this potential inverse causality between labor productivity and ICT adoption, we apply an instrumental variable approach (more precisely Double Least Squares). However, adequately controlling for endogeneity is not an easy task in survey data that does not come from a natural experiment. However, we use two sets of instruments. First, following the work of Commander & Svejnar (2011), and those of Vaumi & al, (2022) we use skills as the first instrument. Our second instrument is the labor regulatory framework.

Our estimates involving DMCs include validity tests so the most important are the Kleibergen- Paap test (K-P); the Stock and Yogo test (S-Y) and finally the

Hansen test. The K-P test is a robust heteroscedasticity test for under-identification. The Stock and Yogo test is a test of under-identification of instruments. And finally, the Hansen test is a test of the validity of the instruments.

The main results obtained by the estimate by the RCDs are shown in the table below.

Table 4: Determinants of productivity, IV results

	Model 1	Model 2	Model 3	Model 4
VARIABLES	Productivity	Productivity	Productivity	Productivity
Email	0,938***	0,922***	1,337***	0,961***
	-0,142	-0,108	-0,239	-0,153
Website	1,120***	0,400***	0,072	0,07**
	-0,342	-0,151	-0,188	-0,166
Mobile money	-0,194***	-0,244**	-0,980***	-1,186***
	-0,071	-0,117	-0,182	-0,126
Gender of CEO	-0,0243	-0,0817	-0,055*	-0,225***
	-0,0873	-0,149	-0,338	-0,219
Women owners		0,211*	0,348*	0,411**
		-0,121	-0,2	-0,161
CEO Experience		0,0184***	-0,00227	-0,00043
		-0,00498	-0,00824	-0,00654
Education		0,00615***	0,0176***	0,0171***
		-0,00128	-0,00271	-0,00167
Taxes		-0,509***	0,485	-1,129***
		-0,193	-0,378	-0,279
Corruption		-0,12	-0,612**	-1,261***
		-0,122	-0,304	-0,186
Access to finance		2,672***	-2,360*	4,348***
		-0,869	-1,225	-1,008
Innovation		-0,260**	0,0331	-0,0116
		-0,106	-0,179	-0,136
Size		-0,0913	-0,0505	0,215**
		-0,0999	-0,119	-0,0866
Electricity		-0,00153	-0,00794**	-0,00645***
		-0,00254	-0,00392	-0,00244
R&D		0,188	0,363*	0,253
		-0,142	-0,213	-0,18
Constant	8,194***	5,963***	10,95***	6,432***
	-0,0546	-0,679	-0,878	-0,763
Country fixed effects	Yes	Yes	Yes	Yes
Observations	3238	1691	1000	2691

R-squared	0,747	0,637	0,185	-0,11
H-3	146,505	32,648	29,604	71,029
C-D	198,081	14,147	21,488	37,966
S-Y	16,38	9,08	19,93	19,93
Hansen P-value	11,086	0,3604	0,181	0,1956

Source: Author; Note: Robust standard errors in parentheses ***p < 0,01, **p < 0,05, *p < 0,1.

Model 2 and Model 3 represent the estimate of labor productivity only for small and medium- sized firms, respectively. Model 4 includes all SMEs. We focus our attention on the latter. However, overall, the results obtained corroborate those of the MCO. Specifically, regarding the effect of ICT adoption on labor productivity, it is always positive for the email and website

variables, but negative for the mobile money variable. However, we note that the gender variable of the CEO, in addition to telling us that female CEOs have a productivity 22.5% lower than that of male CEOs, is in this case significant at 1% (which was not the case in the results obtained by the MCO. However, this rate is significantly higher than that of Table 3 which was 5.1%. In all our models, the instruments are exogenous because the value of the Kleibergen-Paap statistic is higher than that of the Stock-Yogo statistic when calculated at the 10% level. In addition, the instrument validity test proposed by Sargan (1958) and Hansen (1982) confirms that the instruments chosen are valid.

5.2. Refocused influence function (RIF) decomposition

The gender productivity gaps presented in Section 4 were calculated by comparing an average male CEO to an average female CEO. The analysis thus implicitly assumed that the estimated gender gaps were evenly distributed across the distribution of productivity. But this is not necessarily the case, and it can hide large variations in the gender gap depending on where we are on the distribution of productivity (Mukasa & al, 2015). For example, the gap between the least productive and least productive women managers and between the most productive women and men may differ considerably from that obtained using average decomposition approaches. Thus, to go beyond the standard Oaxaca-Blinder decomposition approach, we analyze the gender gaps in the entire productivity distribution of our sample using a quantile regression (QR) or refocused influence function regression (RIF) framework as proposed by Firpo & al, (2009).

It is primarily decompositions on al quantile regression procedure providing estimates of the Blinder-Oaxaca decomposition at each specified point in the productivity distribution. Indeed, an RIF regression is like a standard OLD regression, except that in this case, the dependent variable Y is replaced by the distributive statistic of interest of its refocused influence function. The approach assumes that the conditional expectation of the RIF ($y ; v$) can be modeled as a

linear function of observable attributes « X », such as $E[RIF(y; v)/X] = X\gamma$ is the mean decomposition. Assuming that $IF(y; v)$ is the influence function corresponding to an observed productivity result Y , for distributive statistics $v(FY)$, the RIF is defined as follows

$$RIF(y; v) = v(FY) + IF(y; v)$$

In the case of quantiles, the influence function is written as follows:

$$IF(y; QT) = (T - 1\{Y \leq QT\}) / f_Y(QT)$$

Where $1\{Y \leq QT\}$ is an indicator function equal to 1 if the value of the outcome variable is less than or equal to the quantile QT and 0 otherwise, $f_Y(QT)$ is the density of the marginal distribution of Y and QT is the population quantile T of the unconditional distribution of Y .

We report estimates of the RIF decomposition of labour productivity by sex in Table 5 below. Overall, our results provide evidence of a gender gap in different productivity distributions, although for the gap is small for the 50th quantile (0.022%) and for the 25th quantile (4.86%). However, the gap becomes large when we compare high-productivity firms (100% for the 75th quantile and 67.4% for the 95th quantile). The increase in these differences in the 75th and 95th quantiles is mainly due to differences in unobservable characteristics (structural factors) of 122.5%. These are essentially: email; corruption; access to finance (see Table 5). Observable characteristics (staffing factors) explain only 37% of the gender productivity gap. The variables concerned are mobile money; CEO experience and company size (see Table 5). Among all these variables, it should be noted that the most relevant variables to consider here are: mobile money and CEO experience (because of their degree of significance in the different estimates and their recurrence). In addition, not only are women managers less likely to adopt new technologies (in this case ICT), but they also have less management experience than their male counterparts, which seriously hampers the productivity of their companies

Table 5: RIF decomposition

A. Gender Differential									
	Q 0.25	Q 0.50					Q 0.75	Q 0.95	
Average productivity of men	8.001*** (0.0602)	9.609*** (0.0594)					11.06*** (0.0857)	16.20*** (0.108)	
Average productivity of women	7.952*** (0.142)	9.608*** (0.209)					12.07*** (0.255)	16.87*** (0.216)	
Gender productivity gap (M-F)	0.0489 (0.155)	0.000222 (0.217)					-1.009* (0.562)	-0.674** (0.224)	
B. Aggregated decomposition									
Staffing Factors	-0.112 (0.100)	-0.0865 (0.104)					-0.270*** (0.152)	0.551 (0.598)	
Factors of discrimination	0.160 (0.165)	0.0867 (0.227)					-0.626 (0.567)	-1.225* (0.698)	
C. Detailed breakdown									
	Staffing Factors				Factors of discrimination				
	Q 0.25	Q 0.50	Q 0.75	Q 0.95	Q 0.25	Q 0.50	Q 0.75	Q 0.95	
Email	0.0645* (0.0272)	0.0500* (0.0291)	0.0206 (0.0196)	0.0210 (0.0224)	0.0576 (0.194)	0.0472 (0.272)	1.167* (0.656)	-0.0227 (0.622)	
Website	0.00849 (0.00719)	0.00326 (0.00618)	-0.00112 (0.00908)	-0.00522 (0.0220)	-0.0507 (0.0862)	-0.126 (0.126)	-0.462 (0.245)	-0.0681 (0.267)	
Mobile money	-0.0217* (0.0116)	-0.0609*** (0.0179)	-0.0852*** (0.0339)	-0.123*** (0.0571)	0.116 (0.0802)	0.182 (0.111)	0.660*** (0.249)	0.272* (0.160)	
Women owners	-0.150* (0.0769)	-0.180* (0.0823)	-0.218*** (0.129)	0.376 (0.605)	0.268 (0.259)	0.106 (0.496)	2.088* (1.266)	0.477* (0.260)	
CEO Experience	0.0275*** (0.0124)	0.0168 (0.00992)	-0.0188 (0.0164)	0.0156 (0.0668)	-0.107 (0.250)	-0.0857 (0.266)	1.788*** (0.908)	-0.222 (0.509)	
Education	-0.00698 (0.0211)	-0.00692 (0.0208)	-0.00867 (0.0286)	-0.0121 (0.0529)	0.227 (0.200)	0.190 (0.287)	-0.816 (0.724)	-0.620 (0.665)	
Tenure	-0.00622 (0.00682)	-0.00987 (0.00825)	-0.0178 (0.0129)	-0.0266 (0.0277)	0.0566 (0.225)	-0.226 (0.467)	-0.129 (1.267)	0.416 (0.849)	
Corruption	-0.00762 (0.00698)	-0.0121 (0.00975)	-0.0286 (0.0214)	-0.0325 (0.0242)	-0.165 (0.264)	0.219 (0.252)	2.605*** (0.959)	-0.221 (0.622)	
Access to funding	-0.00199 (0.00258)	-0.00145 (0.00222)	-0.00390 (0.00636)	0.0204 (0.0276)	-0.290 (0.222)	-0.218 (0.439)	-2.086* (1.108)	-0.754 (0.692)	
Innovation	-0.00267 (0.00421)	0.000278 (0.00238)	0.00485 (0.00884)	0.0262 (0.0317)	0.0298 (0.194)	0.109 (0.182)	0.0121 (0.438)	-0.210 (0.212)	
Size	-0.0281 (0.0186)	0.0716*** (0.0222)	0.0609*** (0.0292)	-0.218* (0.112)	0.0657 (0.477)	0.726 (0.629)	2.005 (1.597)	2.999*** (1.156)	
Electricity	0.00640 (0.00922)	0.00267 (0.00541)	0.0116 (0.0162)	0.0102 (0.0150)	-0.118*** (0.0517)	0.00842 (0.0798)	0.272* (0.142)	-0.00186 (0.0587)	
R&D	0.00126 (0.00709)	0.00129 (0.00790)	0.000239 (0.0162)	-0.00123 (0.00795)	0.0264 (0.0728)	-0.0216 (0.106)	0.152 (0.282)	0.150 (0.200)	
Constant					-0.00892 (0.794)	-0.702 (1.116)	-7.662*** (2.822)	-2.172 (1.960)	
Country fixed effects	No	Yes	No	No	No	Yes	No	No	
Observations	2691	2691	2691	2691	2691	2691	2691	2691	

Source: Author. Note: Robust standard errors in parentheses ***p < 0.01, **p < 0.05, *p < 0.1.

Conclusion and implications of economic policies

Labor productivity is a fundamental measure of economic efficiency and, in general, a key determinant of structural transformation and well-being. However, despite the high rate of women's participation in entrepreneurial activities, data on the determinants of the variation in productivity levels between firms by CEO gender show that women are more often underperforming than men. Moreover, in the wake of the third industrial revolution, namely information and communication technologies, up to 52% of women still feel that technology is a male industry and 32% still consider gender bias to be a major obstacle in the process of business creation (World Economic Forum, 2017). This leads to a new form of gender segregation to the disadvantage of women. The objective of this research was therefore to analyze on the one hand the determinants of the labour productivity of SMEs in SSA on the one hand, and to examine the existence and extent of the productivity gap between firms according to the gender of the CEO on the other hand while highlighting the role played by the adoption of ICT. Following the main results presented in the previous section, we formulate some economic policy recommendations. First, the negative effect of staffing factors (especially mobile money) suggests that policies to improve women's mobile money would be effective in improving women's productivity and thus reducing the gender productivity gap. Second, the negative effect of website use suggests that women should improve their digital literacy to get the most out of website use like their male counterparts. And this includes the role of promoting women's education with a particular focus on digital skills.

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Notes

¹ Sustainable Development Goals

² Eradicating poverty

³ Zero hunger

⁴ Robust

⁵ Gender equality

Advanced Digital Technologies, Defeminization, and Informalization in India's Manufacturing¹

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Abstract

The increasing use of Advanced Digital Technologies (AITs) in manufacturing affects labor employment. We combine factory-level data from organized manufacturing from 1998-99 through 2015-16 with panel econometric models corrected for possible endogeneity bias and examine the impact of AITs on total employment. We also evaluate the impact of these technologies on the defeminization and informalization in the industry. The emerging evidence of the study will help understand the quantity (total employment) and quality (defeminization and informalization) of employment change by applying such digital technologies. The findings of the study will also help design a suitable manufacturing employment policy in developing economies

1. Introduction

The manufacturing sector in India contributed around 15-16% of its Gross Domestic Product (GDP) in 2010-11. The share of manufacturing in India's total economic activity is relatively smaller than other emerging Asian economies such as Thailand (29-30%), China (27-28%), Malaysia (22-23%), Indonesia (21-22%), and Philippines (20-21%). Recognizing the vast potential of the sector in sustaining the national GDP and creating higher employment opportunities, the National Manufacturing Policy (NMP) 2011 aimed to expand manufacturing activities to raise its contribution to 25% of the national GDP by 2022 and accomplish double-digit growth. The policy also set out to create additional employment of 100 million during the same time (Kujur and Goswami, 2021). From 1998-99 to 2015-16, the average growth rate of gross value added (GVA) in manufacturing was around 7%, while the growth rate in employment was only about 2% (Reserve Bank of India' RBI', 2022). This phenomenon of a high production growth rate accompanying low employment growth has invited successive academic and policy debates. The phenomenon of jobless growth leading to declining in employment in manufacturing is attributed to various factors, including capital-intensive production and technological progress

(Mazumdar and Sarkar, 2004; Kannan and Raveendran, 2009; Sankaran et al., 2010; Mehrotra et al., 2014; Kapoor, 2015; Sen and Das, 2015; Kujur, 2018; Majumdar, 2018). However, the decline in manufacturing employment caused by technological progress did not reveal much about the impact of advanced digital technologies (ADT) on employment change in manufacturing in India. The ICT-based ADT is centered around extensive and intensive usage of Computer equipment including software (CES). CES enables these physical and ICT-embodied digital technologies for manufacturing automation. With these technologies as a multiplier, ADT-induced automation improves product quality, decision-making process, and productivity. The application of ADT-based automation increases the cost of production. In particular, the application of ADT-induced technologies such as payroll processing software, factory automation, computer-controlled machines, automated inventory control, word processing, and email across the critical areas of the production process and management department of the factory, substitute the manual and routine task content performed by the clerical or mid-level workers (Brynjolfsson and McAfee, 2014). The deployment of such technologies, in turn, reduces the labor claim (Dalengogare et al., 2018). The adverse effect of ADT-embodied automation on labour may not be uniform but may be biased towards some and against others. ADT-enabled automation requires high-skilled laborers to operate and manage the production systems. Therefore, manufacturing factories with automation technologies in production and distribution prefer high-skilled male workers over low-skilled female workers. Hence, ADT-enabled automation might substitute the female laborers and thus defeminize the industry. Further, to control the unit cost of production, the factory might downsize the permanent employee and prefer low-salaried contractual workers. As a result, ADT-induced automation would informalize the labor in the sector. Although the wider application of such technology might polarize and affect the employment quality, there has not been an attempt to understand the impact of ADT-based automation on employment, defeminisation, and informalisation. Therefore, the present study examines the impact of ADT-induced automation on labor employment, (in)formalisation, and (de)feminization taking India's manufacturing as a representation. Against this background, we set the following hypotheses (H) to empirically test in this research:

H1: ADT-induced automation displaces labor and reduces overall employment in manufacturing

H2: ADT-induced automation informalize the formal labor in manufacturing

H3: ADT-induced automation defeminize the labor in manufacturing

The study contributes to the literature in four major ways. First, the research, for the first time, goes beyond evaluating the impact of ICT and assess ADT-enabled automation in the Indian context. Existing literature shows that

using ICT reduces production inefficiency, generates inter-industry spillovers, and improves total factor productivity growth (Dahl et al., 2011; Corrado et al., 2017; Pieri et al., 2018; Kim et al., 2021; Appiah-Otto and Song, 2021). In India, the use of ICT has improved gross value added (Sharma and Singh, 2013), labor productivity, and total factor productivity growth (Commander et al., 2011; Mitra et al., 2016; Erumban and Das, 2016, 2020; Khanna and Sharma, 2018; 2021). The application of ICT has also enhanced firm competitiveness in India's manufacturing (Sahoo et al., 2021). These studies have used various indicators to proxy ICT (Appiah-Otto and Song, 2021). For example, Pieri et al. (2018) considered information on access to computers, communication equipment, and software to reflect ICT use. Maurseth (2018), Haftu (2019), and Myovella et al. (2020) employed the use of mobile and internet use to indicate ICT for their analysis. Lee and Brahmasrene (2014); Latif et al. (2018); and Appiah-Otto and Song (2021) developed an ICT index of mobile, internet, and fixed broadband application to capture the effect of ICT. Similarly, other existing studies have considered ICT capital stock (Shahiduzzaman and Alam, 2014a, b), ICT capital services (Niebel et al., 2018), ICT export (Nguyen et al., 2020), and ICT compensation in GDP (Kim et al., 2021) as a proxy for ICT in their studies. These studies have limited their analysis to the application of ICT. In our study, we consider advanced physical and digital technologies used in the production process to evaluate manufacturing automation. Among the physical technologies, we consider Continuously Variable Transmission (CVT)- an automatic transmission that allows seamless gear rotation of machinery and machine tools, which automatizes the production process, improves machine runnability and reduces operational costs. Since energy is a critical factor input for production, we take the Uninterrupted Power Supply (UPS) application that safeguards against the disruption in power supply and thereby increases energy efficiency and enhances production efficiency. We also take the printers and other related physical technologies integrated with various ICT-based digital technologies to improve the decision-making process, reduce operational expenses and improve overall productivity (Dalenogare et al., 2018). In addition to physical technology, we consider advanced digital technologies such as computer equipment and software. Further, we include customized software and database software used in manufacturing. The example of customized software applied in manufacturing is Enterprise Resource Planning (ERP) to manage business operations, including inventory and financial accounting management, Computerised Maintenance Management System (CMMS) to ensure efficient maintenance of factories, Computer-Aided Manufacturing (CAM) to automate the manufacturing process, Computer-Aided Design (CAD) to design products, Engineer to Order (ETO) to create accurate quotes for customized products. Some of the examples of database software are related to cloud computing and big data analytics that store, optimize, and manage data to draw real-time insights on the performances of different departments of the factory. This ADT-enabled automation integrates the supply chain and manufacturing process digitally, manages real-time production flow,

systematize real-time inventory management and control. It conserves resources, enhances environmental sustainability, customizes the product depending on the market response, and improves product quality (Ghobakhloo, 2020). Understanding the impact of such technology on labor will provide an empirical background to infer suitable policy implications on manufacturing employment and possible social change.

Second, the research contributes to understanding the impact of ADT-driven automation on employment in manufacturing. While manufacturing automation is forecasted to improve productivity and sustainability, it is also expected to reduce labor claims. Analyzing the relationship between ADT-based automation and employment will give us a perspective on whether such technology has a positive or negative impact on labor. Third, our study makes a maiden attempt to understand the impact of ADT-based automation on female employment. Empirical evidence on the relationship between ADT-driven automation and female employment will help us explain whether (de)feminisation in India's manufacturing is effected by such technology. Fourth, the study, for the first time, explores the relationship between ADT-driven automation and informality. Findings from organized manufacturing will underscore whether such technology (in)formalise labor in industry. In all, our study will contribute to comprehending manufacturing ADT-induced automation under industry 4.0 and the quality of employment. In particular, the study will provide a perspective on the possible impact of manufacturing automation under industry 4.0 on future employment possibilities. The findings of study will help policy designers to forecast the employment impact of manufacturing automation, which has a wider socioeconomic implication. The insights from the study will guide the firms and corporate to suitably design their policies for positive social impact locally. The findings will also provide a new dimension to the discussion on the priority theme of the United Nations Sustainable development goal 5 on gender equality, goal 8 on decent work and economic growth, and goal 9 on the industry, innovation, and infrastructure.

2. Literature review

2.1. *Industry 4.0 and productivity growth*

In endogenous growth theory, technological progress is identified as a source of technical progress, leading to total factor productivity growth (Romer, 1990). This hypothesis of technology playing a crucial role in economic growth has also been empirically tested in developed and developing economies (CITATION). Over the centuries, from the first industrial revolution through the third industrial revolution, advanced technologies played a pivotal role in increasing productivity. The first industrial revolution in the 18th century (from 1771 to 1875) promoted wider use of water and steam power instead of animal and human power in mass manufacturing. The finished goods were manufactured by machines rather than a large number of human hands. The

second industrial revolution in the 19th century (from 1908 onwards) used oil, gas, and electric power in manufacturing. Along with the new power sources, the application of advanced communication technologies such as telephone and telegraph streamlined production and brought out some degree of automation in manufacturing. The third industrial revolution in the 20th century (from 1971 onwards) promoted the application of computers and advanced telecommunications and data analysis. This helped manufacturing factories digitize the production line by emending the programmable logic controller (PLCs) into the machinery and automatizing the production process. Automating the production process also helped collect and share the data for a better decision. The current wave of the fourth industrial revolution (from 2010 onwards) is characterized by increasing automation and smart and connected production systems that enhance efficiency across the value chains and raise productivity in manufacturing (United Nations Conference on Trade and Development 'UNCTAD', 2022).

Industry 4.0 entails vertically and horizontally integrated smart manufacturing that comprises an advanced level of physical and digital technologies. The physical technology includes industrial robots (robots working independently of workers), cobots (robots operating with workers), three-dimensional printers, technologically less advanced machinery, equipment and machine tools. Digital technologies refers to ICT-based technologies such as, enterprise systems, computer-aided manufacturing, computer-integrated manufacturing, and computer-aided design, as well as data analytics based on big data, artificial intelligence, and the internet of things. Both these physical and digital technologies are networked systems designed to sense, predict and improve decision-making in real-time on the consumption of resources, integrated production across the value chain, and market responses. The application of industry 4.0 technologies improves the productivity of the whole economy. Such an increase in productivity is also associated with increase in employment (UNIDO, 2020).

Developing countries are not yet fully using the advanced technologies of industry 4.0. For example, manufacturing in Senegal and Viet Nam is still using general-purpose ICT based to perform business administration, production planning, supply chain management, marketing, sales, and payment. (Cirera et al., 2021a, b). Although some of these technologies are in their incipient in developing countries, they will be impacted by industry 4.0 as this is said to have a historical precedent in terms of the speed of spread, breadth and magnitude of industries affected (World Economic Forum, 2016). Therefore, it is critical that we understand the various dimensions of labour employment.

2.2. Employment, informalization, and defeminization

In growth theories, labor is considered one of the factor inputs in production. As the economy intends to expand its production activity and achieve higher

economic growth, more amount of capital and labor are expected to be employed in the production process. However, over the years, labor employment in India has been falling even though the economy was growing (Bhalhotra, 1998; Mukherjee, 2012, 2014; Thomas, 2013; Roy Choudhury and Chatterjee, 2015; Tejani, 2016; Abraham, 2019). This phenomenon of jobless growth in the Indian economy has also been seen in the manufacturing sector (Nagraj, 2004, 2011). This decline in manufacturing employment is because of inflexible labour laws (Kapoor, 2015), an unfavorable domestic real exchange rate (Mazumdar and Sarkar, 2004), and increasing demand for capital-intensive goods (Kannan and Raveendran, 2009). In addition, the availability of cheap capital following trade liberalization (Sankaran et al., 2010; Mehrotra et al., 2014; Sen and Das, 2015) increased the capital intensity (Kujur, 2018; Majumdar, 2018) and displaced labor in the industry.

In addition to joblessness, India's industrial sector witnessed increasing informalization (percentage share of contract workers to permanent workers) in India (Goldar and Aggarwal, 2012, 2014; Mehrotra et al., 2013). The experience of increasing informalization in India's manufacturing is due to the rigid labour market (Sapkal, 2016; Singh, 2022). The rigidity in the labour laws or pro-workers labour laws, particularly the employment protection legislation, increases the firing cost of factories. This discourages employers from hiring permanent workers and induces the informalization of labor in India's organised manufacturing (Besley and Burgess, 2004). Further, the increasing trade volatility requires employers to adjust labour usage frequently to maintain the optimal factors inputs used in the production. The optimal level of input use encourages employers to hire more contractual labourers. Besides, the low bargaining power of labour and import competition are other vital reasons for the increasing informalization of labour in organised manufacturing in India (Goldar and Aggarwal, 2012; Sofi and Sharma, 2015).

Similar to the increasing informalisation, manufacturing in India has also been witnessing defeminisation (percentage share of female to total workers). Manufacturing in India absorbs only around 12% of the female labour force (Lahoti and Swaminathan, 2016). The already low-skilled female labourers are mostly employed in labor-intensive traditional small-scale manufacturing on a contractual basis without the provision of social security (Thomas, 2012; Organisation for Economic Co-operation and Development' OECD', 2014; Lahoti and Swaminathan, 2016; Mehrotra and Parida, 2017). In the absence of gainful employment, female laborers withdraw themselves from the labour market when there is a rise in the household's income (Thomas, 2012). The increasing attendance of girl child in educational institutions, and fall in child labour also plays a decisive role in declining female labour force participation. The lack of required infrastructure and social and cultural factors also keeps female labour away from the labour force in India (Sorsa et al., 2015; Lahoti and Swaminathan, 2016; Mehrotra and Parida, 2017; Mehrotra and Sinha, 2017). In

addition, the growing capital intensity in manufacturing and the fall in the international demand for products for labor-intensive industries are the important reasons for defeminisation in the industry. Although there are emerging shreds of evidence on the relationships between the use of ICT and female employment in the industry (Weinberg, 2000; Iglesias-Fernández et al., 2010; Jain, 2021; Viollaz and Winkler, 2022), the literature is largely based on cross-sectional firm-level data. The lack of micro evidence using factory-level data offers an opportunity to investigate the impact of AITs on female employment.

These studies at the aggregate level suggest that the application of ICT increases total factor productivity. Although the increase in total factor productivity has been augmented by the use of critical factor inputs like labor and their rising productivity, there has not been an attempt to understand the possible employment/unemployment caused by industry 4.0. We remedy these limitations. Since there has been a decline in employment and an increase in informalisation and defeminization in the manufacturing sector, it is vital that we examine whether these trends in employment are also caused by industry 4.0. Understanding the impact of industry 4.0 on declining total employment and increasing informalisation and defeminization in manufacturing would provide evidence of the impact of industry 4.0 on employment dynamics in manufacturing. It will offer a possible explanation for emerging employment patterns in manufacturing. The study will also help the policy designer to forecast the impact of industry 4.0 on employment and subsequent social change.

3. Empirical setting

3.1. Methods

We adopt the following dynamic labor demand model to examine the impact of AITs on labor employment.

$$\begin{aligned} \ln L_{i,j,t} = & \sigma + \theta_0 \ln L_{i,j,t-1} + \theta_{11} \ln ICT_{i,j,t} + \theta_{12} \ln ICT_{i,j,t-1} + \theta_{21} \ln \\ & \text{input}_{i,j,t} \\ & + \theta_{22} \ln \text{input}_{i,j,t-1} + \theta_{31} \ln \text{wages}_{i,j,t} + \theta_{32} \ln \text{wages}_{i,j,t-1} \\ & + \theta_{41} \ln GVA_{i,j,t} + \theta_{42} \ln GVA_{i,j,t-1} + \theta_{51} \ln \text{profit}_{i,j,t} \\ & + \theta_{52} \ln \text{profit}_{i,j,t-1} + r_i + \varphi_i \\ & + \varepsilon_i, \end{aligned} \quad (1)$$

Size (output or capital), age should be controlled

Where L is the (i) aggregate labor employment, (ii) informalisation, and (iii) defeminization. We use the total number of persons engaged in indicating aggregate employment in organized manufacturing. We calculate Informalization as the percentage share of contract workers to permanent workers in manufacturing, while the defeminisation is computed as the percentage share of female to male workers in the industry. CES is the actual value of computer, equipment and software. $Input$ actual value of intermediate inputs, $Wage$ the actual value wages and salaries of the labourers, GVA is the

actual value of gross value added, and *Profit* is the actual value of profit of the factory. All variables are in logarithmic form. r is the time-specific effect, φ represents the individual-specific effects (the unobserved heterogeneity), and ε_i is the random error term. The inclusion of time dummies captures the effect of any event that affects the variables of interest domestically and globally (e.g., policy change). It ensures that the estimates are not biased because of the occurrences of any such event.

Before estimating the dynamic panel model, we first present the pooled ordinary least squares (POLS) and fixed effects (FE) estimations as they provide valuable checks. We apply Hausman (1978) test to arrive at the appropriate model between Fixed Effect (FE) and Random Effect (RE) models. In the presence of lagged dependent variable as a regressor, the autoregressive coefficient is biased upwards in the POLS estimation while being biased downwards in the FE estimation (see Bond, 2002 for detail). Therefore, to correct this biasness, we estimate the dynamic panel model.

In the presence of heteroscedasticity, autocorrelation and endogeneity in the panel data, the researchers have applied first-differences generalised methods of moments (GMM) estimation (Arellano & Bond, 1991) as a robust alternative estimator. However, when the time series are persistent, lagged values of the variable are only weakly correlated with the endogenous variables and are weak instruments. The first-differences GMM also suffers from a loss of valuable observations. Under these conditions, the first-differences GMM is likely to perform poorly and has poor finite sample properties (bias and imprecision). This concern has been addressed by the systems-GMM estimate (Arellano and Bover, 1995; Blundell and Bond, 1998). The system-GMM estimator combines the standard set of equations in first differences and an additional set of level equations. According to Blundell and Bond (1998), the stationarity/time-invariant means of x_{ijt} and y_{ijt} series allows the lagged first differences of the dependent and independent variables as instruments for the level equation. They showed that the system-GMM estimator results in consistent and efficient parameter estimates and has better asymptotic and finite sample properties than the straightforward first-differences GMM estimator.

The specification tests proposed by Arellano and Bover (1995) are applied to test the validity of the instruments in our GMM estimation. First, Arellano and Bond (1991) test for the serial correlation is adopted to test whether there is a second-order serial correlation in the first-differenced residuals. The null hypothesis is that the residuals are serially correlated. If the null hypothesis cannot be rejected, it provides evidence that there is no second-order serial correlation, and the GM estimator is consistent. Second, the Hansen-J test is applied to test the null hypothesis of instrument validity and the validity of additional moment restrictions necessary for system-GMM. Failure to reject this null hypothesis means that the instruments are valid.

We also adopt other approaches to improve the efficiency of the system-GMM estimation. First, according to Roodman (2009), we restrict the number of instruments used in the system-GMM estimation by using only two lags for instruments in the first-differenced equations and collapsing the instrument sets. Second, time-specific effects are included in our regression equation to reduce the influence of cross-sectional error dependence in the short- term dynamic panel (Ding and Knight, 2011).

3.2. Data and summary statistics

We use the factory-level data in the organized manufacturing industry in India from 1998-99 to 2015-16, provided by the Annual Survey of Industries (ASI, 2015-16), Central Statistical Office, Ministry of Statistics and Program Implementation, Government of India. The factory- level ASI database covers both census and sample sectors surveyed by CSO. We apply the sample multiplier given by ASI wherever required to make the data comparable. We retain the factory with information for at least three consecutive years to make the panel data. The unbalanced panel data used in this research has 160524 factory-level observations from 1998- 99 through 2015-16. The summary statistics of the variables used are presented in Table 1. The unit-level ASI unit-level data allows us to disentangle the use of CES from the total amount of fixed capital used in the factory. This separation helps us explore the level of use of CES and its possible impact on employment in the organised manufacturing industry in India. We deflated the nominal value of CES by the Wholesale price index (WPI) of machinery and machine tools at 2011-12 prices to get their actual values. As a control, we use other industrial characteristics, such as intermediate inputs, wages and salaries, Gross Value Added (GVA), and profit in our model. We deflate the nominal value of GVA, profits, and intermediate inputs by output WPI of respective industries at 2011-12 prices. The WPIs at 2011-12 base for different industries is collected from the Economic and Political Weekly Research Foundation (EPWRF, 2020). We apply the National Industrial Classification (NIC) of 1998, 2004, and 2008 to have harmonised 2-digit data series based on NIC-2004 and make data comparable.²

Table 1. Summary statistics, 1998-99 to 2015-16					
Variable	Obs.	Mean	Std. Dev.	Min	Max
Year	160524	2010	4.21	1999	2015
Total employment	160524	11.38	0.01	11.38	12.07
Informalization	160524	0.968	0.001	0.912	1.030
Defeminization	160524	1.073	0.002	1.027	1.138
ICT	160524	21.94	0.01	21.92	22.63
GVA	160524	26.81	0.01	26.71	27.50
Profit	160524	26.80	0.01	26.69	27.49
Input	160524	27.22	0.01	27.22	27.92

Wages	160524	23.42	0.01	23.41	24.10
Note: All variables are in logarithmic form.					
Source: Author's calculations using ASI data.					

4. Results and discussion

4.1. AITs and total employment

The estimated results show that, among the AITs, the higher use of ICT significantly reduces employment in India's manufacturing (Table 2). Among the considered confounder, the higher use of intermediate inputs, and increases in wage and profit significantly reduces the overall employment in manufacturing.

Table 2. Impact of AITs on employment in India's manufacturing			
Dependent variable: Total number of persons engaged			
Independent variable	1	2	3
	Pooled OLS (robust)	FE (robust)	Sys-GMM
	(Coefficient: t-value)	(Coefficient:t- value)	(Coefficient:t-value)
Dependent variable $t-1$	--	--	0.543*** (0.137)
ICT	-0.096*** (0.018)	-0.025* (0.015)	-0.114** (0.047)
ICT $t-1$	--	--	0.034 (0.031)
PAT	-0.001 (0.025)	0.013 (0.012)	0.004 (0.052)
PAT $t-1$	--	--	0.017 (0.031)
Input	0.071*** (0.027)	0.116*** (0.033)	0.136** (0.068)
Input $t-1$	--	--	-0.016 (0.068)
Wages	0.495*** (0.025)	0.365*** (0.029)	0.851*** (0.157)
Wage $t-1$	--	--	-0.675*** (0.224)
GVA	0.054 (0.151)	0.485** (0.224)	0.050 (0.068)
GVA $t-1$	--	--	--
Profit	-0.080 (0.146)	-0.429** (0.218)	--
Profit $t-1$			-0.105** (0.042)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	--
State fixed effects	Yes	--	--
F-statistics	--	--	2.11e+09
Prob > F	--	--	0.000
R ²	0.511	0.363	
Hausman test		chi2(6) = 1753.47 Prob>chi2 = 0.000	
Number of			136

instruments			
Hansen J-test			Chi2(107)=4942.24 Prob>chi2= 0.000

4.2. AITs and informalisation

On the relationships between AITs and informalisation, we find that the increase in the use of ICT significantly reduces employment in the industry. The intermediate input as a control also significantly reduces the employment generation potential in the industry. However, among the AITs, the PAT is observed to be significantly escalating the trend of informalisation in manufacturing.

	Pooled OLS (robust) coefficient:t-value)	FE (robust) coefficient:t-value)	Sys-GMM coefficient:t-value)
Dependent variablet-1	--	--	-0.125*** (0.042)
ICT	-0.003 (0.002)	-0.002 (0.001)	-0.012*** (0.004)
ICTt-1	--	--	-0.006 (0.004)

Table 3. Impact of AITs on informalization in India's manufacturing

Dependent variable: Ratio of contractual/permanent labour employed			
Independent variable	1	2	3
PAT	0.009*** (0.002)	0.004** (0.002)	0.006*** (0.001)
PATt-1	--	--	0.005** (0.002)
Input	0.005 (0.003)	0.004** (0.002)	-0.004 (0.006)
Inputt-1	--	--	-0.009* (0.005)
Wages	-0.014*** (0.003)	0.006*** (0.002)	0.003 (0.007)
Wagest-1	--	--	-0.004 (0.006)
GVA	0.033* (0.017)	-0.017 (0.015)	--
GVA t-1	--	--	-0.011 (0.007)
Profit	-0.030* (0.017)	0.016 (0.014)	0.002 (0.003)
Profit t-1	--	--	0.010 (0.007)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	--
State fixed effects	Yes	--	--
F-statistics	--	--	100.50
Prob > F	--	--	0.000
R2	0.102	0.02	--
Hausman test	--	chi2(6) = 1608.80 Prob>chi2 = 0.000	--
Number of instruments	--	--	254
Hansen J-test	--	--	chi2(225) =1051.07

			Prob > chi2 = 0.000
AR1	--	--	z = 0.48 Pr > z = 0.632
AR2	--	--	z = -4.82 Pr > z = 0.000
Number of observations	160524	160524	138014
Number of groups	--	22357	22315
Notes: *p 0.10, **p 0.05, ***p 0.01. All variables are in logarithmic form. Constant not reported. Robust standard errors in parentheses. The instrument matrix has been collapsed to avoid instrument proliferation, and only three lags have been used as instruments. Hansen J -test reports the p-values for the null that instruments are valid. The p-values reported for AR(1) and AR(2) are for first and second-order autocorrelated disturbances in the first differences equations. Source: Authors estimate using ASI data.			

4.3. AITs and defeminisation

The estimated model show that higher application of both AITs, such as ICT and PAT, significantly reduces the proportionate use of female laborers, thereby defeminizing manufacturing. We also notice that the use of intermediate inputs and wages increases the trend of defeminization. The increase in GVA and profit also escalate the process of defeminization in the industry.

Table 4. Impact of AIT on defeminization in India's manufacturing			
Dependent variable: Ratio of women/men employment			
Independent variable	1	2	3
	Pooled OLS (robust)	FE (robust)	Sys-GMM
	Coefficient:t-value)	Coefficient:t-value)	Coefficient:t-value)
Dependent variable t-1	--	--	0.172* (0.093)
ICT	0.003 (0.003)	0.003 (0.002)	-0.001 (0.004)
ICT_{t-1}	--	--	-0.020*** (0.007)
PAT	0.002 (0.003)	0.001 (0.002)	0.001 (0.004)
PAT_{t-1}	--	--	-0.014** (0.006)
Input	-0.013*** (0.003)	-0.017*** (0.005)	-0.036* (0.020)
$Input_{t-1}$	--	--	-0.022* (0.012)
Wages	-0.061*** (0.003)	-0.034*** (0.004)	-0.120*** (0.029)
$Wage_{t-1}$	--	--	0.092** (0.040)
GVA	-0.037 (0.023)	-0.076** (0.035)	0.017*** (0.006)
GVA_{t-1}	--	--	--
Profit	0.038* (0.023)	0.066* (0.035)	--

$Profit_{t-1}$	--	-	-0.012* (0.007)
Year fixed effects	Yes	Yes	Yes
Industry fixed effect s	Yes	Yes	
State fixed effects	Yes		
F-statistics			54.64
Prob > F			0.000
R2	0.415	0.131	--
Hausman test	--	chi2(6) = 1748.72 Prob>chi2 = 0.000	--
Number of instruments	--	--	254
Hansen J-test			chi2(225) =1158.45 Prob > chi2 = 0.000
AR1	--	--	z = -2.79 Pr > z = 0.005
AR2	--	--	z = 0.95 Pr > z = 0.343
Number of observations	160524	160524	138014
Number of groups	--	22357	22315
Notes: *p 0.10, **p 0.05, ***p 0.01. All variables are in logarithmic form. Constant not reported. Robust standard errors in parentheses. The instrument matrix has been collapsed to avoid instrumentproliferation, and only three lags have been used as instruments. Hansen J -test reports the p-values for the null that instruments are valid. The p-values reported for AR(1) and AR(2) are for first and second-order autocorrelated disturbances in the first differences equations. Source: Authors estimate using ASI data.			

5. Discussion

The use of ICT reduces technical inefficiency and improves productivity. However, with some degree of automation, the ICT-enabled production process displaces the routine or manual task content of the job in manufacturing in India (Sharma, 2016; Vashisht, 2018; Vashisht and Dubey, 2019). The embodiment of ICT in the different stages of the production process, in turn, reduces overall employment in manufacturing. Our evidence of the labour-displacing act of ICT in aggregate manufacturing is similar to the findings of Kumar and Kumar (2022). The adverse impact of ICT on manufacturing employment suggests that ICT-enabled manufacturing displaces those laborers who are insufficiently skilled to manage ICT-based operations.

The use of ICT can be upskilling or deskilling, depending on the nature of the job performed by the workers. The ICT-enabled production system requires highly skilled laborers who perform cognitive activities such as product

development and process innovation to generate high-value-added output. This increases the demand for highly skilled permanent laborers in manufacturing (Becchetti et al., 2003; Peng et al., 2018; Taniguchi and Yamada, 2020). The increasing demand for such laborers reduces the need for low-skilled contractual laborers. The reduction in the employment potential of low-skilled contractual workers in the ICT-enabled factories, in turn, significantly reduces the informalisation in the industry. Unlike ICT, which is used to reduce inefficiency, the PATs are installed in manufacturing as a response to strict enforcement of environmental regulations by the government. Installing such sophisticated technologies in the factory increases their cost of production. Therefore, to reduce the unit cost of production, the factory downsizes the permanent workers and employs low- salaried contractual labourers. The firms also prefer more contractual workers to circumvent the cost of compliance of permanent workers enforced by the various labour laws (Sapkal, 2016). This increasing preferences for contractual workers significantly add to informalisation in manufacturing.

In India, around 34.5% of women in India were still illiterate, 18.9% were educated only up to the primary, and 14.1% were educated up to the middle class in 2017-18. Only 14.2% of females were educated up to the secondary level, while 9.8% were educated up to the higher secondary level. Only 8.3% of females in India are graduates and above (Government of India, 2020). Owing to the low level of education and skills among females (Lahoti and Swaminathan, 2016; Mehrotra and Parida, 2017), manufacturing prefers highly skilled male workers to manage the AITs, such as ICT and PAT, in the production processes. The AIT- embodied manufacturing, as a consequence, defeminizes labor employment. Our finding is contrary to a lone study by Jain (2021). Using the World Bank Enterprise Survey (WBES) of 2014, the author observed that using ICT in the Indian industry increased job opportunities, especially for highly-skilled female laborers. The findings of this study may not entirely represent the trend of the Indian industry as WBES collects information from a sample of around 8800 private firms operating in India in 2013-14. However, in our study, we use sample and census representation of around 160524 factories operating between 1998-99 and 2015-

16. Our findings based on the official panel data for about 18 years would give us the proper perspective on the long-term employment effect of AITs in India.

6. Implications and policy suggestions

The existing research revealed that using AITs such as ICT and PAT improves economic performance. However, as an upshot, the application of ICT and PAT might as well worsen the declining employment and exacerbate the increasing informalisation and defeminization in India's aggregate manufacturing. We provide evidence of the labor displacement potential of AITs adoption in the sector. The research also evaluates informalization and defeminization in

manufacturing caused by the use of AITs during 1998-99 to 2015-16. Understanding these issues are imperative as manufacturing with massive potential in India promises to generate enormous employment opportunities. The study will also help us comprehend the employment quality affected by AITs in manufacturing. In addition, the study will guide us in forecasting the impact of new technologies and design suitable resilience strategies for positive social change.

In view of the adverse effect of ICT on employment, generating more real employment opportunities in manufacturing is an arduous task. However, expansion in the production activity in the sector can generate demand for labor and create more employment opportunities (Kujur, 2018). The government should also further improve its skill development programs to impart the youth with necessary ICT-based skills and improve its resilience to the displacement potential of ICT. This way, India could foster productivity and not hamper employment growth because of ICT use.

While we appreciate that ICT-enabled production in India's manufacturing reduces the informalization, it is worrying that adopting PAT increases the informalization. Reducing the investment cost of PAT installation in the factories would help manufacturers reduce the reliance on low-salaried contractual workers and hire more permanent workers. In view of this, besides enforcing the pollution control norms, the government should also consider providing financial incentives to reduce the PAT investment burden on the factories. This would encourage the factories to consider employing more permanent workers while adopting PAT.

Our findings on defeminization in aggregate manufacturing caused by AITs indicate the prevalence of low education and skill levels among females. Because of this, females are deprived of the opportunity to contribute to manufacturing growth. Imparting higher education and skills among females would resolve the supply-side bottleneck. Solving the supply-side issue would also improve the quality of employment in manufacturing and bring about positive social change.

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Notes

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Gender and transformative innovation within the 4IR in Africa: Exploring key attributes and characteristics of women innovators operating in maker spaces in Nairobi and Johannesburg.

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Abstract

This paper explores the opportunities and challenges for women innovators undertaking transformative innovation within the 4th Industrial Revolution in Africa. Based on a narrative inquiry into the lived experiences of 22 female entrepreneurs operating in selected maker spaces in Johannesburg, Africa and Nairobi, Kenya; the findings highlight key attributes and competencies which women naturally possess and are key to transformative innovation processes; which if harnessed could help them overcome the major barriers and constraints they face in the innovation. The paper contributes towards the growing literature on gender and innovation in Africa and could guide strategic policy interventions towards enhancing the participation of women in transformative innovation and 4th industrial revolution.

Women entrepreneurs, transformation innovation, 4th Industrial revolution(4IR), Makerspaces.

1. Introduction

Innovation has become a vital component of sustainable development in today's globalized economy and supporting the role of women in innovation should be a key component of any country's national development strategies. Indeed, innovation and technology are seen to provide unprecedented opportunities to reach those who are the most likely to be left behind; hence the need to focus on enhancing the capacity of all players, including men and women; in order to accelerate industry-wide transformational changes and remove the barriers to growth and competitiveness; as prescribed in the UN Sustainable Development Goals 2030 (UN Women, 2017).

Advocating for the participation of more women in innovation, scholars argue that economic growth and development is highest if the innovative capacity of the entire workforce is exploited (Dakhli & De Clercq, 2004; Green & Cohen, 1995) and not just a portion of it, as is the norm in current discourse on innovation; where the male has been taken as the dominant player (Pettersson, 2007; Pecis, 2016). These scholars note that despite rising interest in the intertwining of individuals, organizations and institutions in innovation research, scant attention has been paid to the ways that relationships between them produce and reproduce specific gender dynamics throughout the innovation processes. They lament that Innovation research has been characterized by a gender blindness that conceals the gendered nature of innovation. Others have highlighted the social and economic benefits of female entrepreneurship and technology leadership (Scuotto et al., 2019; Etim & Iwu, 2019; Chengadu & Scheepers, 2017; Frietsch et al., 2009), noting that in general, there is a clear statistical pattern that women are less involved than men in innovation, and in the creation of scientific and industrial knowledge, which hinders the full realisation of impact of innovations.

Like in the rest of the world, studies conducted in Africa report alarmingly low participation of women in innovation, with many advancing a variety of reasons; such as low levels of access to education (Chinomona, & Maziriri, 2015; Kyalo & Kiganane, 2014), lack of access to affordable finance (Mandipaka, 2014; Amine and Staub, 2009), as well as prevalent gender bias and patriarchal cultural norms that limit the participation of women in economic processes (Mahemba & Bruijn, 2003; Singh & Belwal, 2008). However, despite these challenges and seemingly insurmountable barriers in their paths, more and more women in Africa are reported to continue with their quest for personal fulfilment and finding meaning through innovation and entrepreneurship, thereby creating transformative impacts in their communities and markets

(Chinomona and Maziriri, 2015; Kyalo & Kiganane, 2014; Mazonde, 2016; Manimekalai, 2016).

1.1 Emerging opportunities for women in transformative innovation and 4IR

Recently, innovation research is seen to be redirected in new pathways that can lead to more transformative changes, in order to adequately address pressing global challenges confronting the world today. development (Daniels & Tang, 2019). This thinking about alternative innovation pathways is being articulated under different labels; including responsible innovation (Stilgoe, Owen & Macnaghten 2013), inclusive innovation (Chataway, Hanlin & Kaplinsky 2014), social innovation (Joly, 2017; Mulgan, 2007), grassroots innovation (Gupta 2012; Smith & Seyfang 2013; Smith, Fressoli & Thomas 2014), frugal innovation (Radjou & Prabhu 2014), innovation for inclusive development (Daniels & Tang, 2019) and transformative innovations (Schot and Steinmuller, 2018), among others. The basic recurrent themes among these alternative approaches are the co-production of science and technology with society; emphasizing the non-neutral nature of technology and the need for greater consideration for the environment. Other themes that have emerged in this new innovation perspective include an emphasis on the transformative potential of civil society, attentiveness to the needs and wants of users and non-users alike, and the necessity for innovation to respond better to the needs of lower-income segments of the society and others like women and girls, who have previously been excluded (OECD, 2012).

Contemporary insights indicate that these new innovation pathways will require different skill sets and competencies such as emotional intelligence and communication skills, which could give a new lease of life to the visibility of women in innovation processes. This is because sectors previously considered to be beyond the purview of innovation; such as the public, non-profit and social sectors, where women traditionally dominate become crucial in the shift to making innovation more transformative, with greater impact on society.

The concurrent transformative shifts towards the 4th Industrial Revolution (4IR); characterized by technologies that blur the divide among the physical, digital and biological spheres; such as artificial intelligence, robotics, the Internet of Things(ToT), 3D printing, nanotechnology, among others, is at the same time found to be more likely to offer new opportunities for individuals, firms and national economies that have the capabilities to harness the transformative potential within it. Scholars note that while the 4IR has the potential to create green, clean, equitable and sustainable production systems (Amoah, 2019; Xing and Marwalla 2017; Ndungu, 2018), it could simultaneously pose great competitive, economic and social threats to

individuals, organisations and even nations lacking effective capabilities to exploit opportunities within it (The World Economic Forum, 2016).

The success of the 4IR is centered on benefitting from the revolution in terms of accessing technology and creating new products and services that can enhance the quality of life and decrease inequalities. These technologies are often transformative in nature, for example the use of artificial intelligence and human-machine collaboration to enhance productivity and improve efficiencies in agricultural production or the use of mobile applications and drones to provide visibility on the ground in conflict settings, allowing organizations to deliver life-saving treatment to remote locations. Scholars note that the introduction of these disruptive technologies will not only transform life in general, but will also transform the future of work as we know it; in terms of business models, nature of talent and type of skills that will be required, and those missing those skills are likely to be excluded from the workforce (Chiweshe, 2019; World Economic Forum, 2019)

While there are emerging debates about Africa's role within this fast-rising revolution (Amoah, 2019; Xing and Marwalla 2017; Ndungu 2018), very little attention has been paid so far to how African women fit into this process, given their previous minimal inclusion in STEM related sectors and general minimal experience in the technology fields, which have been found to be a key prerequisite to developing skills for innovation (UN Women 2017). Aligning the rise of 4IR in terms of exponential technologies, automation and digitisation with corresponding influence on the future of work through a gendered lens is seen to be a critical first step towards addressing the gender gaps likely to occur in the 4IR. This is even more critical for women in Africa who largely undertake labour-intensity but low-skill, low-paying, routinized jobs such as those in agriculture and retail, where technology-driven models will likely replace human efforts earlier than in other sectors (Chiweshe, 2019).

1.2 Objectives of the study

Previous studies exploring the reasons for the low participation of women in innovative sectors in Africa have often focused on exogenous factors such as lack of access to finance, poor access to education and training, as well as entrenched cultural norms and beliefs (Mandipaka, 2014; Kyalo & Kiganane, 2014; Mahemba & Bruijn, 2003), and very little exists in terms of literature specifically examining endogenous factors such as key attributes and natural competencies of women; which could offer them an advantage in innovation and enable them to design and develop products and services with transformative potential.

This study takes an endogenous approach to explore the key attributes and characteristics of female entrepreneurs and innovators undertaking transformative innovation within the 4IR fields in Africa. Focusing on women

entrepreneurs and innovators participating in selected maker spaces in Johannesburg (South Africa) and Nairobi (Kenya), the main objective to identify and highlight the human, relational, structural attributes that female entrepreneurs and innovators possess and can be deploy to develop, pilot and commercialize transformative innovations within the 4th industrial revolution. The study was guided by the following research questions:

1. What are the key attributes and characteristics of women undertaking transformative innovation within the 4IR fields in Africa?
2. How do these women deploy these attributes and special characteristics to plan, develop, pilot and commercialize transformative innovations that can create impact on their communities and markets?
3. What are the main barriers and challenges faced by women in undertaking transformative innovation within maker spaces in Johannesburg and Nairobi?

To answer these questions, the study took a qualitative approach, based on a narrative inquiry into the lived experiences of 22 women operating in selected maker spaces in Johannesburg, South Africa and Nairobi, Kenya. The rest of the paper is organized in four sections. The first section focuses on gender and innovation and an exposition on the dangers of exclusion of women in innovation discourse. In the second section, we draw from the theories of innovation and entrepreneurship and management studies to propose a theoretical framework about the critical role of women in innovation and social economic processes. The third section discussed the study design while the fourth section dwells on discussions and conclusions.

2.0 Factors influencing the participation of women in innovation and technology

Women entrepreneurs make significant contributions to the socio-economic wellbeing of their families and economies at large and there is a wealth of literature discussing their growing role in entrepreneurial development across the world (UN women 2017). Their role in innovation and technology, however, is currently underrepresented, both in literature and in practice (Dakhli & De Clercq, 2004; Green & Cohen, 1995). For example, a MasterCard Index of Women Entrepreneurs 2017 report highlights that men account for more than 92% of partners in the top 100 venture funded firms worldwide, while female-founded start-ups received only about 2% of total investments by venture capitalists in that year. In Africa, studies reveal that 93% of the funding in 2021 went to start-ups led by male CEOs, with less than 1% going to female-only founding teams. This is despite some studies indicating that women led startups yield 35% higher returns on investments than those led by men and a company's chance of success is increased by over 144% if it taps into women leaders to understand female consumers.

Studies on the participation of women in innovation are currently entrenched within the general literature on the performance of women in technology and entrepreneurship . Most of these studies indicate that women generally face greater challenges and barriers in their paths to innovation than men (Karibedou, 2020); Carayannis and Stewart ,2013; Scuotto et al., 2019) and Etim & Iwu, (2019). The challenges begin from early life, especially in Africa where the girl child is often the victim when it comes to missing out on school due to lack of adequate resource (Chinomona & Maziriri, 2015), leading to unequal access to education compared to their male counterparts.

This trend continues to youth when most girls are discouraged from undertaking subjects in the STEM related fields, through creating fear that they are naturally not gifted in those fields or even through well-orchestrated gender norms that tell the girl child that those subjects lead to male careers (UN women 2017) that might make them miss husbands if they follow them. (Buera et al., 2014), thus dividing technical skills and domains of expertise between the sexes, shaping masculinities and femininities. By the time that they adults, the die is cast and they further suffer cultural prejudice that leads to lack of access to finance, time poverty due to additional gender roles and low motivation, due to entrenched cultural norms that lowers their self-esteem in business. These together lead to human, financial and social capital challenges faced by women entrepreneurs and innovators .For example, low levels of education challenge their ability to save and acquire credit or equity finance and other resources to fully develop and commercialize their ideas ((Mandipaka,2014; Kyalo & Kiganane, 2014; Mahemba & Bruijn, 2003; ECA, 2019), as well as attract and develop highly qualified staff with the technical skills and competencies for innovation (Aderemi et al., 2008); while poor access to finance confines them to necessity driven entrepreneurship, often in the low growth, low impact informal sectors .

2.2 Opportunities and challenges for women in innovation and technology

A growing line of studies within the transformative innovation sphere however portends a new dawn for the role of women in innovation; which could greatly boost their participation in the fast rising 4th industrial revolution. (UN women 2017). Taking an endogenous approach, these studies argue along lines of personal attributes, characteristics and individual's competencies to explore new opportunities that could lead women to effective leadership of entrepreneurial ventures. The scholars in this view argue that women tend to have more progressive managerial approaches; being more democratic, interactive and transformational leaders, among other qualities that favour women regarding the creativity and innovativeness of employees working under them (Etim & Iwu, 2019; Chiweshe, 2019). Others highlight natural attributes such as women being better listeners and having greater tendency to collaborate and share information and knowledge, which are attributes that

have been found to be very important for success of innovative teams (Nahlinder, 2010; Chiweshe 2019; Lewis, 2006; Motilewa & Onakoya, 2015).

Numerous studies aligned to this school of thought highlight other gender differences in favour of women regarding the innovativeness of organisations. For example, Kamberidou & Fabry (2012) observed that women enjoy an edge over their male counterparts when it comes to group communication skills, pointing out that the collective creativity of a team rises when it includes more women. Closer home in Africa, Kraemer- Mbula and Garba, (2018) found that female workers' years of education mediate fully and positively the effect of gender diversity on innovative capability of enterprises in Nigeria. At the same time, an EAC report (2019) notes that increase in women education level had higher percentage increase in enterprise performance than that of men. The study also found that increasing women's educational attainment can improve their ability to own a bank account and save for business, thus removing one of the key barriers to their participation in opportunity led entrepreneurship, which is lack of access to affordable finance.

While analyzing two cases in the SME sector operating in the creative industry in the city of Turin, Italy Scuotto, et al. (2019), using the six key dimensions of the business model framework: value proposition, target market, value chain, value network, revenue mechanism and competitive strategy, found that women highlight the importance of the "value networks" to improve the working experience of the employees and that of the customers, which are key attributes in enhancing innovativeness of firms.

Despite these advantages, women are still glaringly invisible as inventors, innovators or entrepreneurs than men in innovation discourses across the world. The main debates in the literature accounting for this anomaly has developed along two schools of thought: that more women work in occupations that are not traditionally associated with innovation and therefore not likely to account much in the literature on innovation (Nyberg ,2009; Ahl ,2002) and the second one being that women lack the self-confidence to implement the full spectrum of innovation; from conceptualisation to full commercialisation (Nahlinder 2010; Sundin and Holm Quist, 1989; Moore, 1990).

The first perspective gets credence from studies conducted on the general occupational choice of women and men, highlighting that men and women tend to work in different occupations; a well- known labour market phenomenon, referred to as horizontal or occupational segregation (Anker, 1997). The general perception in this literature is that women tend work in occupations that are not usually associated with innovation, thus less likely to be visible. Nyberg (2009) reports that being an innovator is not regarded as a feminine trait, even among female inventors themselves; since the image of the inventor is not compatible with the image of being a woman; being that of a male nerd in large ill-fitting eyeglasses. The reluctance to identify themselves

with the (nerd) inventor, does not, however, prevent women from feeling a sense of pride over what they have accomplished in that space (Nyberg, 2009). The scholar further argues that the social visibility of technology is higher in men-dominated sectors than in women-dominated sectors such as care, retail and textiles.

The phenomenon of self-confidence has mostly been examined in relation to motivation; i.e. what motivates one to delve into self-employment (Klofsten and Davidson, 2003; Balachandra, & Bush 2016). Kirkwood (2009) notes that while self-confidence is a key feature for success in entrepreneurship, women generally exhibit a low level of self-confidence in their own abilities compared to men, even in other field like formal employment. Additionally, once their businesses are established, they tend to relate to it less often than the men do, due to time contracts placed on them by gender norms (Chinomona & Maziriri 2015). Studies indicate that while for some women their entrepreneurial self-confidence grew with time as they saw their businesses thrive, for the majority, it is a constant constraint; mostly due to inability to access finance and other resources such as social capital necessary for continuous growth (Etim & Iwu, 2019; Chiweshe, 2019). According to The Global Entrepreneurship Monitor (GEM) report (2014) on female entrepreneurship, only 29% of women in the world consider themselves capable of successfully starting a business, compared to 42% of men. Based on several indicators including psychological, educational and social biases, lack of confidence was found to be a major obstacle to success in entrepreneurship among women.

The phenomenon is more pronounced in Africa where women-owned businesses tend to be predominantly in the informal sector with a limited growth potential, in comparison to those run by men (Edoho, 2015; Chinomona & Maziriri 2015). While this has often been attributed to lack of access to education and resources such as finance, the entrenched patriarchal structures and complex administrative frameworks that exist in these economies, more recent studies also align to the role of the low self-confidence, which puts a limit of how female entrepreneurs interpret their success in entrepreneurship (Etim and Iwu, 2019). Generally, entrepreneurship in Africa is strongly linked to the family and the local community that can play both supportive and obstructive role and for women; with the entrenched norms and beliefs translating to low confidence in the male dominated field of innovation and entrepreneurship (Kimbu and Ngoasong, 2019; Khavul et al., 2009; Melese, 2018; Adesola et al., 2019; Edoho, 2015)

Elsewhere studies have shown that among various motivational aspects of entrepreneurship, only self-confidence was found to differ between men and women entrepreneurs in a study conducted by Birley (1989) and Kirkwood (2009). The scholars note that the lower self-confidence of women entrepreneurs has a negative impact on the rate of success of female entrepreneurs in general and could be one explanatory factor why women start new ventures to a lower

degree than men. Tedesco (2019) agrees, noting that it is lack of self-confidence and not competence that holds back most women from realizing their full potential in entrepreneurship, especially in the male dominated technology sectors.

The redirecting of innovation from the technology-led inventions perspective to new innovation pathways could therefore give a new lease of life to the participation and visibility of women in innovation processes. This is because as the world moves towards the transformative innovation views, sectors previously considered to be beyond the purview of innovation such as the public, nonprofit and social enterprise sectors etc. are gaining credence in innovation, which is more likely to give women a voice in innovation discourse; as part of the shift from an industrial to a knowledge-based economy (Siba 2019; Mitchell, 2011; Ranga and Etzkowitz, 2010).

3.0 The study context: Nairobi and Johannesburg

Currently, Kenya is perceived as one of Africa's leading economies due to its vibrant financial and information communication and telecommunication (ICT) services sectors, supported by professional workers (Ndemo & Weiss, 2016). The mobile phone revolution has resulted in technological transformations over the last two decades in especially the capital city, Nairobi. Mobile communication has often provided a platform for local entrepreneurs to come up with indigenous transformative innovations and create new start-up ventures that address local challenges like poverty and disease. Venture capital funds have been flowing into the city over the past decade, scouting for opportunities to collaborate and partner with local techno-savvy entrepreneurs, resulting in what has become known as the Silicon Savannah (Hain & Jurowetzki, 2018).

Technology-enabled entrepreneurship and local inventions in Nairobi frequently take place inside small informal technology communities, locally known as the I-Hubs, most of which harbor makerspaces, most of which are government owned and found within existing government facilities like libraries and public universities, while a few are private owned. They are essentially safe spaces where software developers, engineers and other creatives come together to brainstorm ideas, make business connections and get access to tools and fabrication labs to develop, pilot and commercialize their new ideas.

South Africa on the other hand tops the rest of African countries in the current Global Innovation Index (GII, 2020). The country supports its human development for technological innovations with much development in the IT field and the South African universities constitute most of the best-ranked universities in Africa with better facilities than most. Johannesburg, the capital of Gauteng province, is not only the economic hub of South Africa, which contributes heavily in the financial, manufacturing, transport, technology and

telecommunications sectors but also hosts, more than any other country on the continent, the largest number of overseas companies requiring a commercial base in Africa (Colombo, 2005). Scholars studying women-owned businesses in the city contend that although women entrepreneurs now account for almost a quarter to a third of all businesses in the formal economy, most of them are concentrated within the micro and small enterprises and in specific sectors, typically those with lower technical skills and other entrance requirements such as lower capital outlay; mainly in the retail and service sectors (Marvel, M. R., & Lumpkin, G. T. (2007).

3.1 Research Design and Sampling techniques

This study took a qualitative approach; based on narrative inquiry in order to capitalize on insights derived from in-depth interviews to capture individual stories of female participants in predominantly male dominated makerspaces in Kenya and Johannesburg. A key characteristic of narrative inquiry is that it captures individual's experiences in great detail; including respondents' personal views, opinions and their social interactions with others; reliving them as stories in a chronological sequence (Chase, 2018). This research design was found to be especially important in this study to allow the voice of the women to be heard, since most studies on women and innovation have often used the unit of analysis as the firm and often quantitatively determined the factors affecting their growth and performance, without capturing the human element.

Population sample consisted of 22 female respondents (11 in Nairobi and 11 in Johannesburg) whose projects involved transformative innovation within any aspect of the 4IR such as AI, robotics, 3D printing etc. The respondents were subjected to in-depth face to face interviews lasting about 1- 1.5 hours each, which were recorded and later transcribed. The narrative interviews followed a three step approach; beginning with participants first sharing stories of how they came to be in their current position as participants in the male dominated makerspaces, which was followed by detailed narratives on gender based aspects of the participant's experiences in the spaces. The final phase was semi-structured interview questions that were focused on the participant's personal views and opinions on the challenges faced and how they have handled them in order to exploit their full potential as entrepreneurs and innovators

3.1 Data analysis

The recorded interviews were transcribed and entered into qualitative analysis software Atlas Ti for coding and further analysis to come with thematic representation on the intersection between gender, transformative innovation and 4IR. Efforts were made to give voice to the respondents from the early stages of analysis, so as to create rich opportunities for the discovery of new concepts rather than the affirmation of existing concepts as recommended in Gioia and Corley (2012). The analysis proceeded first with open coding, where

concepts (codes) were attached to the observed data and observed phenomenon (Strauss & Corbin, 1990). In this first level of data analysis, informant terms are used as codes to allow categories to emerging quite early on.

Axial coding was employed next as second level of analysis used to relate emerging codes (categories and concepts) to each other via a combination of inductive reasoning to allow grouping of similar codes and group them into thematic categories representing the key thematic constructs under study. Finally, selective coding was used to select categories aligned to the main areas of interest, which were gender, transformative innovation and the 4IR.

4.0 Opportunities for women in in transformative innovation and the 4IR

Common themes emerged across the stories in this study but also clear differences were found among the respondents interviewed in this study, based on their personal attributes. The common themes converged first on the gender; the fact that as women, they all faced some form of gender based bias in the predominantly male makerspaces, which contributed greatly towards the negative aspects of the narratives. On the other hand, there were positive narratives of how the makerspaces gave the participants advanced technical skills and access a wide range of resources that they would ordinarily not be able to get on their own.

The positive narratives were dominated by the respondent's belief that they had key attributes and competencies different from their male counterparts which often contributed to the success of their new products or services, many times performing better than their male counterparts. The women in this study general believe that although they faced greatly challenges and barriers in these makerspaces, their final products were better and had more impact in the market and society as evidenced by their sales levels and feedback from their leaders. Many of them narrated how they leveraged on key competencies like patience, resilience, attention to detail, collaboration and communication skills to get an edge over others in the makerspaces, while others were more focused on how the digital technologies available in the makerspaces have made their work as innovators easier.

These findings are aligned with emerging studies in the field of gender and innovation that show that in the advent of new technologies, traditional hierarchical organizational models are transitioning rapidly to more unstructured or adhocracy teams within smaller nimble enterprises (ILO, 2018), which are required for faster decision-making in this new era of transformative innovation. This means that a diverse workforce with totally different skills and talents will be required. These skills include soft skills like emotional intelligence, problem-solving, communication and stakeholder engagement and opportunity recognition which are key to creativity and innovation (Nahlinder 2010; Chiweshe 2019, World Economic Forum, 2019). In terms of gender

inclusivity, this is expected to give women more voice and visibility as these are competencies and skills sets in which they tend to excel (Kamberidou & Labovas, 2012; Scuotto et al., 2019).

However, for women entrepreneurs in Africa, the context may make it difficult to exploit these emerging opportunities. A report for the UN in 2017 indicates that technological advances in Africa have not been met by a change in socio-cultural systems, which underpin women's exclusion and gender disparities; which could have detrimental consequences in terms of competitive, social and economic consequences for the participation of women in emerging industries (UN women 2017). The studies indicate that new technologies are more likely to entrench the prevailing socio- cultural barriers of patriarchal inequalities; as women still lack access to resources such as land, technology and credit, which their male counterparts possess and can utilize to entrench their dominant positions in economic processes.

Some scholars note that women's participation in innovation, although appreciated at policy level in these countries; is still greatly restrained at the family and community level in most of Africa; since it challenges traditional understandings of gender roles and cultural norms (Cesaroni et al, 2017; Etim & Iwu, 2019; Chengadu & Scheepers, 2017; Mazonde, 2016).

Women entrepreneurs in this region generally suffer more time poverty compared to their male counterparts or women elsewhere in the world; due to the strains they face on their time in taking care of the family and community; which could in turn have a great impact on their focus, creativity and ability to follow through on their entrepreneurial vision. For example, Carayannis and Stewart (2013), note that the critical attributes, competencies and behavioral characteristics of successful entrepreneurs in the current knowledge-based economy are the propensity to anticipate and recognize challenges and convert them into opportunities. To pursue such a vision requires entrepreneurs to have the capacity and ability to leverage strategic knowledge, have the technological foresight and follow through with unrelenting persistence and practice, in order to realize effective implementation.

This would be a challenge for women working under entrenched patriarchal systems that expects them to be more of home makers than anything else; being available to cook, clean, tend to the sick and generally manage the home. In the case of frontier technologies, starting a new venture is particularly tenuous, due to the competitive and strikingly turbulent and stochastic environmental forces that require the relentless pursuit of a self-assured vision (Carayannis and Stewart, 2013). Affirming this, Bezergianni (2013) highlights that the basis for technological creativity and innovation is conceiving and exploiting new ideas, adding that the most important step is having the potential to transform it to a successful business solution, which requires a great deal of focus and self-

assuredness. The above arguments lead us to the conceptually framework below.

Previous studies conducted on the role of women as innovators suggest that the digital technologies that predominantly prevail in the 4th industrial revolution, such as those found in the makerspaces can magnify existing inequalities and widen prevailing gender gaps (Siba 2019). Others contend that this revolution offers opportunities that can be consciously useful towards mitigating inequities in economic empowerment and inclusion of women (Alsos 2013, Mitchell, 2011). Scholars in the later view argue that the pervasive spread of technology in the society can help narrow the digital divide between men and women e.g. by facilitating women to work from home and giving a new impetus to the creation of female-owned businesses through digitalization (Mitchell, 2011). Additionally, technology can provide exceptions to prevalent gender bias, as a potentially neutral place in which the gender may be disguised through the creation of software agents (Haraway, 1991).

Several studies support this view, showing that digital tools and transformative innovations are giving women a chance to bypass some of the challenges they face in business, such as the multitasking whirlpool (Kamberidou, 2020). The scholar notes that women can now build and run a business from the comfort of their home and maintain a work-life balance e.g. through e-commerce where they can apply the power of artificial intelligence and big data to create unique work schedules for themselves, engage and collaborate with other stakeholders such as customers, suppliers and other business owners from remote locations, as well as offer leadership in attraction of more female customers by creating relevant for them (Kamberidou & Labovas, 2012; Scuotto et al., 2019).

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Southern transnational migrants and entrepreneurship in the Global South: Exploring the role of Indian migrants in South-South pharmaceutical production networks

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Abstract

Most of the literature on migration, entrepreneurship and development has focused on North-South transnational entrepreneurship. However, increasing migrant flows among southern countries and the emergence of southern countries such as China and India as global powers raises new questions about entrepreneurial dynamics led by the migrants who have returned from Global South countries. This paper focuses on the nature and dynamics of 'transnational migrants' and their influence on South-South production networks. There is growing evidence of fluid and transitory movement of migrants between home and host countries, highlighting that in an age of circulation, return does not imply permanency of stay or the complete withdrawal of resources or skills. When individuals move between countries, they can apply skills, knowledge and capabilities to new contexts and exploit their financial links and social and professional networks in their host countries. However, our knowledge of entrepreneurship from transnational migrant communities in the Global South and its influence within the South-South production networks remains limited. Focusing on the transnational migrants of Indian origin operating in the South-South pharmaceutical production networks, this paper shows the critical but often neglected role of these communities as global connectors that help to improve the economic competitiveness of host and home countries through their skills, knowledge, and networks.

Key Words: Transnational Entrepreneurship; Global Production Networks; Global South; Pharmaceutical industry

1. Introduction

With 'migrants' recognised as a key means of promoting international trade and investment and transferring technology, skills, and knowledge (Laczko and Lönnback 2013), migration emerged as an important determinant in discussions of the economic competitiveness and development of both sending and receiving countries. For a long time, the migration literature dominated in analysing the role of migrants in capacity development or knowledge transfer in a host country (brain gain) or migrant country (brain drain). However, migrants are being increasingly studied as major transmitters of knowledge across borders, a resource which is at the root of the development of modern economies (A. Williams and Baláž 2014). Amongst these, return migrants have emerged as a significant focus of the migration and development literature for their role, which seems to supersede the role of diasporas established abroad (Meyer 2011).

Cassarino (2004, 262), highlighting the connectedness of sites, people, and wellbeing, defines return migration as 'part and parcel of a circular system of social and economic relationships and exchanges facilitating the reintegration of migrants while conveying knowledge, information and membership'. Most work has, however, focused on the bilateral migratory relationship between the North and South country (Chacko 2007; Davis and Hart 2010; Tung and Haq 2012; Özden et al. 2011; Nanda and Khanna 2010; Kale 2009). For many Southern countries, return migration represents a major source of foreign direct investment, market development, and more intangible flows of new attitudes and cultural influences. This has been well documented in Saxenian's (2005) work on the contribution of Indian and Taiwanese high-skilled returnees from the US to develop local technology sectors. When individuals move between organisations or countries, they can apply this knowledge to new contexts, thereby transferring knowledge across different boundaries. Thus, return migration can play an important role in capability-building processes, especially where knowledge tends to be 'sticky' and remains localised within firms, regions, and countries (Szulanski 1996). Still, in practice, the contributions of return migrations have become more complex, global, and multi-faceted. Adepoju et al. (2007) argues that return migration is more heterogeneous than the current understanding captures and raises the point that there is a need for a more nuanced and complex understanding of return migration. Specifically, the return migration is still predominantly studied through the lens of what benefits returns migrants from northern countries hold for their country of origin in the Global South.

Furthermore, much of the research is centred on treating returns as permanent and exploring the possible benefits for the home countries. However, Wang (2016, 1943) argues that return migration is 'no longer limited by the paradigm

of unidirectional movement followed by permanent settlement in new societies, international migration is increasingly conceived of as a circular process for many who choose to resettle in their countries of origin or sometimes migrate back-and-forth between home and host societies'. So, rather than seeing returnees as permanently residing in the country of origin, they can help us understand migration cycles. It is increasingly evident that in the age of circulation, there appears a need to advance theoretical, policy and empirical thinking around the transnational migration (Douglas 2015). The migration-development literature recognises that transnational migrants hold 'global' benefits (Davis and Hart 2010; De Bree, Davids, and De Haas 2010; Gibson and McKenzie 2012; González-Ferrer et al. 2014). But where these 'benefits' are referenced, it is treated in a cursory way. There is often very little qualification as to what these benefits look like, how they can be understood theoretically, and no attention is given to the empirical research.

David & Hart (2010) capture the overwhelming paucity of policy analysis by arguing that the 'processes by which knowledge and skills are created, shared, and received are changing rapidly, transforming labour markets, and with it, migration patterns on a global scale expanding the range of opportunities for mutual gain. Unfortunately, migration policy is not keeping pace'. There is limited research going beyond just an awareness of this potential. Theoretically and empirically, there is a clear need to advance thinking around transnational migrants and their role in improving economic competitiveness through entrepreneurship. The increasing economic growth rate in African countries and the influential rise of southern powers on global geopolitics has brought a new wave of entrepreneurial dynamism led by southern transnational migrants within southern countries, which is yet to be studied by innovation and development scholars. This paper fills the gap. This research not only looks at how migration participates in transnational entrepreneurship by helping them find global resources to develop locally but also investigates how it supports the development of global production networks. It focuses on the entrepreneurial dynamics led by Indian migrants who have returned from Global South countries and investigates their role in South-South pharmaceutical production networks.

The remainder of this paper is structured as follows. Section 2 reviews the literature on transnational migration and entrepreneurship in the Global South. Section 3 presents the research methodology underpinning this paper, while section 4 discusses case studies of Indian returnees and transnational migrant entrepreneurship in South-South production networks. Section 5 analyses the data and discusses the main themes that emanate from the findings. Section 6 concludes the paper with a summary of the overall argument put forth in the paper.

2. Southern transnational migrants and entrepreneurship in global south

2.1. Transnational migrant entrepreneurship and international business development

Over the years, the policy and research on return migration suggest that apart from financial remittances, migration can play a critical role in economic development and resource mobilisation through diverse tangible and intangible routes (Newland and Patrick 2004; Wahba 2014). Business, management studies and economics have produced a significant body of work on migrant entrepreneurship, mostly in relation to economic growth, capability development and knowledge transfer (Henn and Bathelt 2017; Kale, Wield, and Chataway 2008). This research highlights that transnational communities use different approaches to contribute towards local development by providing consultative services to home-country governments (Lucas 2001), facilitating access to technology know-how through license agreements, mentoring, capital investments (Kapur 2001) and developing business networks linking home-country businesses to technology networks (Newland and Patrick 2004). But there is growing interest in migrants who are engaged in transnational entrepreneurship. Drori et al. (2009, 1) describe transnational entrepreneurship as a ‘social realm of immigrants operating in complex, cross-national domains, with dual cultural, institutional, and economic features that facilitate and require various entrepreneurial strategies’.

It is argued that exposure to diverse working environments and being part of various professional networks provide these entrepreneurs with unique insights that allow them to identify new market opportunities, raise capital, build management teams, and establish partnerships with suppliers far away (Kale and Little 2007). Saxenian (2006), terming these migrants as new ‘Argonauts’, argues that they create an alternative to the old pattern of one-way flows of technology and capital from core to periphery, a complex two-way flow of tangible and intangible resources.

Building on this, Chukuakadibia (2018) argues that ‘ethnic resources’, which include social capital, social networks, and solidarity, are key to understanding the entrepreneurship that emerges from immigration. Language proficiency and networking ability are identified as the key variables. Fuller-Love and Akiode (2020) provide a similar argument but differentiate between the cultural, social, and material attributes, which they assert can help to create suitable environments for the emergence of entrepreneurs. For example, transnational economic exchanges can include tangible resources such as remittances and investment and trade in specialised goods and services sought by migrants in countries of destination from countries of origin, for instance.

Many scholars highlighted the importance of networks in the creation of opportunities for entrepreneurship (Crush and Williams 2005; Fuller-Love and

Akiode 2020; Saxenian 2002) and the maintenance of links 'home' (Rogerson and Mushawemhuka 2015). Networks create opportunities for newcomers from 'home' to find employment with compatriots or other ethnic-owned SMMEs, gaining access to on-the-job training and role models (Khosa and Kalitanyi 2016). Diaspora networks are a source relied upon for finance and contacts, particularly amongst business owners who previously lived abroad, whilst forming local support associations in host countries are also key (Nanda and Khanna 2010).

It is suggested that innovation is another key aspect of how migrants contribute to local development. For example, it is argued that even at a very small scale, migrant entrepreneurs can be innovators by introducing new products or identifying new markets (Rath and Schutjens 2015). In recognition of such gaps in provision, migrant entrepreneurs can carve out space for new initiatives that can have significant impacts on host economies (Khosa and Kalitanyi 2016). However, the effective utilisation of skills, knowledge, and resources of transnational migrant entrepreneurs by local innovation systems strongly depends on the interactions of migrants with local organisations and institutions that make up that system (Kale and Little 2007). Building on this, migration scholars point out that changes in migration patterns over the past decades require a shift in observation, analysis, and policy.

2.2. Transnational entrepreneurship and global production networks

Transnational networks and knowledge transfer are frequently interlinked in the return migration research to explore the nature of cross-border networks that migrants try to proactively maintain or build once they return (Sinatti 2015; Nanda and Khanna 2010; Anwar and Chan 2016). According to Saxenian (2002), the transnational migrant entrepreneurs, professionals and their communities provide a significant mechanism of knowledge transfer and the upgrading of the local capabilities – one distinct from, but complementary to, global production networks.

Building on this idea of network building, migration scholars bring the idea of knowledge transfer and exchange (Kuschminder 2014; Parutis 2014). They argue that migrants can transfer knowledge, skills, and technology (A. M. Williams 2009). Central to this is tacit knowledge, which is not easily codified and tends to be deeply embodied, meaning that it is most effectively transferred through the copresence (Kale 2009; Song, Almeida, and Wu 2003; A. M. Williams 2007). Tacit knowledge is vital in the global knowledge economy and as 'carriers' of this knowledge, international migrants are seen as important sources of regional innovation and competitive advantage (Florida 2005; Sepulveda, Syrett, and Lyon 2011).

There are suggestions that migrants' transnational social networks, knowledge and capabilities can benefit the 'host' country by facilitating international trade and foreign investment (Chung and Tung 2013; Javorcik et al. 2011; Leblang 2010; Nijkamp, Gheasi, and Rietveld 2011). These quantitative studies infer that migrant transnational networks provide information that aids the identification of opportunities and reduces the risks of exploiting them. Thus, migrants act as conduits for further investment from their 'home' countries while helping enterprises from the 'host' country access goods, services, and markets in their countries of origin (A. M. Williams 2009; Sepulveda, Syrett, and Lyon 2011).

A key issue is the social and economic linkages migrants form with local actors, such as through employment, supply and distribution arrangements, and customer relations. This influences the potential for mutually beneficial exchanges. In exploring these linkages, the local agency is important as it actively shapes the nature and outcomes of relations with migrants (Mohan and Lampert 2013). Despite this awareness, there has been a deficiency among European countries in using this knowledge to inform more effective immigration policies that would accentuate the benefits of the circular migration (Schneider and Parusel 2015; Hugo 2012). Part of the problem, Seo and Skelton (2017) suggests, is that the existing evidence base is thin. Schneider and Parusel (2015) identify that much of the research focuses on seasonal migration and the agricultural sector but recognise that significant numbers of professionals and entrepreneurs engage in this type of migration.

2.3. *Transnational entrepreneurship in the Global South*

The literature review focused on transnational entrepreneurship in the global south reveals that attention is sometimes, but not uniformly, given to the direction of the migration flow, with business and economic journals typically not contextualising the research in a North- South (NS) or South-South (SS) framework.

One strand of the small but distinct literature on transnational entrepreneurship in the Global South has focused on the diasporic 'return' migration from Europe and North America to migrants' places of origin in the Global South (Ammassari 2004; Ray 2013). For example, the diasporic belongings of the British population point to the significance of language (Finch, Andrew, and Latorre 2010), culture (Walsh 2015; Coles and Walsh 2010), and forms of sociality (Beaverstock 2011) as determinants of connectedness. This research has predominantly focused on two groups; retirees (King et al. 2000) and those employed, often in highly skilled sectors of the labour market (Beaverstock 2011; Favell 2008). These two strands remain unconnected as the former are analysed through the lens of lifestyle migration (M. C. Benson 2010; M. Benson and O'reilly 2009) while the latter are seen primarily as drivers of the economy (Leonard 2010).

While diaspora studies have focused on the cultural and social aspects of migration, the migration and development literature has primarily seen diaspora as economic agents who will help in development. Interestingly, a study by Finch et al., (2010) found that the British diaspora, at large, would welcome more engagement from the British government and calls for the UK Government to revise their relationship with the diaspora overseas to encourage more engagement with the UK to boost the economy and skill outflow. In this research and policy discussions, 'development' is firmly placed in the Global South (Raghuram 2009). A SNIS (2013) study on diaspora focused on its role in the development of a home country (India) despite finding that number of returned professionals continued to maintain strong links with the host country. Very few studies link return migration with the diaspora. This suggests a need for a rethink on how government understand and approaches diaspora as a potential asset for development – a rethink on how to engage with returnees.

The second strand of emerging literature explores the role of transnational entrepreneurship in the Global South as complementary to global production networks. For example, Antwi Bosiakoh (2020) shows that cross-border flows of goods can be multi- country rather than from home to host or vice versa. Transnational networks (as opposed to just social networks) "help the entrepreneurs by facilitating their entrepreneurial processes, serving as points of contact not only for the supply of goods from Nigeria but also in employee recruitment. This way, the entrepreneurs' transnational networks help to sustain their retail and wholesale economic activities in Ghana as well as helping to build transnational relationships anchored in bounded solidarity and trust that stem from common national origin." (p. 1193). He states that these networks operate in what he calls "one-way transnationalism", "two-way transnationalism", or "tripartite transnationalism". Tripartite transnationalism refers to triangular movements between Ghana, China and Nigeria whereby transnational migrant entrepreneurs use Nigeria as a stepping-stone to import products manufactured and sourced in China to sell in Ghana as a means of bypassing higher Ghanaian import taxes. Further, Kaplinsky (2013) shows how flows of low-cost innovative capital goods are changing the landscape in Sub-Saharan Africa, such as motorbikes, tractors, solar chargers, farm equipment, and machinery used in various industries by reducing barriers to entry for small producers. Antwi Bosiakoh and Williams Tetteh (2019) give an example of a female entrepreneur who operates transnationally in import, supply, and retail, which "is not only in the very downstream sector of the ethnic/traditional food economy but also in the middle and upper streams" (p. 47). Located physically on the border, she is active transnationally in supply and demand, embedded within the Nigerian ethnic economy in Ghana, an opportunity related to specific ethnic needs. As the two researchers stress, "[n]ot only does ethnicity underlie the business identification and or motivation rationales, it also forms part of the business operation architectures." There are

examples given of people relying on family for labour, sometimes unpaid. This could potentially be seen as contributing to inclusive growth in the sense that in learning the ropes in an informal type of apprenticeship common in Nigeria, it is argued that this “way of working serves as a kind of incubation or mentoring process for the employees/apprentices, and bodes well for the growth and development potentials of the immigrant businesses” (Bosiakoh and Tetteh 2018, 48). Nowrasteh (2017) argues that transnational migrant entrepreneurs are a driver of innovation and startups in host countries, a similar finding to Kohnert (2010) whose exploration of whether Chinese entrepreneurs in Africa were more innovative than their Nigerian counterparts concluded that the superior innovative nature of some entrepreneurs was due to their continual adaptation via transnational networks within a global framework.

The research also highlights that the networking strategies by Nigerian migrant entrepreneurs’ associations in Ghana are used to reinforce their concentration in different places, becoming “vortexes attracting other micro-level entrepreneurs” (Antwi Bosiakoh 2017, 155). In the Chinese case, Liu (2019) argues that the practice of *guanxi* has been miscategorised as ‘social networks’ by many scholars. She contends it can be interpreted in different ways, including power relations or connections used for a particular purpose. In her research, Liu found that *guanxi* frequently strengthens personal and business relationships. Despite the claims made about the potential benefits circulatory migration hold for home, host and migrant, there appears to be a distinct lack of a cohesive theoretical approach, and there is no research that tries to unpack what the advantages would be, which suggests a significant gap. This review highlights a lack of understanding about how and what conditions and to what extent transnational migrants can transfer these capabilities between their home and host context. And there is still much unknown about how the local actors utilise these capabilities, knowledge and skills in both home and host contexts. This research explores this research gap.

3. Methods and data

This research focuses on Indian transnational migrants operating in South-South pharmaceutical production networks to explore the linkage between transnational migrants and entrepreneurship dynamism in host countries and investigate how these migrants support the development of global production networks.

3.1 Research site: Indian transnational migrants and south – south pharma production networks

The research on the Indian pharmaceutical industry and south-south pharmaceutical production network have pointed out that interpersonal ties across countries, especially in the Global South, where India makes half of its drug export turnover, are extensively used to connect to intermediaries, acquire

information, and find buyers and suppliers (Yves and Kale, 2022; Horner and Murphy (2017). But none of this research has explored the role of transnational Indian migrants in south-south pharmaceutical production networks providing an appropriate setting for the study. This research tries to bridge this gap in pharmaceutical studies and, more broadly, contribute to research on the diversity of transnational entrepreneurship in the Global South and its multifarious contribution to developing global production networks.

Further, India's transnational entrepreneurship is a prime example of an activity drawing on migration (Saxenian, 2005). The Indian diaspora is one the largest in the world and includes about 32 million people of Indian birth or ancestry (Ministry of External Affairs 2018). Among them, about 19 million reside in Asia, 6 million in the Americas, 3 million in Africa, 1 million in Europe, and 1 million in Oceania. Due to their large presence worldwide, Indian migrants have, for a long time, been studied in the context of their host countries, and most often in cities of the Global North, as ethnic entrepreneurs (Azmat and Fujimoto 2016; Chand and Ghorbani 2011). Some studies highlighted their role in India's development by looking at their impact on local economic development, particularly in providing remittances to their relatives back home or facilitating emigration from certain regions (Rutten et Patel 2002). In the last two decades, the increasing trend of returning Indian migrants has also led to new studies of their role in this new migration phase. The emergence of Bangalore's IT industry has often been analysed as the outcome of these transnational entrepreneurs who facilitated the connection with business networks in the Global North (Varrel 2008). In her study of immigrant entrepreneurs, Saxenian (2002) specifically looks at the Indian transnational community alongside the Chinese one to highlight their role in the development of local IT industries in the countries of origin and in Silicon Valley and Route 128. Several works thus suggest that Indian migrants are bringing much more than just remittances and insist on their role in technology transfers and investments and the development of high-tech sectors like the information technology industry (Nanda and Khanna 2010). However, virtually no research has been done on the entrepreneurs who have returned from countries in the Global South.

3.2 Data collection

The primary data was collected by interviewing transnational Indians who are working as executive directors in India. These migrants had significant work experience overseas before returning to India to launch their pharmaceutical businesses. From 2015 to 2023, we interacted with 58 executives of pharmaceutical firms based in India and engaged in international activities. We avoided the snowball approach of securing interviews to ensure the diversity of transnational entrepreneurs and limit the possibility of only interacting with similarly structured networks. We used the contact details obtained from India's registrar of companies to get in touch with several company directors

randomly. Existing empirical studies do that by selecting entrepreneurs based on the nature of their work or their migration trajectory, with return migrants as central objects of study. In this research, they are defined as transnational entrepreneurs a posteriori if they mobilise resources in at least two countries to support their entrepreneurial activities. In this article, we selected five case studies of transnational entrepreneurship that heavily relied on the director's experience as a migrant in the Global South. We illustrate how these types of returnees also play a major role in improving the economic competitiveness of host and home countries through their skills, knowledge, and networks and significantly participate in developing South-South pharmaceutical production networks.

We conducted semi-structured interviews focused on the networking practices of the company directors to understand how they mobilised resources, which resources, and from which networks. During these interviews, we also inquired about the social context in which the interviewees got to know the person or organisation that was bringing such or such resources and paid special attention to resources brought about by migration experiences or migrant networks.

4. Case Studies of Southern returnee entrepreneurs

4.1. Profiles of returnee entrepreneurs

Strikingly, many of the executive directors involved in international activities had an experience of migration abroad. Those who returned from the Global North generally migrated to study before working for local companies for some time. Most often, they studied

pharmaceutical or business-related subjects in American or UK universities. Among our dataset, we found only two instances where the directors had studied in countries of the Global South. These entrepreneurs often returned to India after their studies in global north due to family pull. Sometimes, they took over the family business, but in most instances, they created their venture. However, they were not necessarily focused on Northern markets in their endeavours, and many of their transnational activities had a Southern component.

Several of them have found that they could replicate in India and the Global South some existing products and processes that they observed in the North. They applied their skills and knowledge to fill some gaps in their organisations and sometimes leveraged their social networks to develop their enterprises, raise capital and find partners. Their subsequent experiences in Northern companies seemed particularly useful in accessing finance and technology.

The entrepreneurs who returned from the Global South were overwhelmingly professionals who were involved in marketing activities in Latin America,

Eastern Europe, Southeast Asia, and Africa, especially Sub-Saharan Africa. They generally worked in managerial positions where they handled staff mainly composed of local sales representatives. Many Indian companies operate in the Global South, with about 4,300 firms registered for exports (Pharmexcil 2023) and many small ones supplying the so-called 'semi-regulated markets' where regulations are less stringent. Their return to India was motivated by a desire to live closer to their family. The business they created often involved supplying generic intermediates and bulk substances, commodity generics and conventional dosage forms to distributors in Southern countries. Few entrepreneurs worked at manufacturing facilities as well. Local pharmaceutical manufacturing in Africa remains limited but is increasingly promoted by foreign firms (Chaudhuri 2016). In one instance, an entrepreneur acted as a factory manager in Malawi and Zimbabwe, where he worked towards getting manufacturing certifications from the World Health Organization.

In summary, the entrepreneurs who migrated to the Global North usually did so to study before returning to India. In contrast, the entrepreneurs who returned from the Global South were mainly involved in marketing activities. The following section presents three cases of entrepreneurs who worked in pharmaceutical sales in Sub-Saharan Africa, Southeast Asia, and Latin America before starting their own pharmaceutical business in India.

4.2 Key case studies

4.2.1 From sales manager in Sub-Saharan Africa to pan-African manufacturer

The first example is about an 'entrepreneur extraordinaire', as he was described to us by one of his acquaintances, who started as a medical representative in Africa. We interviewed him in between two meetings with his managers, who were just back from Africa, where his manufacturing operations are located. With a Bachelor's in Maths and Physics from Mumbai University in 1979, he was initially hired as a medical representative for various Indian companies with marketing operations abroad, like Lupin, Concept Pharma and Indiechemie.

Posted in various locations in sub-Saharan Africa in the 1980s and the early 1990s, he observed companies from Germany and the United Kingdom exporting products to Africa from India and began making contract manufacturing for them under the loan license scheme allowed by the Indian government. However, this did not work out as expected. He then partnered with colleagues to start a direct export business to Africa, mostly to Nigeria at the time. In 1994, he established his manufacturing plant in Palghar and started exporting to West, Central, and East Africa. His business, Simron Pharmaceuticals, grew, and he eventually sold it to Strides Shasun, a company

created and managed by a former colleague he met in Africa. He then worked as the CEO of Strides Africa between 2008 and 2017, when he got the opportunity to acquire the group's entire African manufacturing facilities.

His company now owns seven plants specialised in drug packaging and manufacturing in Africa (Cameroon, Botswana, Namibia, and Burkina Faso) with a minimum of 700 employees across various segments like diabetes and OTC products. It also produces essential generics like antibiotics, paracetamol, and anti-malaria and is one of the rare actors present in the entire pharmaceutical supply chain in Africa. With certifications from the WHO, the firm works in collaboration with international donors and organisations to supply several markets in the African continent, with a strong presence in sub-Saharan Africa. With its headquarters in Mumbai and registered in the Mauritius stock exchange, the director still spends 20 days per month in Africa and reads a daily average of 35 reports on the activities of the manufacturing units.

4.2.2 From medical representative in Southeast Asia to Africa supplier

The second example narrates the experience of a former sales representative in Africa and Southeast Asia who became a major actor in the production of pharmaceuticals exported to the Global South. When we met him at his Ahmedabad headquarter on 18 October 2016, the 60-years-old executive director of a manufacturing firm made a point to demonstrate that his pharmaceuticals were of the highest standard, even though they were commercialized in the Global South. As he dropped a paracetamol tablet in a glass of water, he said 'what I don't take, I don't make', a sentence that seemed to be coming straight away from a medical representative handbook. During the interview, he insists that we come to visit his factory located in the neighbouring city Gandhinagar and

The director has had long experience as a medical representative in several countries of the Global South before he started his main venture in 2007, a company specialised in the manufacturing of low-value generic drugs which are exported to Africa. With a bachelor's degree in physics obtained from Amritsar (Punjab), he was hired by Zydus, a Gujarat-based company, as a sales officer in India. In the early 1980s, he was sent as a regional manager in Malaysia, where he had to develop strategies to increase the companies' sales in Southeast Asia. He was eventually hired by a Malaysian company, ASEM Pharmaceuticals, for which he worked for one and a half years. His last regular job was for Torrent, an Ahmedabad-based company. He decided to start an export-oriented manufacturing company in Ahmedabad because he felt his experience in Southern markets was insufficiently valued.

He is today on the board of directors of 10 pharmaceutical companies with a strong focus on manufacturing in India and distribution in the Global South. His main company, Amideep Pharmaceuticals, has a manufacturing unit certified by the World Health Organisation (WHO) that produces drugs for 35 countries in Latin America, Africa, South Asia, and Southeast Asia. His previous networks in the Global South have been particularly instrumental in finding buyers; for instance, he met his logistic partner in Southeast Asia when he was posted there as a regional manager. He continues to travel back and forth in several countries of the Global South to meet partners or for training programs; he notably followed a course in Finance and Entrepreneurship from the Philippines and obtained a postgraduate diploma in marketing from Nigeria University, Lagos. For him, “in the export business, we already know what will happen in the next 2-3 months, but we have to anticipate market evolutions in the long run.”

4.2.3 From regional manager in Latin America to Global South exporter

The third example is about two transnational entrepreneurs who met in Latin America when they were posted as local managers for an Indian company. We met one of them on 22 February 2022 in his Ahmedabad office. Aged 40 years old, he has graduated with a Bachelor's degree in pharmacy and a Master of Business Administration in Marketing. He was first hired by the Gujarati firm Claris Lifesciences in 2002, where he was sent to Latin America as a country manager for Mexico. He was promoted to regional business head, based in Sao Paulo, in charge of Latin America, where he was managing five different subsidiaries of Claris and managing 250 people across the region. Within 10 years in Claris' international business, he travelled in more than 100 countries, according to his count.

He met his future business partner when he was posted in Mexico and Sao Paulo. Both were working in similar positions. As is common in the pharmaceutical industry, they were both 'poached' by another firm, Sterling Biotech, in 2010. It allowed them to return to Mumbai, where they were both from, as they were both eager to spend more time near their family. They launched their new company, given a Spanish name, in 2012, and the countries from Latin America became their first market.

Both Spanish-speaking, the partners' experience at Claris Lifesciences in Mexico and Sao Paulo enabled them to develop their activity rapidly. They knew 'the retailers, the exporters, the importers, the manufacturers, and all the main actors of the industry'. Additionally, they could hire employees from Claris that they knew personally, including sales representatives in Latin America. They also set up offices in Uzbekistan, Sri Lanka, Ecuador, and Vietnam, representing several firms based in Gujarat. Initially supplying drugs through contract manufacturing, they invested in their manufacturing unit in Gandhinagar, on the outskirts of Ahmedabad, and planned to open another manufacturing unit

in Colombo (Sri Lanka). They export their products to 27 countries in Latin America, Asia, and Eastern Europe.

5. Discussion

5.1. The geographies of Southern returnees

The migration experience in the South is a determining factor in the business choices of transnational pharmaceutical entrepreneurs. The geography of migration plays a significant role in shaping the orientation of businesses and their target markets. The returnees from South countries are deeply embedded in their geographical trajectory. Their experiences in one country in the South can serve as a gateway to all the countries in the region. However, this is not the case entering Northern country markets, which confirms the relevance of the North/South paradigm.

Some authors, however, argue that since we cannot distinguish between South and North, we cannot assume that South-South migration should differ from North-North migration regarding the human development (Bakewell et al. 2009). In our paper, we show that this distinction still holds some relevance but recognise the necessity to study the relation between migration and development at multiple scales to gain a better understanding of the phenomenon. South-South production networks are organised on a regional basis, which implies that the knowledge shared has strong territorial dimensions and is adapted to the local industries and markets. For many of these entrepreneurs, the pharmaceutical markets are divided into two blocks distinct in their norms and market logic: regulated and semi-regulated. The first block includes the United States, Canada, Australia, New Zealand, and the European Union. The second block is more precisely defined and is composed of less regulated countries, roughly matching the most frequent definition of the Global South. It is divided into several sub-blocks, corresponding to free trade zones or cultural areas.

Several transnational entrepreneurs also used alternative sources, such as social media sites, to find connections and consultants to get registrations and other resources. Many of them were using diasporic ties to mobilise resources. The networks have evolved, and community ties that shaped the diaspora are now mobilised aside from professional, academic, and internet-based ties. New groups of migrants have multiple identities obscuring their links as host or migrant-sending countries. The transnational entrepreneurs' trajectories have multiplied and are not only due to economic reasons but also academic and professional expatriations. They are also not one-sided, as many migrants return to their place of origin and do not settle in their host countries.

In conclusion, the migration experience in the South is a crucial factor in the business choices of transnational pharmaceutical entrepreneurs. The geography of migration plays a significant role in shaping the orientation of businesses and

their target markets. South-South production networks are organised on a regional basis, and the knowledge shared has strong territorial dimensions that are adapted to the local industries and markets.

5.2. *The resources of Southern pharmaceutical entrepreneurship*

The Indian transnational entrepreneurs with significant professional experience in the Global South leverage various knowledge resources to operate their businesses effectively in different areas of the India-South pharmaceutical production networks. Our paper shows that these entrepreneurs utilise various knowledge resources, such as technical expertise in pharmaceutical manufacturing, familiarity with local markets and regulations, and access to informal networks of industry experts and business associates.

Transnational entrepreneurs from India who have returned to their home country after professional experience in the Global South have a unique advantage in leveraging technical knowledge for their ventures. This knowledge includes expertise in product development, manufacturing processes, and regulatory compliance. Experience is essential in the pharmaceutical industry to obtain the licenses necessary for commercialising pharmaceutical products. The Indian entrepreneurs who have worked in the South have knowledge of the complex regulatory environments in these regions, which can be valuable in navigating similar environments in other countries.

Familiarity with local markets is a strong asset for returnee transnational entrepreneurs. Generally, Transnational entrepreneurs also leverage their technical expertise and innovation capabilities to develop products and processes tailored to the local market, which can provide a competitive advantage (Dunning and Lundan 2008). This access to local knowledge and resources is especially critical in the South, where institutional voids and weak regulatory environments can pose significant challenges for foreign firms entering these markets (Elango and Pattnaik 2007). In addition, they draw on their social capital through strong relationships with key stakeholders such as suppliers, customers, and regulators to navigate complex business environments and ensure their products meet the necessary regulatory standards.

Their previous experience in the local markets of the southern country has also helped them develop important networks locally. These industry networks provide access to crucial resources, such as raw materials, distribution channels, and market intelligence. In low-end value chains, entrepreneurs need to manage complex supply chains that involve multiple intermediaries, such as wholesalers, distributors, and pharmacies, to ensure that their products reach patients in a timely and efficient manner. Cultural competence, including familiarity with local business practices and customs, is thus essential for

building trust and establishing successful partnerships with counterparts in the Global South. In small-scale international trade in the Global South, the agreements between buyers and suppliers are principles agreements that do not lead to the signing of a contract and are established based on trust relationships. Nair et al. (2016) thus rightly emphasises the role of cultural competence in facilitating knowledge transfer and effective collaboration in cross-border partnerships.

Among this, speaking the local languages appears central, which explains why Indian firms have a stronger presence in English-speaking countries and a better international reach than certain competitors like the Chinese.

Overall, the resource mobilisation strategies of Indian transnational entrepreneurs with professional experience in the Global South are shaped by their technical expertise, social capital, and knowledge of local markets and regulations. By leveraging these resources effectively, they can successfully operate their businesses and compete in the highly competitive pharmaceutical industry in the Global South.

5.3. The industrial impact of Southern returnees

The impacts of South-South migration have been relatively understudied or have focused primarily on the monetary aspects of their development role (Hujo and Piper 2007). Our paper shows that Indian transnational entrepreneurs significantly contribute to the circulating of many knowledge resources among local stakeholders. The form of knowledge exchange seemed to differ from the processes of knowledge transfer and exchanges noted in the discussion of North-South migration. South-South production networks often operate in less formal and more flexible environments, where rules and regulations are less stringent, and knowledge exchange is based on trust and personal relationships. In contrast, North-South production networks operate in more formal and standardised environments, where legal contracts and agreements often govern knowledge exchange. The existing research suggests that more equal relationships in the Global South could promote knowledge exchange rather than top-down knowledge transfer from the lead firms to suppliers. This finding complements recent GVC/GPN work suggesting that several local firms operating in the same area can group as 'collaborating competitors' and enable quicker responses to fast-changing market demands (Tessmann 2018).

The South-South pharmaceutical networks returnee entrepreneurs have facilitated the development of local pharmaceutical industries in African countries, with Indian companies investing in production facilities and sharing good manufacturing practices, although African manufacturing remains nascent. Regarding manufacturing, the role of the returnee entrepreneurs in upgrading processes in the Global South differs from those led by the firms

from the Global North. They upgrade manufacturers in line with local market needs, which is generally geared towards low-cost pharmaceuticals. Indian entrepreneurs can leverage their experience in developing and implementing low-cost production processes, which can be critical in markets where cost is a key factor. For instance, Indian pharmaceutical companies have been successful in developing and manufacturing generic drugs, and this expertise has been exported to other countries. They bring necessary knowledge capital to support the adoption of improved manufacturing technologies and standards of production, as well as diversification of product and brand portfolios.

In commercializing pharmaceuticals, compliance is another area of significant knowledge exchange across pharmaceutical value chains. Pharmaceutical companies must comply with a complex web of regulations and guidelines set by various national and international regulatory bodies. Knowledge exchange in this area involves the sharing of information related to clinical trial design and execution, data analysis and reporting, and compliance with Good Manufacturing Practice (GMP) and other quality standards.

Conclusion

The paper highlights the importance of migration in discussions of the economic competitiveness and development of both sending and receiving countries, especially in terms of knowledge transfer and capacity development. While previous literature has mainly focused on the bilateral migratory relationship between the North and South country, return migration has emerged as a significant focus for their role in transmitting knowledge across borders. Return migration is defined as a circular system of social and economic relationships and exchanges facilitating the reintegration of migrants while conveying knowledge, information, and membership. However, the contributions of return migration have become more complex, global, and multi-faceted, and there is a need to advance theoretical, policy, and empirical thinking around transnational migration. The paper focuses on the entrepreneurial dynamics led by Indian migrants who have returned from Global South countries and investigates their role in South-South pharmaceutical production networks. The research methodology is presented, and case studies of Indian returnees and transnational migrant entrepreneurship in South-South production networks are discussed. The findings show that transnational migrant entrepreneurship led by migrants who returned from the South can improve economic competitiveness and contribute to the development of pharmaceutical production networks in the Global South. The paper concludes with a call for more attention to be given to transnational migrants' role in improving economic competitiveness through entrepreneurship, and the need to advance thinking around this topic. Improvement suggestions include further research into the specific benefits of transnational migration and the development of policy that keeps pace with changing knowledge and skill creation and sharing processes.

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Product Market Concentration with Ownership Characteristics: An Exploration into the Consolidation Activities of Business Groups

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Abstract

Often, the competition regulation is applied on the narrowly defined product level market, which ignores the aggregate level concentration. Though the trade-off between efficiency creation and market concentration is discussed, ownership level concentration at the aggregate level is ignored. This study aims to unravel the likelihood of concentration of economic power in the context of the Competition Act, 2002. It is observed that the synergy creation through M&As is much more for business groups compared to standalone firms due to the existence of multi-products and affiliates across various regions. The study suggests that the business groups strategically use M&As to become globally competitive through deriving horizontal and vertical linkages, while the regulators need to ensure that it does not lead to the concentration of assets in few hands at the aggregate level, which is likely to harm market competition across various products in the future.

Key Words: Regulation and Industrial Policy; Firm Performance; Size Distribution of Firms; Monopolisation Strategies; Antitrust Issues and Policies

JEL Code: L5; L25; L11, L12, G34

I. The Context

Globally, the concentrated distribution of wealth is a widespread socioeconomic phenomenon. For long, both income inequality and wealth inequality have seen aggravation in most countries across the world, albeit at disparate speed. These different patterns in inequality are considered to be a product of the disparate policy and institutional atmosphere of the countries in purview. Nevertheless, competition regulation in its current form is mainly concentrated on the concept of 'economic efficiency' and not on addressing the 'social fairness' concept comprehensively (Lianos, 2020). Competition regulation is based on the principles of market mechanism, which is expected to generate maximum consumer welfare. Often, competition regulation is applied to the narrowly defined product level market, which ignores the aggregate level concentration. Though the trade-off between efficiency creation and market concentration is discussed as part of competition regulation, it seldom addresses the ownership level concentration at the aggregate level. Often, business groups have presence in multiple products and markets. Further, the business groups own not only business power, but also economic, social, and political power, the net effect of which is immeasurable.

In India, the concentration of economic assets in the hands of big business groups had been an important policy issue during the MRTP regime.¹ However, with the amendment made in 1991, the concentration of economic power has been de-emphasised, and the new competition regime, i.e. Competition Act, 2002, implemented in the country from 2009 onwards. Many a time, mergers and acquisitions (M&As) are used as a tool to consolidate various business operations across various product lines, which ultimately increase the concentration of economic asset of the concerned business owners. This is not to undermine the fact that for them M&As are also a tool for restructuring and competence building, which can create and strengthen strong backward and forward linkages within the group. In this background, this study examines to what extent the business groups engaged in consolidation activities such as M&As to grow their size and improve competitiveness, and how it is reflecting on the product market competition in the selected sectors. This paper is organised into six sections. After introducing the context in the first section, the second section discusses how the formation of business groups and M&As have comparable goals. The third section reviews important studies on income and wealth concentration, followed by data and methodology in the fourth section and major findings in the fifth section. The sixth section concludes the findings.

II. Effects of Business Group Consolidation on Competition

The literature on M&As identifies three types of consolidation activities. They are: (i) horizontal deals, (ii) vertical deals, and (iii) conglomerate or unrelated

deals. Horizontal deals are those in which firms producing similar products consolidate their operations, whereas vertical deals occur when the firms in buyer-seller relation consolidate their operations. These two types of deals are considered more important when competition assessment is made. This is because the likelihood of creating market barriers are higher under these two cases and the competition authorities generally treat these deals with special caution. The third, i.e. conglomerate deals occur in unrelated business activities. Hence, these deals may not directly pose a challenge to the existing level of competition. However, it is possible that in some circumstances, these firms can cut the production of unprofitable areas of business operations, which may adversely affect the existing consumers of those products, especially when there is no or less alternate supplier for those products. Even in conglomerate deals, synergies may be created in the marketing, advertisement, and distribution channels.

Similar to the above discussion on M&As, the literature on business groups identifies three types of diversification. They are, (i) related (ii) linked, and (iii) unrelated diversification (Galbraith, 1998, as in Kakani, Sangem, and Sethi, 2015). In the related line, the group branches out into new, closely related business lines/product lines. For example, the company producing coconut hair oil may diversify into hair care, refined oil, personal care, etc., under the same business umbrella. Here the synergy creation is much more since the raw materials used and production is closely related. The effects of related diversification is similar to the horizontal M&As discussed above. This enables them to strengthen their competitiveness in their core area of production. In the second case, business groups diversify into the vertical line of business activities, i.e. in the buyer-seller relationship. Such integration may be forward or backward. This is mainly applicable when the firms procure raw materials and such other intermediary goods from others. When the group firms engage in such lines of business, it becomes easy to procure such items and the synergy creation is also high in the process. In this way, the firms can control the cost to a great extent. For example, groups which focus on automobiles, basic metals, and so on. Here the metal requirement of the automobile firm can be met by the same affiliate group firm. Similarly, the group may also enter into the next level of output, which the consumer demands. The third line, i.e. conglomerate, is where the affiliated firms engage in different business lines, which does not have any type of linkages or buyer-seller relation. For example, affiliated firms engage in pharmaceutical production and the automobile sector. Here it can be noticed that the degree of diversification increases in the case of conglomerate line of business, whereas the specialisation or product concentration increases in the case of related/horizontal deals, which are less diversified. Even in conglomerate structure, synergy creation may be possible. For instance, in the above example of the pharmaceutical and automobile business, it is possible to derive synergies in marketing and distribution.

From the above discussion, it can be seen that the purpose behind the creation of business groups and that of consolidation activities are somewhat similar when analysed from the producers' point of view.² Under both situations, one of the major business interests is to reduce the cost of production and thereby increase profitability; this can be achieved by generating synergies using both the group affiliation channel and the consolidation of the business. In addition, consolidation enables these groups to further strengthen the market power of various products. These deals may also help the group to lessen future competition by taking over potential competitors, both experienced firms and start-ups in vertical and horizontal lines. This is not to undermine the fact that each deal is different, which needs to be assessed separately. It is also possible that certain consolidation activities increase competition, especially when the deals are undertaken by the incumbent firms, which ultimately increase competition among the top firms in the relevant sector. This may result in increased consumer welfare, either through the reduction in prices or increased quantity/quality of products or services.

III. Income and Wealth Inequality and the Concentration of Economic Power among Big Business Groups: A Look into the Literature

Two streams of literature can be identified in this connection. First is the studies on unequal distribution of income and wealth, i.e. inequality in general. Any discussion on wealth concentration will be meaningless if it does not discuss the distribution of wealth across the various strata in society. Various studies like Banerjee and Piketty (2005), Sarma, Saha, and Jayakumar (2017), Jayadev, Motiram, and Vakulabharanam (2007) and Anand and Thampi (2016) examined various aspects of the unequal distribution of income and wealth in India and pointed out the widening income and wealth disparity in the country, especially during the post the liberalisation period that brought a slew of policy upheavals. Banerjee and Piketty (2005) observed the income shares of the top 0.01 percent, 0.1 percent and 1 percent substantially shrank from the 1950s to mid-1980s and then rose again in the 1990s. This U-shaped pattern is broadly in line with the economic policies implemented. The initial income share of the top groups were small. Although the rich were getting richer their impact on the overall income distribution was insignificant.³ In this context, the business network in India is considerably influenced by a handful of business groups that have a significant share in the overall business portfolios. With time, the large business houses have expanded their wings of operation to various diversified activities, which further strengthened their imprints on the economy. This is the focus of the second stream of literature, i.e. on the concentration of economic assets in the hands of big business groups. Important studies under this stream are discussed here.

Need to Distinguish Market Power and Economic Power

The Monopolies Inquiry Commission (MIC) Report, 1965 (GoI, 1965) clearly stated that concentration of economic power is a central problem and the monopolistic and restrictive practices can be considered as the two major 'functions' of such concentration of economic power. Two important kinds of concentration of economic power exist in the industries. They are: (i) product-wise concentration, and (ii) country-wise concentration.⁴ MIC found the prodigious existence of both country-wise and product-wise concentration.

Monopolies Inquiry Commission found that, out of the 100 selected products, which are important for ordinary consumers, high concentration exists for 65 products, medium concentration was found for ten products, concentration was low for eight products, and in 17 products, concentration was nil.⁵ High concentration was registered for crucial consumption items such as various medicines, automobiles, rubber, footwear, and so on. Low concentration was found mainly for textile and food items. In 41 products, the maximum number of firms engaged in production was less than or equal to four. Table 1 shows details of product-wise concentration across various broad categories.

Table 1: Product-wise Concentration across Various Products as per MIC Report

<i>Sl. No</i>	<i>Sector</i>	<i>High (≥75)</i>	<i>Medium (60-75)</i>	<i>Low (50-60)</i>	<i>Nil (<50)</i>	<i>Total</i>
1	Food	3	1		5	9
2	Clothing			2	7	9
3	Fuel	2			1	3
4	Household Goods	12	4	4	2	22
5	Conventional Necessaries	9				9
6	Medicines	18	1			19
7	Transport Goods	19	3	1		23
8	Building Materials	2	1	1	2	6
	Total	65	10	8	17	100

Source: Author's compilation from Monopolies Inquiry Commission Report, 1965.

In order to understand the extent of country-wise concentration, Monopolies Inquiry Commission (MIC) prepared a list of industrial houses and the affiliated companies based on secondary sources of information and circulated it to the respective houses to correct it.⁶ The MIC's final list consists of 75 business groups with more than Rs 5 crore asset size, which again consists of 1536 affiliated companies with more than Rs 1 crore asset size. The MIC found that the asset share of these groups in all non-government and non-banking

companies is 47 percent, while the share based on paid-up capital is 44 percent. It can be seen from the table that large affiliated companies constitute the major portion of the assets of the groups (see Table 2). In addition, MIC noted 16 companies with country-wise concentration; they are not part of the 75 groups mentioned. These 16 companies are engaged in diversified activities and the asset size of many of these companies was even higher than that of the group assets size.

Table 2: Asset share of large affiliated companies in Total group

Group	Affiliated Companies (AC) (in No.)			Assets (in Rs Lakhs)		Share (%)
	Total	with $\geq$ Rs. 1 crore	Share (%)	Total	with $\geq$ Rs. 1 crore	
Tata	53	27	51	41772	38499	92
Birla	151	54	36	29272	27104	93
Martin Burn	21	9	43	14961	14471	97
Bangur	81	15	19	7791	5836	75
ACC	5	3	60	7736	7599	98

Source: Author's compilation from Monopolies Inquiry Commission Report, 1965

The MIC also discussed the existence of monopolistic and restrictive trade practices, social and economic consequences of concentration, and so on. The MIC recommended establishing a permanent body to protect the country from future threat from the concentration of economic power in private hands and also to eliminate the monopolistic and restrictive trade practices. Overall, MIC's stand was not against big business, but to ensure that it is not misusing the concentration of economic power. It is also to be mentioned that MIC took a balanced approach towards M&As as well. It is mentioned that, "it is wrong to look upon mergers and amalgamations to be per se harmful to public interest. A cautious approach is therefore desirable." When M&As of dominant enterprises are involved, its positive and negative effects need to be evaluated and the deal should be approved only if the positive elements are clearly higher than negative effects.

There is a need to distinguish between business power and economic power (Goyal, 1979). Business power and concentration can be quantified using various indicators, whereas economic power is a qualitative concept and its extent depends on various additional factors. Though the control of assets by a particular business ownership reflects the relative size of the business empire of that house, it seldom reveals the actual control of that house on various strata of the society and the country. Chaudhuri (1975) says, the disproportionate

influence exerted by the top business groups is not measurable statistically with some simple statistical concentration ratios. Many a time, even minority ownership is sufficient to gain such control. Hence, the controlling block is not always necessary. Such indirect control is operationalised through the instruments of interlocking directorship and inter-corporate investment. However, in the open economy framework, a certain level of dominance is essential to compete in the global market.

From the policy point of view, often the market structure and concentration are assessed, based on the market share of firms in the respective sector. However, it is observed that business groups own multiple companies in the same sector with forward and backward linkages with own companies in other sectors. Hence, ownership needs to be considered while assessing market concentration. This study is an attempt to address this.

IV. Data and Methodology

We have used PROWESS database of Centre for Monitoring Indian Economy (CMIE) for collecting data on business groups. In order to get information on the M&As undertaken by business groups, we have used Venture Intelligence database. There is no direct database on the M&As undertaken by the business groups. We have identified it case by case. The period of study is 1990 to 2019. In order to understand the depth of M&A activity among business groups, we have selected the top 50 business groups as covered by the PROWESS database. PROWESS identified the top 50 business groups based on the size of assets. We have identified the transactions related to all the selected 50 business groups from the M&A database of Venture Intelligence by screening each transaction based on the name search of the groups and affiliated companies. Data on M&As covers the period January 2004 to July 19, 2019. Out of the top 50 business groups identified from PROWESS, data for M&As is available for 43 groups from Venture Intelligence. Simple statistical techniques are used to understand the intensity of M&As undertaken by the business groups. The study examined the product market competition with ownership criteria for which we have calculated the market concentration with ownership characteristics.

V. Major Observations from the Study

5.1. Business Groups and Income Inequality in India

Table 3 shows the richest Indians in the world, who come under the billionaires' list. Bloomberg publishes a daily index of the world's top 500 richest people based on the value of the net worth of each billionaire. Now there are 19 billionaires from India listed in the world's billionaires list. Of these, the richest Indian is Mukesh Ambani – ranked 11 globally – having a net worth of around \$76.3 billion, which is approximately 3.6 percent of Indian GDP. The second richest Indian is Gautam Adani with a global rank of 40. Adani has a net worth

of \$1.53 billion, which is around 1.5 percent of the Indian GDP. In total, the net worth of the 19 richest Indians are around \$293.49 billion, which is roughly around 14 percent of Indian GDP.

Table 3: Indian Business Reflected in World's Billionaires Index (as of December 21, 2020)

SNo.	Business Group	Total Networth (Bn \$)	Rank Globally	Approx. Share of GDP (%)
1	Mukesh Ambani (Reliance Industries)	76.3	11	3.61
2	Gautam Adani (Adani)	32.2	40	1.53
3	Azim Premji (Wipro)	24	62	1.14
4	Shiv Nadar (HCL)	22.7	69	1.08
5	Lakshmi Mittal (Arcelor Mittal)	16.4	119	0.78
6	Cyrus Poonawalla (Serum Institute of India)	16.2	121	0.77
7	Uday Kotak (Kotak Mahindra)	15.9	126	0.75
8	Radhakishan Damani (Avenue Supermarts)	14.2	142	0.67
9	Dilip Shanghvi (Sun Pharma)	9.83	224	0.47
10	Sunil Mittal (Bharti Airtel)	8.87	260	0.42
11	Nusli Wadia (Wadia group)	8.12	287	0.38
12	Benu Gopal Bangur (Sthree cement)	7.69	305	0.36
13	Savitri Jindal (OP Jindal Group)	7.1	343	0.34
14	Kumar Birla (Aditya Birla)	6.77	367	0.32
15	KP Sing (DLF)	5.58	458	0.26
16	Rahul Bajaj (Bajaj group)	5.55	461	0.26
17	Aswin Dani (Asian Paints)	5.45	470	0.26
18	Abhay Vakil (Asian Paints)	5.39	479	0.26
19	Pankaj Patel (Cadila Healthcare)	5.24	499	0.25
	Total	293.49		13.90

Source: Compiled from Bloomberg Billionaires Index 2020

<https://www.bloomberg.com/billionaires/>

Note: As per the Economic Survey (2019-20), the GDP at a constant price for 2019-20 (AE) is Rs. 14778878 crores, which is converted to US dollar using the approximate exchange rate 1: 70.

The Forbes list 2020 placed several of India's business groups in the top 100 for their shares spoke volumes about their aggrandised role in the business landscape of the world. The net worth of the richest Indians as rated by the Forbes list as of October 7, 2020 is given in Table 4. The first 25 ranks are listed in the table. Mukesh Ambani tops the list with around \$89 billion. Here, it can be noticed that the net worth of Mukesh Ambani is less than that given in

Bloomberg list. The data points for both lists is different. As per October 2020 data, Mukesh Ambani's net worth was around 4.2 percent of Indian GDP, and that of Gautam Adani was 1.2 percent. In total, the 25 listed richest Indians constitute approximately 15.4 percent of the Indian GDP.⁷ In Table 4, we have compiled the business in which the richest Indians are engaged. It can be seen that the business interest varies from IT to petrochemicals, paints, and cement. And many of them are part of the conglomerate business structure.

Table 4: Top 25 Richest Indians in 2020 (as on October, 2020)

<i>Rank</i>	<i>Business Group</i>	<i>Main Business</i>	<i>Total Net worth (Bn.\$)</i>	<i>Approx. share of GDP (Approx.)</i>
1	Mukesh Ambani (Reliance Industries)	Diversified: Petrochemicals, oil and gas, retail, telecom	88.7	4.2
2	Gautam Adani (Adani)	Commodities, Power generation & transmission, ports, real estate, defence, data centres	25.2	1.2
3	Shiv Nadar (HCL)	Software services	20.4	0.97
4	Radhakishan Damani (Avenue Supermarts)	Supermarket	15.4	0.73
5	Hinduja Brothers (Hinduja-Ashok Leyland)	Conglomerate including trucks, lubricants, banking, cable TV	12.8	0.61
6	Cyrus Poonawalla (Serum Institute of India)	Vaccines	11.5	0.54
7	Pallonji Mistry (Shapoorji Pallonji Group)	Engineering & Construction	11.4	0.54
8	Uday Kotak (Kotak Mahindra)	Bank	11.3	0.54
9	Godrej Family (Godrej Group)	Consumer goods	11.0	0.52
10	Lakshmi Mittal (Arcelor Mittal)	Steel	10.3	0.49
11	Sunil Mittal (Bharti Airtel)	Telecom Network	10.2	0.48
12	Dilip Shanghvi (Sun Pharma)	Pharmaceutical	9.5	0.45
13	Burman Family (Dabur)	Consumer goods-hair oil, fruit juice, health	9.2	0.44

		supplements		
14	Kumar Birla (Aditya Birla)	Conglomerate including cement, aluminum, telecom, financial service	8.5	0.40
15	Azim Premji (Wipro)	IT, Consulting and Outsourcing	7.9	0.37
16	Bajaj Family (Bajaj)	Motor cycle, auto, and financial service	7.4	0.35
17	Madhukar Parekh (Pidilite Industries)	Adhesives and sealants- fevicol glue popular)	7.2	0.34
18	Kuldip Singh Gurbachan Singh Dhingra (Berger Paints)	Paints	6.8	0.32
19	Savitri Jindal (OP Jindal Group)	Conglomerate including steel, power, cement and infrastructure	6.6	0.31
20	Murali Divi (Divi Laboratories)	API exports	6.5	0.30
21	Benu Gopal Bangur (Sthree cement)	Cement	6.1	0.29
22	Sudhir Mehta Samir Mehta (Torrent group- Torrent Pharma and Torrent Power)	Electricity and Pharmaceutical	5.9	0.28
23	Hasmukh Chudgar (Intas Pharmaceutical)	Pharmaceutical	5.4	0.26
24	Ashwin Dani (Asian Paints)	Paints	5.3	0.25
25	Girdhari Lal Bawri Rajendra Agarwal Banwari Lal Bawri (Macleods Pharmaceutical)	Pharmaceutical	5.0	0.24
	Total		325.5	15.41

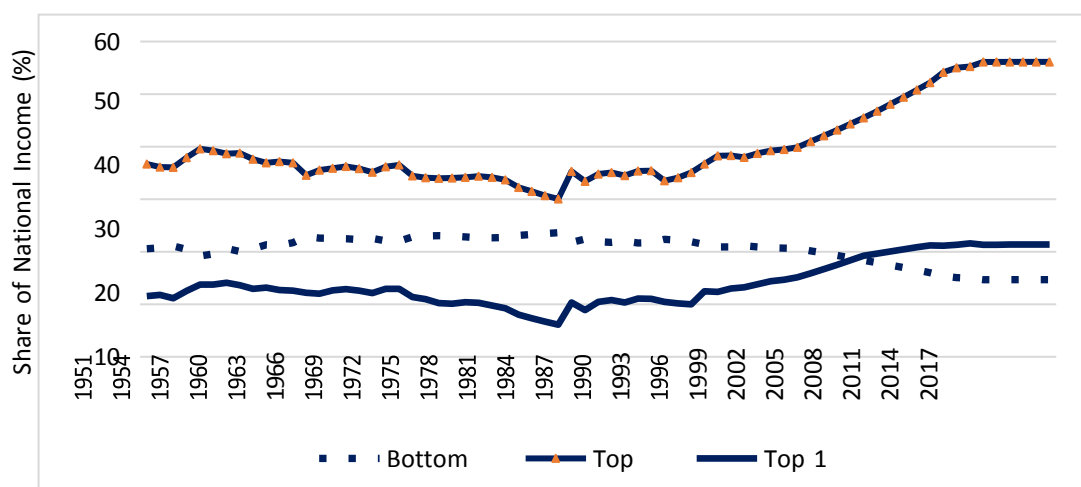
Source: Compiled from the Forbes List <https://www.forbes.com/india-billionaires/list/#tab:overall>

Note: (i) Company affiliation is given in parenthesis (ii) As per the Economic Survey (2019-20), the GDP at constant price for 2019-20 (AE) is Rs 14778878

crores, which is converted to US dollar using the approximate exchange rate 1: 70.

As per the World Inequality Report 2018, the top ten percent of the population in India held 55 percent of the GDP in the year 2018. This percentage makes India come just behind the raging income inequality in the Middle East region where the top ten percent pocket 61 percent of the national income. From the look of the top ten percent share in the national income, Europe appears to have the lowest rate of income inequality at 37 percent of national income. Nevertheless, the situation is grim in dilapidated areas of the African continent and Latin America in that both Sub-Saharan Africa and Brazil show gloomy days of income inequality where the top ten percent clasps 54 percent and 55 percent of the national income, respectively. This places India and Brazil at the cusp of simmering income inequality. Throughout the 1990s and 2000s up until 2015, wealth inequality has also seen a sharp rise as told through the Forbes India rich list. Affluent Indians who made it to the Forbes list in the 1990s constituted two percent share in the national income of the country which increased to a whopping 27 percent in the period following the global financial crash of 2007-08 but again coming down to ten percent in the year 2015 (Chancel and Piketty, 2019). The latest data reported by World Inequality Database shows that the income owned by the top one percent population in India increased to 21.4 percent in 2019 from 1951 level of 11.5 percent, and the same for the top ten percent population increased to 56 percent from 37. On the other side, the share of income held by the bottom 50 percent population declined further to 14.7 percent from 20.6 percent (see Figure1). Hence, it is clear that in India, more than half of the income share is accrued by the top ten percent of the population, whereas there has been a fall in the income owned by the bottom 50 percent.

Figure 1: Income Shares in India across Population Groups: 1950-2019



5.2. *M&As undertaken by Business Groups*

As per the data collected, the 43 groups or their affiliated companies are appearing in 1083 transactions. Out of these, 352 transactions are minority deals or sales of various assets. The rest of the 731 transactions can be counted as majority acquisitions. The maximum number of transactions are undertaken by Tata group, i.e. 144 transactions. Out of that, 38 are the sale of assets/minority deals and 106 majority deals. Reliance is the next top deal maker with 116 transactions. Out of this, 69 are majority deals. Mahindra is third with 105 transactions. If we are counting by majority deals, Mahindra comes second with 82 majority deals. Next, Birla is having 67 transactions, of which 44 are majority deals. Essar (Ruia) and Wipro have 55 transactions each, out of which 23 and 32 are minority and majority deals respectively. Larsen & Toubro (L&T) and Godrej have 35 majority transactions each. Other consolidation intensive groups are OP Jindal (45 transactions, 28 majority deals); Piramal (45, 21); TVS (44, 31); HCL (40, 26), Hero (Munjal) (29, 19), and so on.⁸ There was very little involvement of groups like Mafatlal, Lalbhai, and MA Chidambaram in consolidation activities.⁹

When we look at the major sectors in which the top business groups engaged in consolidation activities, IT and IT-enabled sector (IT & ITES) occupy the topmost position, comprising 18 percent of all transactions (134 out of 732 majority deals). The automobiles sector ranks second with 92 transactions (13 percent). Next come basic metals (48, 7%), energy (45, 6%), banking and financial service (41, 6%), food and beverages (39, 5%), engineering & construction and telecom (30, 4%) each, machinery (29, 4%), pharmaceuticals (25, 3%), media and entertainment (22, 3%), shipping & logistics (22, 3%), and so on. Coming to the question as to who was the top dealmaker within these preferred sectors, the study observed that in the IT and ITES, HCL and Wipro are the top dealmakers with 22 and 20 deals respectively. Mahindra also has 19 deals in the sector. L&T and Tata are the other top deal makers with 12 and 10 deals respectively. In the automobile sector, Mahindra and Tata are the top transaction makers who accounted for more than 50 percent of all transactions in the sector. Mahindra is engaged in 26 transactions, which makes 32 percent of all transactions in this sector and that of Tata is 16, which is 20 percent of all transactions in the sector. Hero (Munjal), Bharat Forge (Kalyani), and Essar (Ruia) are the next coming deal makers in the sector. In basic metals, out of the 48 deals, 25 belong to Tata and OP Jindal (OPJ) groups. Tata has 14 and OPJ has 11 transactions. Essar (Ruia) is next with seven deals. All others have a minimal presence. The next important sector is banking, financial services, and insurance, where Reliance and Mahindra share the top

position with seven transactions each, followed by L&T which has five transactions.

It is interesting to note that out of the 38 sectors for which we have information, Tata consolidated its operations in 23 sectors, Birla in 22 sectors, Reliance in 16, and Mahindra in 14. L&T, TVS, Piramal, OPJ, and Godrej have consolidated their operations in 12, 11, nine, nine, and nine sectors each. This needs to be read in the context of the diversification and conglomerate characteristics of the Indian business groups.

We have further examined the type of consolidation in which the top business groups are involved. The data revealed that the top business groups remained as acquirers rather than as targets. Out of the total 106 transactions of Tata, except for 22 transactions, for 73 transactions Tata remained as the acquirer, which makes 69 percent of the transactions involved by Tata. In the case of another 10 transactions, Tata remained as both target and acquirer, in other words, it was a consolidation within the group. Hence, this needs to be it was in the acquiring role, in ten percent (eight transactions) it was in the target role, and the rest were related transactions. A similar trend is seen in the case of Reliance, Essar (Ruia), Godrej. Reliance was in acquiring role in 74 percent (51) of the transactions and in target role in 19 percent (13) of the deals. Related transactions are seven percent of the deals (5). In Birla's case, only 51 percent of the deals (23) were made in an acquiring role. Target 12 transactions and in another 10 transactions, it was related transactions. Similar trend is visible for other top groups as well. In Wipro's case, out of 32 deals, Wipro was in acquiring role in 31 cases. In only one case, it remained in the target role. Hence, in general, it can be said that the top business group's involvement in business transactions was mainly to acquire other companies or to complement the existing resources by purchasing the assets of other companies.

The next important question is, Where are the groups consolidating their operations? Are they engaged in foreign transactions or domestic transactions? How many of them are acquiring firms abroad? We tried to answer such questions with the available information. It is seen that the top consolidation intensive groups like Tata, Mahindra, Reliance, Godrej, and Wipro are engaged in a large number of outbound transactions, along with their inbound and domestic presence in consolidation activities. Interestingly, the number of groups in inbound transactions is very less compared to the domestic deals and outbound transactions, which may be indirectly indicating that the group affiliation enables firms to withstand competition from foreign firms compared to their independent standalone peers. There were 266 outbound acquisitions undertaken by the top groups, while the number of inbound acquisitions is only 83. Mahindra has undertaken 42 outbound transactions, whereas it is involved only in four inbound acquisitions. Tata has made 41 outbound transactions and 15 inbound transactions. Wipro has 24 outbound transactions; and no inbound transaction was noticed. Reliance and Godrej have 18 outbound transactions

each, and only 12 and 4 inbound transactions respectively. Within the domestic deals, dominant groups involved are Tata (50 deals), Reliance (39), Mahindra (36), Birla (32), L&T (23), Essar (Ruia) (22), and so on.

In general, it is observed that a large number of unlisted firms in India are involved in the consolidation scenario. A study¹⁰ observed that 95 percent of the cross-border M&As in India belong to unlisted firms. However, such large-scale involvement of unlisted firms is not visible in the case of the top group's consolidation. The frequency of unlisted firms is 42 percent of all transactions in the case of Tata, 16 percent for Mahindra, 36 percent for Reliance, 60 percent for Birla, 79 for Essar (Ruia), 23 for Godrej, and so on. The same trend is applicable for other groups as well.

5.3. *Product-wise Concentration with Ownership characteristics*

Normally, product market concentration is measured in terms of firm-level concentration, i.e. the share of sales or assets held by the top firms in the relevant sector. This is one of the crucial indicators for competition assessment, which is also used by the competition regulators across the globe. Here, the ownership of firms is not emphasised while analysing the competition. Most of the business groups have multiple affiliate group companies that exist in the same industry group. This is also noticed by earlier studies on business groups such as Mazumdar (2008). Further, many group companies are present in multiple sectors. In this context, the point made by Chaudhuri (1975) regarding localised or product-wise concentration becomes relevant. Chaudhuri (1975) observed that, though product-wise concentration is important and reveals glimpses of the nature and the extent of the concentration of economic power, it is inadequate for a full understanding of the problem. As the economy grows, the product-wise concentration may show a declining trend. And most importantly, the economic power exercised by the top business groups is not only on a particular product or group of products, but also over a large number of economic activities simultaneously.

Here, the study examined the product market concentration with ownership criteria for three sub-sectors (i) basic metals, (ii) machinery, and (iii) automobiles. In order to give a clearer view, we have further disaggregated the sub-sector in some cases. For example, ferrous metals is examined from basic metals sector, and from the automobile sector (i) automobile parts and accessories and (ii) other transport equipment are examined. Major observations from the data analysis are as follows.

Table 5 shows the share of Tata and OP Jindal in ferrous metals over time. Tata and OP Jindal have a large number of firms operating in the ferrous metals segment. Tata was having a sales share of 15.4 percent in the 1990s, which peaked at 16 percent in the year 1993. Thereafter, Tata's share gradually declined and became ten percent in the year 2015. From there, it again saw a

rising trend. In 2019, the share is 14 percent. On the other hand, OP Jindal was having a meagre three percent in 1990, which increased to 22 percent in the year 2019. When we do a firm-level analysis, the top Tata group firm in the ferrous sector, i.e. Tata Steel has only a 9.5 percent share in 2019, whereas the same for Tata as a group in the ferrous segment is 14 percent. Similarly, the share of JSW Steel, which is the top OP Jindal group firm in the sector is only ten percent in 2019 (Table 6), and that of OP Jindal as a group is 20.7 percent as it can be seen from Table 5.

The combined sales share of the Tata group and OP Jindal group in ferrous metals is 34.7 in 2019 compared to 18 percent in 1990. This shows a clear increasing trend over time and the strong presence of the two groups in the ferrous segment. The two groups control 35 percent of the sales generated and 42 percent of the total assets in the segment. Asset-wise also, there has been an increasing trend compared to 1990s. In 1990, the combined presence of these two groups was only 17 percent – much of which was contributed by Tata at that time – which increased to 42 percent in 2019. In 2019, the contribution of Tata increased to 20 percent compared to the 1990 share of 15 percent. For OP Jindal, the assets share was only two percent in 1990, which is now 22 percent. The increasing presence of Tata and OP Jindal is shown in Figure 2. The next coming groups are Essar (Ruia) and Godrej. When we add these two groups, the presence of the top four groups in the sector, based on sales share, becomes 41 percent.

Table 5: Ferrous Metals: Ownership wise Concentration of Sales and Assets by Tata and OPJ (%)

	Tata Group		OP Jindal Group		Tata + OP Jindal	
	sales	assets	Sales	Assets	Sales	Assets
1990	15.4	15.2	2.9	2.0	18.3	17.2
1991	15.2	11.2	2.7	1.7	17.9	12.9
1992	15.7	13.0	2.4	2.0	18.1	14.9
1993	16.1	14.0	3.0	2.6	19.1	16.6
1994	15.2	13.7	3.5	3.9	18.7	17.6
1995	14.6	11.9	4.0	8.4	18.6	20.3
1996	15.2	12.2	5.6	7.2	20.7	19.4
1997	15.1	12.0	5.4	8.8	20.5	20.8
1998	15.8	11.8	5.5	10.7	21.3	22.5
1999	14.1	12.0	6.4	13.6	20.4	25.6
2000	14.0	13.0	6.1	15.4	20.0	28.4
2001	14.1	13.1	9.3	16.5	23.4	29.6
2002	14.3	13.1	9.8	18.1	24.0	31.2
2003	13.6	12.6	13.6	18.9	27.2	31.5
2004	13.1	12.9	13.6	19.8	26.7	32.7

2005	12.4	12.4	13.5	17.6	26.0	30.0
2006	12.4	11.8	13.0	19.1	25.4	30.8
2007	11.3	14.9	14.7	17.6	26.1	32.5
2008	10.4	19.2	14.3	17.1	24.7	36.3
2009	10.8	19.4	13.3	17.2	24.0	36.6
2010	10.6	18.2	15.7	16.3	26.3	34.5
2011	11.2	19.1	15.4	16.8	26.7	35.9
2012	11.2	18.6	16.7	17.2	27.9	35.8
2013	11.5	18.5	17.3	16.6	28.9	35.1
2014	11.0	18.6	17.1	16.1	28.1	34.7
2015	10.7	17.8	16.9	16.6	27.6	34.4
2016	11.4	17.5	16.1	18.6	27.5	36.1
2017	13.0	18.4	19.1	18.5	32.1	36.9
2018	13.5	18.7	20.2	20.2	33.8	38.9
2019	14.0	19.7	20.7	22.0	34.7	41.7

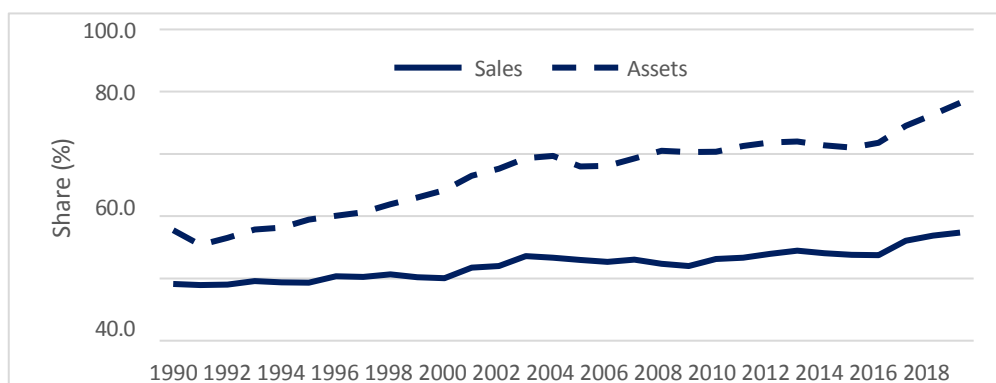
Source: Calculated using PROWESS, CMIE

Table 6: Market Share of Top Group's Affiliated Companies in Ferrous Metals (2019)

Company	Sales (Rs. Mn)	Market Share (%)
Tata steel	706109.2	9.50
JSW steel	767640	10.32

Source: Calculated using PROWESS, CMIE.

Figure 2: Tata and OP Jindal Groups in Ferrous Metals

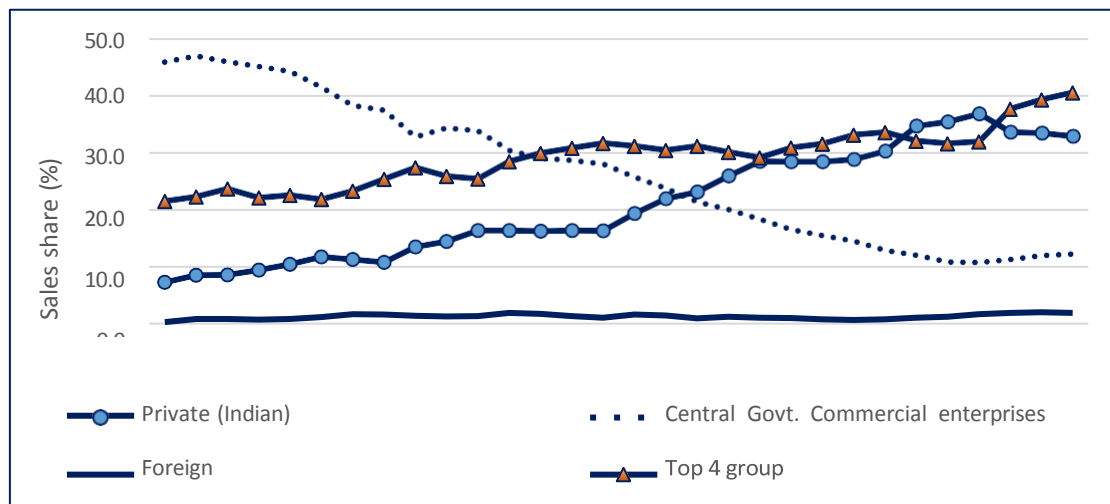


Source: Calculated using PROWESS, CMIE

This sector has got a strong presence in public sector units, too. The central government commercial enterprises controlled 46 percent of the market in 1990.

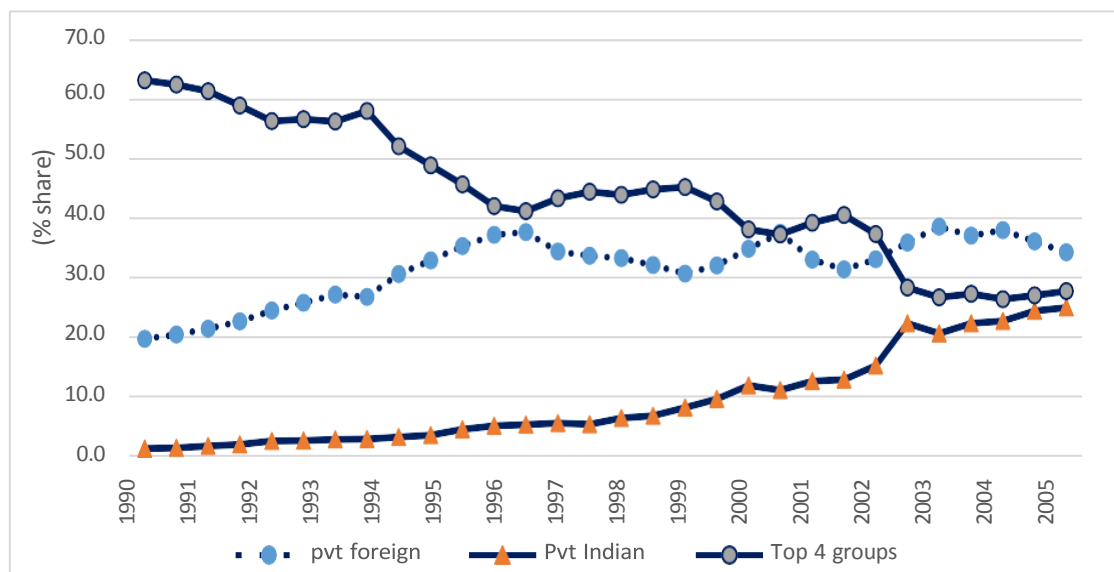
However, the share of public sector enterprises is gradually declining and now it has got only around 12 percent sales-based market share (Figure 3). From the figure, the increasing presence of top business groups and standalone domestic firms are visible. Here, the presence of foreign firms is limited.

Figure 3: Ferrous Metals: Presence of Foreign Firms and Groups



Source: Calculated using PROWESS, CMIE.

Figure 4: Motor Vehicles Trailer and Semi-Trailer: Market Share of Foreign and Indian Owned Firms

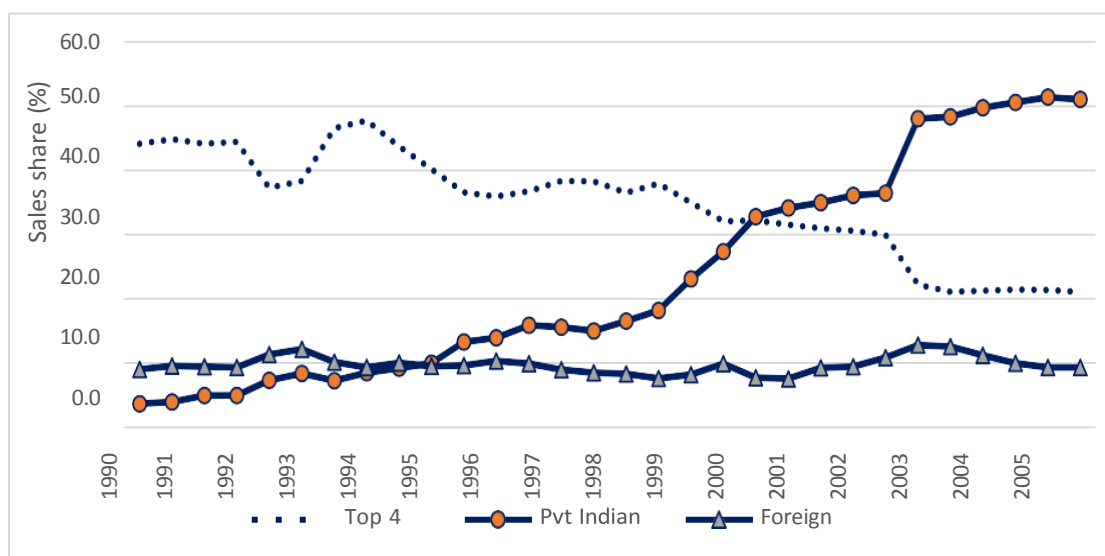


Source: Calculated using PROWESS, CMIE

The study further examined the sales-based concentration levels with ownership categorisation for the motor vehicle parts and accessories. In general, this product comes under the less concentrated category¹¹. In this segment, the current top groups are TVS Iyengar, Samvardhana Motherson, Tata, Hero (Munjal), and Anand DC. Here, too, the share of top two, top three, top four, and top five groups are declining over time.¹² However, individual groups like Motherson and Tata improved their position compared to the 1990 figures. During the early 1990s, the presence of Motherson was very limited through Motherson Sumi Systems. New companies affiliated in the mid-1990s and now the share is five percent compared to the near-zero in 1990. Tata's presence is also the same as that of Motherson in this segment.

Figure 5 shows the market shares owned by foreign firms, private standalone Indian firms, and the top Indian business groups. It can be seen that the share of top groups is declining over time whereas the major gainers are standalone domestic firms. The share of foreign firms is more or less the same over time. Hence, here it is mainly the entry and expansion of the domestic Indian firms that increase the competitive pressure on the top business groups.

Figure 5: Motor Vehicles Parts and Accessories: Presence of Foreign Firms and Domestic Groups

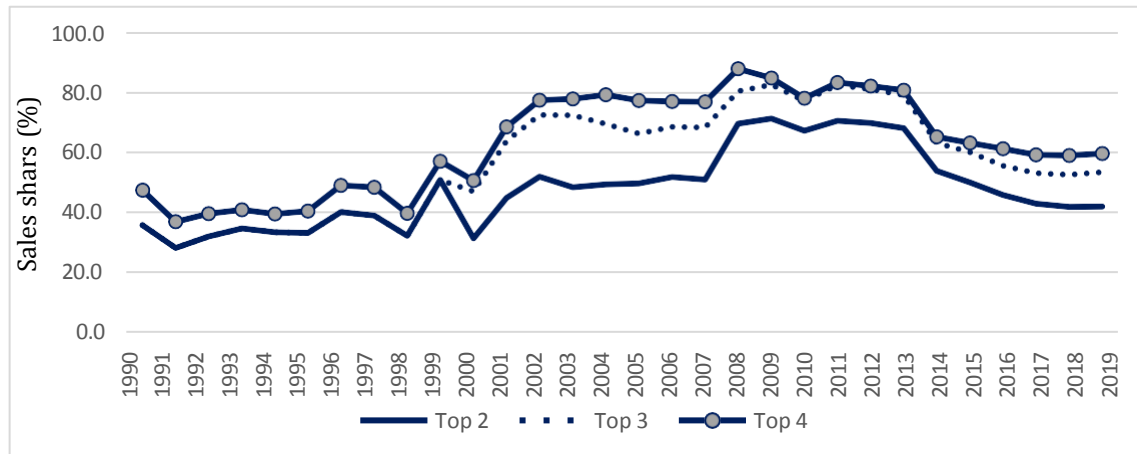


Source: Calculated using PROWESS, CMIE.

A similar estimate is done for the other transport equipment, which includes the manufacture of railway locomotives, manufacture of air and spacecraft & related, manufacture of weapon and ammunition, the building of ships and boats, and manufacture of other transport equipment. Here, the share of the top two groups was 36 percent, which increased to 42 in 2019. It showed an increasing trend, in general, till 2010–11, and it was as high as 71 percent in the year 2010–11, which declined to 42 percent in 2019. Similarly, the share of the

top three groups was 36 percent in 1990, which increased to 53 percent in 2019. The share was very high in some years. For example in 2011, it was 82 percent. The top four groups control 60 percent of the sales revenue of the segment now. This was only 47 percent in 1990. Hence, unlike the motor vehicle production segment, the picture in other transport equipment is more concentrated when the top groups are considered together¹³ (Figure 6).

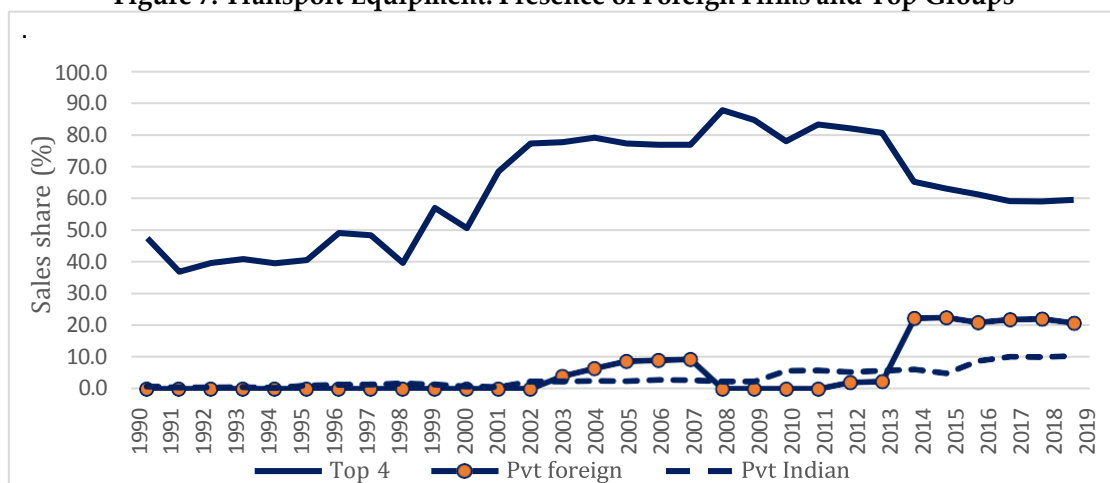
Figure 6: Transport Equipment: Groups' Share in Sales (%)



Source: Calculated using PROWESS, CMIE.

When we look at the foreign presence in this segment, it was minute till the year 2013, whereafter it shows an upward presence (Figure 7). It is visible from the figure that a substantial market of these products is owned by the top four groups, though the share is declining in recent years. The share of private Indian standalone companies is also very low, but it presents an increasing trend in recent years. Hence, the declining presence of top groups in recent years is explained by the upward movements of both foreign and standalone firms.

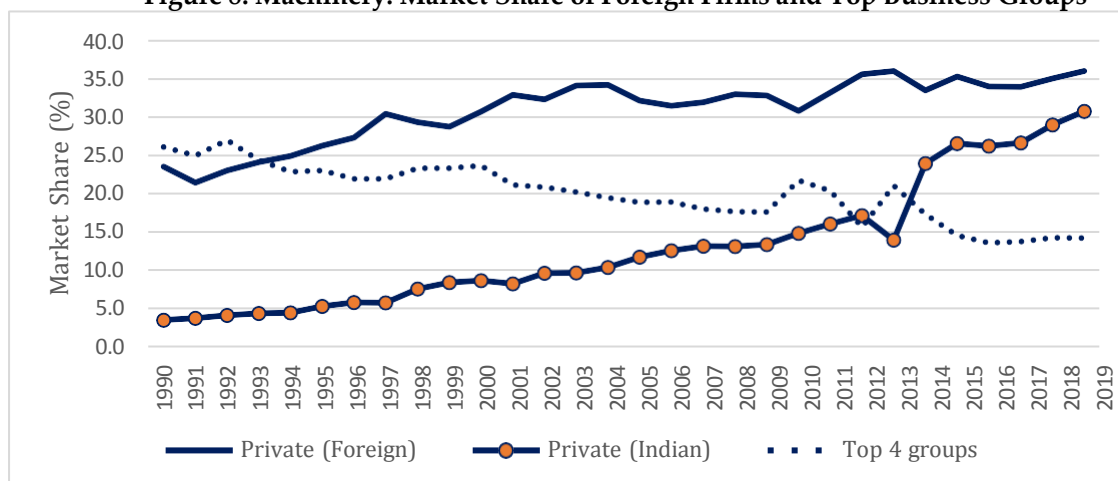
Figure 7: Transport Equipment: Presence of Foreign Firms and Top Groups



Source: Calculated using PROWESS, CMIE.

Next is the machinery sector, in which the top groups are Tata, Amalgamation, Kirloskar, and Escorts. This sector comes under the less concentrated sector in general based on an earlier study of this author. Likewise the automobile sector, here, too, the traditional groups are facing stiff competition. The current top two groups had only around 13 percent hold in 1990 in this sector, which is now around ten percent. The corresponding figures for the top four groups are 26 and 14 percent respectively for 1990 and 2019. All four groups mentioned above lost their market shares over time compared to the 1990 figures. What is more important to note is the increasing presence of foreign firms (Figure 8). In 1990, foreign firms controlled only around 24 percent of the market in this sector, which is 36 percent in 2019. Similarly, there has been an increase in the share of other standalone domestic firms, too. The share of standalone private Indian firms was nearly four percent in 1990, which increased to 31 percent in 2019, whereas the share of top business groups declined during this period. Thus, the competition in the sector increased with the increasing pressure from foreign firms and domestic standalone firms, which may be the reason for less concentration in this sector, too.

Figure 8: Machinery: Market Share of Foreign Firms and Top Business Groups



Source: Calculated using PROWESS, CMIE.

VI. Conclusions and Policy Points

Widening income and wealth inequality has been an important social concern in India. An initial part of this study has shown that the business groups own a substantial share of assets, sales, and profit in India¹⁴. In brief, what emerges from the foregoing discussion on product level concentration of top business groups is that the presence of business groups is increasing in products like basic metals and other transport equipment. “Wherever the presence of top domestic groups is increasing, the presence of foreign firms is coming down,”

which essentially indicates the need to realise the potential of business groups. In less concentrated sub-sectors like motor vehicles and machinery, the market shares owned by the top business groups are declining. Standalone firms are also increasing their presence in these areas. This may be the reason for a less concentrated structure in these sectors, too. Further, it is observed that the market shares are higher when we consider the affiliate companies as a group, rather than as standalone firms. This may be the reason why these firms could sustain in the market compared to the standalone firms.

Competition regulation in its current form is mainly focusing on the concept of 'economic efficiency' and not addressing the 'social fairness' concept comprehensively. The involvement of business groups in consolidation activities results in multiplier effects as they are already part of a diversified and well-structured umbrella of business with horizontal and vertical linkages. It is seen from the study that many affiliated companies of the business groups are operating in the same business activity. All of them are not contributing to the substantial sales revenue for the same segment. It is also noticed that many of these affiliated companies provide forward and backward linkages in the production within the same sector.

Apart from the general implications of M&As reflected in market shares and market competition, these types of synergies derived through ownership are important in efficiently utilising the materials and such other resources under a common umbrella of business. This was crucial to withstand competition from foreign firms and emerging standalone firms. The study suggests the business groups strategically use M&As to become globally competitive firms through deriving horizontal and vertical linkages. At the same time, the regulators need to ensure that it does not lead to the concentration of assets in few hands at the aggregate level, which is likely to harm market competition across various products in the future.

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Notes

¹ The MRTTP Act (1969), Government of India.

² Acquiring ownership control is another important goal. Here we are focusing more on market competition

³ A more detailed review of wealth inequality is available in (Citation removed to facilitate anonymous review). Here we have excluded the details of wealth inequality as it is not the focus of this study

⁴ Product-wise concentration occurs where 'in respect of the production and distribution of any particular commodity or service the controlling power whether by reason of ownership of capital or otherwise is in a single concern or comparatively limited number of concerns or though in a fairly large number of concerns, these concerns themselves are controlled by only a single-family or a few families or business houses.' It can be also called 'industry-wise' concentration if the industry is engaged in the production of one product. The other, that is country-wise concentration, occurs when a large number of concerns engaged in the production or distribution of different commodities are in the controlling hands of one individual or family or group of persons, whether incorporated or not, connected closely by financial or other business interests. Here the concentration of economic power is clearly considered as existing. Hence, MIC distinguishes both product-wise concentration and ownership-wise concentration while defining the concentration of economic power.

⁵ MIC used sales based three-firm concentration ratios (C3) for reflecting the product-wise concentration. If the ratio is 75 percent or more, concentration is considered to be High; if C3 is between 60 and 75 percent concentration is medium; 50 to 60 percent is low; and, if it is less than 50 percent, concentration is nil

⁶ Then the MIC examined the share structure, mode of management, and Board of Directors (BoD) composition. If more than 50 percent of equity capital is controlled by one particular industrialist or his close relatives, then the firm is considered to be controlled by one industrialist. Similarly, if company A and B control more than 50 percent of the equity shares of company C, and the business house X is found to control both companies A and B, then company C is also considered to be part of business house X. Besides, the information on BoD composition and managing agency was used to derive the final list. Jointly controlled firms, foreign subsidiaries, and banking sector firms were excluded from the list.

⁷ We understand that this is not comparable exactly. However, it gives a crude picture on the extent of concentration of wealth

⁸ Data in parenthesis shows the total number of deals and the number of majority transactions respectively.

⁹ A more detailed discussion on M&As undertaken by business groups is available in Reference removed for review purpose.

¹⁰ Citation removed to facilitate anonymous review

¹¹ Based on an earlier study of this author

¹² Table available on request

¹³ Table available on request

¹⁴ Citation removed for review purpose

Gender in innovation: the case of renewable energy resources in a rural setting

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Abstract

Access to energy for all is essential in enhancing sustainable development, but there is evidence that gaps in access to renewable energy (RE) resources can perpetuate gender inequalities. The technological oriented trends observed in the pursuit of energy resources for all have implications for gender and inclusion. This paper argues that although gender equality has been considered as a pathway to meeting the sustainable goals, there is lack of systematic approach on how this can be advanced in the energy sector. The goal of this paper therefore is to document evidence of gender in innovation through the lens of renewable energy resources in a rural setting. The aim is to enrich the debate on inclusive innovation by introducing the gender perspective. Through a qualitative study, evidence suggests that introduction of technologies in a rural community may not necessarily bring benefits to all in an equal manner. In the case of renewable energies, social and economic benefits are less accessible to women.

Key Words: Technological innovation, renewable energy resources, inclusion, gender, Kenya

1. Introduction

The target 7.1 of the Sustainable Development Goal (SDG) number 7 relating to “ensuring access to affordable, reliable, sustainable and modern energy for all” was set to “ensure universal access to affordable, reliable, and modern energy services by 2030”. Globally it is acknowledged that energy is critical to tackling major social, economic and environmental challenges and opportunities the world is encountering today. This implies that access to energy for all would be essential in enhancing sustainable development. The Sustainable Energy for All initiative advanced by the United Nations further recognizes the importance of sustainable energy for sustainable development (SEforALL 2013). Many countries including those in transition have devised policies and strategies to meet the 7.1 target of Goal 7. In Kenya for instance, a recently enacted Act of parliament (GoK 2019) commits to support renewable electrification in order to increase access to electricity by majority of Kenyans in the rural areas that are off grid.

The SDG 7 puts emphasis on leaving no one behind in efforts towards meeting the energy needs of the disadvantaged especially among rural communities such as women, in an affordable, reliable and sustainable way. This is complicated by the fact that securing access to energy in form of electricity, clean fuels or cooking technologies now requires consideration of energy systems that are off grid.

Energy is universally useful as development enabler at the national level but also essential at the households’ level for lighting, cooking and heating. There is evidence of increased decentralized renewable energy systems that are perceived to be cost-effective as a means to ensuring increased energy access for communities that are not yet connected to the grid (Alstone et al., 2015; Karekezi et al., 2009; World Future Council and Hivos, 2016; Yaqoot et al., 2016).

Access to clean, affordable, sustainable energy enhances economic development, poverty reduction, environmental sustainability and promotion of gender equality (SEforALL 2013). Promotion of modern and clean technologies for rural electrification such as wind and solar energy can provide rural communities with affordable energy, while also providing opportunities for empowerment through rural enterprises. However, the process of transitioning to modern and clean energy services has been hampered by failure to address the gender dimensions of energy (Pachauri and Rao 2013). There is evidence that gaps in access to energy and clean cooking fuels can perpetuate gender inequalities (ENERGIA 2019; OSSREA 2015; Khaemba and Kingiri 2020). Arguably, both energy access and gender equality are very

instrumental in attainment of SDGs especially in the economies under transition like Kenya.

This paper argues that although gender equality has been considered as a pathway to meeting the sustainable goals, there is lack of systematic approach on how this can be advanced in the energy sector. The goal of the paper therefore is to document evidence of gender implication in innovation through the lens of renewable energy resources. The aim is to enrich the debate on inclusive innovation by introducing the gender perspective, thereby strengthening the understanding about the gender implication linked to the deployment of improved technologies in a rural community setting. In doing this, the paper attempts to answer the following questions. What evidence exists of gender dynamics in the deployment of renewable resources in the Kenyan rural context? Hopefully this can further the discussions about gendering technological innovations as a pathway to meet the SDGs, especially Goal 7.

The rest of the paper proceeds as follows. The next section provides an overview of gender and inclusion in renewable energy resources focusing on emerging economies. This is followed by the methodological framework adopted for the paper. After this, the paper examines the aspect of inclusion as it plays out in the renewable technologies deployment pathway in a rural setting. The paper concludes with a few recommendations for policy and practice.

2. Overview of gender, inclusion and renewable energy resources

The deployment of renewable energy resources has intensified in the wake of increased global awareness about climate change. This has triggered policy relevant research and initiatives at global and national levels. Towards this end, research points towards perceived modern and clean technologies that can diversify energy supply, reduce energy imports in developing countries, and provide local and global environmental benefits (OSSREA 2015: xvi). The improved or modern technologies like the energy saving stoves, biogas and solar voltaic cells have been found to be quite prevalent in rural communities (Cecelski 2000). Access to renewable energy has been documented to have economic, environmental, health and social benefits to those who acquire it. There are multiple benefits for women who have access to renewable energy; which includes health, security, socio-economic empowerment, skills transfer and capacity building (Clancy et al., 2004; Tornieri, 2016). Renewable energy access and the efficiency of these energy options is seen as meeting multiple goals including gender equality and social inclusiveness.

Discussions on access to energy services are gendered, implying that women and men have diverse needs, while the activities of one may impact the opportunities of the other (ENERGIA 2019). Notably, the role of women in

enhancing access to energy resources has been recognized. At the level of communities, women are perceived to be responsible for major decisions pertaining to the uptake of sustainable energy technologies like clean cooking stoves and lighting devices. This implies that women cannot be ignored in the efforts to achieve universal access to sustainable energy services. These efforts are not without challenges because women are disproportionately impacted by unhealthy energy sources leading to respiratory illnesses, musculoskeletal injuries, eye diseases (Clancy et al., 2004; Kadota et al., 2020; Karekezi, 2002; Odeku & Meyer, 2019; Tornieri, 2016; UNDESA, 2016; WHO, 2018).

A lot of initiatives on deployment of energy resources especially those driven by governments have focused on electricity (mostly for lighting) and solar (for lighting) and rarely on energy for cooking a situation that is common in many rural communities. This has gender implications for energy access. A study in rural Bolivia found that electric lighting had little impact on the lives of men and women because daily livelihood activities in farming were not suited adaptable to electric lighting (Sologuren 2006). Since access to energy for cooking is highly gendered, the energy needs of both men and women must be factored in research and policy (Clancy and Feenstra 2005; Clancy 2006). In the case of Kenya, which is the focus of this paper, the Energy Act (GoK, 2019) in this regard has ignored gender and related implications. In the context of sustainable innovation and development, this implies that gender implications on deployment of energy resources may remain largely unknown. This has implication because 75% of Kenyans still rely on unclean fuels which have health and negative social, economic and environmental impacts (Clancy, Oparaocha and Roehr 2006; Kadota et al. 2020). Only about 25% of Kenyans who rely on clean fuels as a primary source of energy (RoK 2020).

Discussions on social inclusion through the lens of development and innovation have intensified (Khaemba and Kingiri 2020). The bone of contention is that growth may not necessarily improve the welfare of all citizens and might even reduce incomes in some social groups (Heeks, Foster and Nugroho 2014). Since social development challenges are largely concentrated in developing regions, improving the understanding of the role of inclusivity in development is especially relevant to these countries.

A number of analytical frameworks attempt to highlight gender disparities in the energy sector and among these the most notable ones advocate for gender sensitive energy research (Cecelski 2004). However, they are deficient in relation to a systemic analysis of gender and energy dynamics from the perspective of innovation (Khaemba and Kingiri 2020). Gendered research should promote understanding around the wider application of technological innovations being advanced in the energy sector for both women and men.

This paper argues that although gender equality has been considered as a pathway to meeting the sustainable goals, there is lack of systematic approach

on how this can be advanced in the energy sector. In doing this, the paper attempts to expose the practical ways through which inclusion innovation in renewable energy sector can be enhanced. Hopefully this can further the discussions about gendering technological innovation as a pathway to meet the SDG, especially Goal 7. To this end, the paper attempts to document evidence of gender implications on innovation in the access of renewable energy resources in a rural community setting.

2.1 Analytical and methodological framework

2.1.1 Conceptual framing: innovation and inclusion discourse

The discussion around inclusive innovation (referring to process) or innovation for inclusion (referring to outputs) has gained popularity in both policy and practice arena. Arguably, the main goal is the desire to include the “excluded” in various ways, with a view to addressing their needs (Heeks, Foster and Nugroho 2014; George, McGahan and Prabhu 2012). The discussions focus largely on the poor women, informal sector and other excluded groups like those with lowest income, youth among others. The ‘marginalised’ or excluded are further described as targeted consumers of outputs of innovation connected to economic/income poverty (Cozzens and Kaplinsky 2009; Cozzens and Sutz 2014).

In the World Bank report (2013:8), inclusive innovation is perceived as any innovation that helps expand affordable access to quality products and services that create and increase livelihood opportunities for excluded populations. The report outlines that understanding dynamics of inclusion is important because it may perpetuate social transformations that create new opportunities for inclusion and worsening existing forms of exclusion. George, McGahan and Prabhu 2012:663) define inclusive innovation as “the development and implementation of new ideas which aspire to create opportunities that enhance social and economic wellbeing for disenfranchised members of society”. Johnson and Andersen (2012) link inclusion of excluded people to capability deprivation which is connected to poverty alleviation. They argue that inclusion is best understood by answering the following key questions: who are the excluded people? from what are they excluded? and how and why are they excluded?

The understanding of connection between inclusion and innovation is implicit about the distinction between the process of innovation on the one hand, and the output of innovation in relation to inclusion on the other. Chataway, Hanlin and Kaplinsky (2014) make a distinction between process innovation and product innovation and the roles played by the poor as both producers and consumer. This suggests the importance of actors in the innovation process. In this context, inclusion (or exclusion) would be determined by nature of institutions (e.g. rules, policies etc) and the context arising from the system

nature of innovation process, the diversity of actors involved, forms of knowledge generated and learning occurring through the various linkages (Chataway, Hanlin, and Kaplinsky 2014; Joseph 2014).

Creation of opportunities for inclusion or participation in the innovation process to enhance specific outcome (especially social and economic wellbeing) may perpetuate exclusion in different contexts (Joseph 2014). Johnson and Andersen (2012) suggest the need to examine who is excluded, from what they are excluded and how exclusion is taking place where context plays a key role.

A critical look at the literature on inclusive innovation shows that gender is largely ignored. This paper is therefore motivated by the emerging discourse that aims to expand conversation about gender and inclusion from an innovation perspective. Khaemba and Kingiri (2020) for instance demonstrate the relevance of using inclusive thinking to understand access to renewable resources in emerging economies. Gender is also further ignored in empirical research focusing on sustainability and innovation. For instance, Jacobsson and Bergek (2006) focus on innovations for sustainable development, but primarily address technologies of general interest to sustainability, but not linked to a gender. This paper draws insights from Khaemba and Njoroge (2018) who with reference to energy note that gender and social inclusion entail an inclusive-based approach to policies and programs (including decision making, budgeting and implementation) incorporating needs and perspectives of women.

2.1.2 Methodology

The goal of this paper is to document evidence of gender implications on innovation in renewable energy resources. Consequently, the paper is informed by deployment process of selected projects (case studies) in a rural community setting. Case study research is a qualitative inquiry intended to conduct an in-depth analysis of an issue, within its context with a view to understand the issue from the perspective of participants (Creswell 2014; Yin 2014).

The methodological approach entailed analysis of these projects to understand the gender implications through the lens of women as the excluded group, what are they excluded from, and how and why are they excluded. The tools of data collection comprised of different qualitative methods namely, interviews, field visits, experts focus group discussions (FGDs) and analysis of relevant documents including unpublished reports on these projects. The data analyses involved content review of both secondary and primary data to expose thematic aspects of gender and exclusion/inclusion in the selected energy projects.

3. Evidence of gender implications on renewable energy resources deployment

This section documents evidence of gender implications on innovation in renewable energy resources represented by a cluster of green energy projects implemented between 2016 – 2020. The analysis is based on Johnson and Andersen (2012) who suggest the need to examine who is excluded, from what they are excluded, how and why exclusion is taking place, and implication thereof.

3.1 Analysis of the selected energy projects from an inclusive innovation lens

Background about the projects

The cluster of the seven green projects that informs this paper was part of a Strategic Partnership - Energy (SP-E) five-year program in East and Southern Africa focusing on Gender and inclusive Green Energy Sector. The program was implemented by a pan-African knowledge think tank pursuing policy-oriented research for sustainable development in Africa. The selected seven projects focused on investments, adoption and use of renewable energy (Table 1). These projects were selected based on a set criteria of them using renewable energy and having women involvement and benefiting women in the community in demonstrable ways. The county government of Kisumu was instrumental in identifying the projects in their role as ACTS partners for the SP-E project. All the projects presented here involve women either in the design, management or as beneficiaries of the project outputs. These projects were explored through the lens of gender equity and social inclusion.

We draw insights from the inclusive innovation thinking and in particular the notion that creation of opportunities for inclusion or participation in the innovation process to enhance specific outcome (especially social and economic wellbeing) may perpetuate exclusion in different contexts (Joseph 2014). We further explore the nature of participation with a view to understand who is benefiting, potential for exclusion (or inclusion), from what they are excluded (or included) and how and why exclusion/inclusion is taking place (Johnson and Andersen 2012). The presentation of the projects is done with the view to understand gender implication on innovation in these projects.

Table 1: Details of the selected projects under case study 2

No	Name of Project	Type	Ownership	Beneficiaries	Reach
1.	Flexi Biogas Project 1	Biogas from water hyacinth	AstraZeneca and Cambridge Institute for Sustainability	Women who fry fish and cook with biogas at the beach as well as community members who want	Project has installed over 60 domestic biogas systems in the

			Leadership	to install biogas	targeted beach area
2.	Solar Power Box Project 2	Solar	County government	Women and other traders at the market who benefit from lighting at the market translating to longer working hours and increased security from the solar floodlights	Approximately 100 traders at the targeted market
3.	Solar Hybrid Water Project 3	Solar	County government	Community members connected to the water supply	Unknown
4.	Pottery project 4	Clean Cookstoves	Women Group	Women who make the cookstoves as well as those who buy for use in their households with benefits ranging from increased income, reduced indoor air pollution and reduced amounts of fuelwood	2,000 cookstove liners per month and 60 cookstoves per month
5.	Biogas Bio-Tower project 5	Biogas from community latrine	Community	Women who cook at the communal cooking site with benefits including reduced exposure to indoor air pollution and saving of time that would have been used in firewood collection	65 women (on average) use the facility per day for cooking purposes.
6.	Solar Borehole project 6	Solar	School	Schoolchildren and the community have benefited with access to clean and reliable water. Time spent to go long distances in search of water is	The targeted primary school pupils and the community

				saved considering that County 2 is Arid and Semi-Arid Land (ASAL)	
7.	Solar Mini grid project 7	Solar	Community	Community with access to electricity for lighting, powering TVs, charging phones, welding etc.	Up to 3000 people including a school, a health centre, 5 businesses and households in the study area which are connected to solar.

All the projects were implemented at the community level, so the larger community is evidently at the first instance, the beneficiary. This includes the government, women, men, youth, children and persons with disabilities (PWDs) and the projects therefore aimed to meet their specific needs. At the implementation stage, women formed a majority of beneficiaries, with Project 4, Project 5 and Project 6 leading in terms of women being the major beneficiary.

Benefits to women

The women are benefiting in various ways in the many projects. For Project 1, Flexi biogas, women who earn a living as fishmongers are able to fry their fish easily with the biogas as opposed to using charcoal or firewood. This ensures access to clean and affordable energy for cooking. This project was started in the area by youth who saw an opportunity to generate biogas from water hyacinth from Lake Victoria and also install portable biogas systems in homes. The portable biogas systems are easy to install and maintain by women themselves who are the ones mostly involved in cooking. For Project 2, Solar Power Box which is located at the Holo market, women traders are the main beneficiaries being the ones mostly selling their groceries and other wares at the market. With the solar lighting the women are able to work longer hours after dark because they have lighting and customers can come to the market after dark as the place is lit and there is a sense of security. The project was funded by the Kisumu County Government at the request of the market association made up of the women traders. The Solar Hybrid Water borehole (Project 3) benefits women who would have otherwise walked long hours to fetch water from a well, river or other source far away. The water makes this journey shorter and they can easily access water near their residences. This project is also funded and run by the county government, it was set up at the request of

the community members. There are now plans to pipe the water to homes as a way to further respond to user needs and inputs.

Pottery project (project 4) is fully owned and managed by the women who are themselves potters making an impact in clean cookstoves. They design the cookstoves and make them to suit their needs and sell them to other women and others. The cookstoves they fabricate use less firewood and are cleaner compared to ordinary cookstoves thus providing other women with clean alternatives. The women came together to form a group that would enable them develop clean cookstoves to address challenges they faced and also generate income to sustain their livelihoods. This innovation specifically addresses women's needs and the group has over the year's modified their cookstoves to meet evolving needs and ensure more efficient cookstoves. Biogas Bio-Tower (project 5) ensures that women can cook using clean energy thus protecting themselves from health issues that come with cooking with firewood and charcoal. This is a community-led project that arose out of the need to provide clean cooking options for women using the biogas generated from the community latrines. There are plans to install home biogas systems to further meet user needs since at the moment women have to cook communally at the biogas centre.

Solar Borehole (project 6) located at a primary school provides women and children in the area access to water nearby thus saving them time and energy that would have been used to get water from elsewhere which is further away considering that the area is arid and semi-arid and classified as water scarce. Solar Mini grid project 7 managed by the community provides electricity to various community amenities including a health centre as households ensuring they have access to clean energy. The project has also employed women as the managers of the project and trained technicians with the skills and know-how to operate and maintain the project. The project was set up with external support as part of an initiative to connect the community to a clean, reliable and consistent source of energy. The cost of electricity generated from this project is however high due to the high running costs involved and the fact that it is yet to reach full generation capacity, meaning that the poorest including women are not able to easily afford it.

In terms of process and outputs, all projects sought to address an energy problem and in some cases this links to water availability both significant since in most communities women are the ones charged with the responsibility of fetching water and firewood for their households.

Debatably, more could be done to ensure the full engagement and participation by women. The importance of inclusivity cannot be overstated, this was aptly captured by a respondent with a disability who remarked that, 'solar lighting has helped us a lot, and there is no danger of an accident as was the case when using a kerosene lamp'. A beneficiary of the Solar Borehole project 6 noted that

the project 'haina ubaguzi' a Swahili expression denoting lack of discrimination or 'inclusive'. The beneficiary further added, *"as long as kuna jua kuna maji" which means "availability of sun implies availability of water, since solar technology propelled water generation."*

These projects demonstrate aspects of inclusivity in the renewable energy sector and point to ways in which further inclusivity can be achieved. Considering that energy especially household energy for cooking and access to water specifically benefits women (Matinga, Oparaocha and Winther 2012), the aspect of inclusivity becomes key. The projects demonstrate that women are innovators and further show that women have the capacity to innovate and manage the projects. They therefore benefited most from these projects especially the Biogas Tower project 5, Pottery project 4, Solar Water project 6 and the Solar Power Box project 2.

3.3 Pathway to inclusivity in deployment of renewable energy resources

The goal of the paper is to document evidence of gender implication on innovation through the lens of renewable energy resources. We explore in particular creation of opportunities for inclusion, examination of who is excluded, from what they are excluded and how exclusion is taking place. The implication of this is revisited in the conclusion and policy recommendations.

A detailed analysis on pathways to inclusion suggests a number of insights in relation to the projects (see also Annex 1). First, all the technologies considered are renewable which shows some efforts to look into the sustainable energy for all goal (SDG 7). In addition, they reflect that innovations in this sector can enable inclusion. Arguably, these technologies provided additional benefits of reduced indoor air pollution which disproportionately impacts women and girls (Clancy, Oparaocha and Roehr 2006; Ngeno et al. 2018). Second, affordability affects inclusivity because the participating community members were able to access and benefit from the initiatives only to the extent that they could afford. For those that were not able to afford yet considered as 'energy-poor' could still not enjoy clean cooking. This is particularly so in the case of the Bio- Tower project 5 and Flexi Biogas project 1 with fairly low pricing. It is notable that, even though the Solar Mini-grid project 7 reported higher costs as compared to on-grid connections, it still enabled access for the off-grid community and benefitted 3,000 people. Third, contribution to livelihood generation is another key element of inclusive innovation. The women fabricating energy-saving cookstoves at the Pottery project 4 for instance, are able to generate income from the sale of the cookstoves similar to the Flexi biogas youth project 1 who generate income from installations. Increased capacities especially technical training could go a long way in increasing innovation within projects (Chinigo and Kingiri 2013). This would enhance inclusion through engagement of an increased number of people as this appears

to be a limiting factor especially for women who are often excluded where skills that enhance income generation are concerned.

A vast majority of beneficiaries from these technologies are women due to the fact that most of them relate to cooking and water access which are gendered roles (Clancy, Oparaocha and Roehr 2006). Considering that women are the ones primarily charged with cooking and fetching water for household use, the projects reduced the drudgery for women involved in walking long distances in search of water and firewood. The fact that they are also actively engaged in these projects through various innovations, is a clear demonstration not only of their industry, but also their central role in shaping technologies in this area.

The fact that Flexi Biogas project 1 had designed and set up a cooking area for the women and other fisherfolk at the beach to better meet their needs, is a reflection of the potential of social innovation to meet the needs of the community. Additionally, they set-up household biogas systems due to interest generated from this initiative. Plans by the government of County number 1 to expand the Solar Water Borehole project 6 and the Solar Power Box project 2 to other areas to meet the needs of other community members is also reflective of a quest to include those excluded. Inclusive innovation is also about building capacity and skills. Skills and knowledge on drafting a bioenergy policy were also acquired and capacity to engage in gender-sensitive design and implementation of projects as demonstrated in the case study 1. This may contribute to livelihood generation when the skills gained are applied. In the case of the Pottery project 4, women gained increased capacity to produce more cookstoves and liners earning a local reputation for quality products. A follow-up study on the COVID-19 impacts showed that sales for the Kenya ceramic jiko made by the women group had increased significantly¹.

Some key insights drawn from the analysis of these projects include the fact that women participation in renewable energy resources is mostly centered around access to energy for cooking as well as a source of livelihood. Innovations in this sector should therefore take this into consideration as one way of enhancing inclusivity. It is also notable that there is low technical capacity for women, in renewable energy projects especially solar, wind and biogas thus excluding women and other disadvantaged groups from participating in decisions pertaining to their deployment.

While the selected case studies demonstrate evidence of gender and social inclusivity, there are still gaps that need to be addressed specifically around ensuring that cost and technological know-how is not a barrier to technology deployment. However, the case studies show a range of creative approaches or pathways to ensuring gender and social inclusion. This lends credence to the assertion that there is no 'one size fits all' (Sokona 2018) on the road to sustainable energy for all.

4. Conclusion and recommendation

It is noted that analyzing of gender implications on innovation in renewable resources through social inclusion lens exposes elements of exclusion of the socially disadvantaged groups in different aspects of development (SEforALL 2018:11).

This paper set out to explore evidence of gender implication on innovation and what are some of the practical pathways for enhancing inclusion in renewable energy technologies in a rural setting. Through the lens of selected case studies, the study finds that, the introduction of new technologies may not necessarily bring equal benefits to women and men. In addition, technologies emphasizing economic sustainability are usually less accessible to women and inequalities are usually embedded in the social and economic structure which inhibits access for women. As these inequalities are reproduced, they strongly affect the pattern of access to resources. While the conceptual underpinning provides a way to think about how and if gender and social inclusiveness is incorporated, it also provides a way of understanding that local 'innovation' is a main driver in the quest for sustainable energy for all. The case studies offer examples of how this has/could be implemented. One key insight from the case studies is the fact that there are strong linkages between energy access, technology development and livelihoods. Further, participation of women in renewable energy resources is often centered around access to energy for cooking in addition to being a source of livelihood. This is a challenge because they are disadvantaged with regards to low technical capacity that reduces their participation in renewable energy resources related activities.

Some of the recommendations for policy and practice include:

- The relevant stakeholders including policy makers and entrepreneurs should devise strategies to make sure that both men and women benefit from energy resources and services.
- Endeavour to include both women and men in the process of design/choice of technologies.
- Enhance the technical capacity for women, men and PWD in renewable energy projects especially solar, wind and biogas. This is one way to increase their capabilities to gainfully participate in relevant activities.

Overall, an appropriate policy is therefore needed to make sure that women can really access and enjoy the benefits of bioenergy related projects and activities. This calls for generation of gender disaggregated data at different stages of the project's implementation. This enables determination of the impact of the initiatives on both men and women, and whether benefits are equally shared.

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Notes

¹ Attributed to its affordability but also COVID-19 impacts such as loss of livelihoods, increased household sizes, urban-rural migration, high fuel prices, high cost of LPG among others.

Economic Reintegration of Return Migrants in Kerala Lessons from Collective entrepreneurship models

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Abstract

Kerala, till recently the hub of international migration to the gulf region is now having an increasing flow of return migration even as emigration is slowing down. For a developing region highly dependent on remittances even as high unemployment persists, return migration poses an economic challenge. In this context re-integration of these return migrants within the local economy is of importance. This paper examines the trends, patterns and profile of return migrants to Kerala. It further looks into the factors that determine their participation in the local labour market after they return. A review of the best practices in the return migrant policies across the globe is attempted to open policy choices for the local economy. The paper puts forward the case of labour collectives/co-operatives as a way of re-integrating the return migrants back to the Kerala economy thereby ensuring job security and a reasonable livelihood option for the returnees as well as the generation of productive assets in the economy. Taking in lessons from case studies of few existing Pravasi co-operative models, the paper suggests policy recommendations for the formation of collectives as an effective re-integration strategy

1. Introduction

Kerala has a long history of international migration. Ever since the oil boom in Gulf countries during the 1970s, the gulf region has been the predominant destination for the emigrants from Kerala. Migration from Kerala is temporary majorly because of the limitations in permanent residency in the gulf countries. (Dustmann et al, 2007) consider differences in relative prices between host and home country, complementarities between consumption and the location where consumption takes place and the possibility of accumulating human capital abroad, which enhances the immigrant's earnings potential back home as three motives behind temporary migration. According to Kerala migration surveys, "about 90 percent of Kerala migrants leave for the Gulf for temporary contract employment. The Gulf does not provide citizenship. All of them have to return back to Kerala once their contract expires". Thus, return migration to an overwhelming majority of emigrants is inevitable and this is reflected in the tapering off of net migration from Kerala. The slackening of net migration is on account of both slowdown in out migration and increasing rate of return migration. Among multiple reasons some of the issues that has contributed to the weakening of net migration are the nativisation of jobs in the gulf region, the financial meltdown and slow recovery, oil price fluctuations, increasing identity based preferences, increasing cost of living, increasing migration from other low wage competing regions and countries and to some extent increasing wages and salaries in the source region (Sasikumar and Timothy 2015; Khan and Arokkiaraj 2021). Added to this is the COVID 19 induced repatriation of migrants to Kerala in large numbers in a short span.

Even as the enabling conditions for international migration from Kerala are weakening, the structural economic problems within the Kerala economy pose re-integration of these return migrants a challenge. With return migration increasing Kerala is now facing the ominous problem of unemployment creeping up. Return migration from a typical overseas labour market without major shocks would be largely guided by current wages, past savings and retirement. However, return under various shocks, as mentioned above, would be under vulnerable and precarious conditions. (Rajan and Pattath, 2021) show that low wage return migrants are a major share of the COVID 19 return migrants. Moreover, return migration is a double edged problem for Kerala. Gulf return migrants occupy a unique space in the Kerala economy as they have contributed immensely to Kerala's economy and helped in improving economic and social situations of the state. Various studies claim that remittances to Kerala to be substantial, could be as high as 20 to 25 percent of the Gross State Domestic Product of Kerala. Return migration would thus not only add unemployment but also dent the flow of remittances to Kerala. Reintegrating the return emigrants in a way that benefits the source region and the return migrants is thus visibly a challenge to the source region.

Reintegration is a process which enables individuals to re-establish the economic, social and psychosocial relationships needed to maintain life, livelihood and dignity and inclusion in civic life (International Organization of Migration, 2020). A temporal classification of returns has four categories namely occasional, periodic, seasonal, temporary and permanent returns (King, 1978). From a policy perspective, more attention needs to be placed on permanent returns and their accommodation into the local economy. The role of state in the economic integration of the return emigrants into the Kerala economy becomes necessary as the returnees have to be provided with a stable and sustainable livelihood option to make up for the reduction in remittances as well as to ensure that the returnees don't contribute to the increasing unemployment in the state.

Given the above context it becomes imperative to analyse the nature of re-integration of the return migrants to the Kerala economy. Integration of return migrants into the productive economy has to occur by enabling re-entry into the economic system through one or more of the economic flows, as producers or as input providers, such as capital and labour. The existing re-integration strategies in Kerala incentivizes returnees to engage in entrepreneurial ventures and self-employment. While such strategies benefit those returnees who had a successful migration experience, it excludes a major chunk of distressed returnees who come back to the home country with very limited savings. Such distressed returnees may remain as outliers who are unable to join the local labour market mainly due to factors such as lack of demand for labour, lack of market information on labour demand, skill mismatches that deter labour market matching, lack of trust on the worker including her skillsets and social status associated with locally available employment options.

One of the ways to integrate the return migrants could be by collectivising them as workers. Kerala has seen the growth and expansion of a number of collective efforts such as the MILMA, KUDUMBASREE, etc. Among workers collectives the most famous is the ULCCS Ltd that has grown into a major presence in Kerala. Apart from the job security that ULCCS and similar other collectives provide they would provide also the basic social cover required for decent living. The study analyses the profile, trends and patterns of return migration to Kerala and analyses the nature of economic re-integration for the return migrants. The next section provides, trends and patterns of return migration, review of re-integration strategies across the globe and insights and way forward from case studies of few existing workers' collectives in Kerala that suggest formation of labour cooperatives for returnees as a potential re-integration strategy for returnees.

Trends and patterns of return migration to Kerala

a. Numbers and Composition: The outflow of migrants from Kerala is reducing, secondly the inflow of return migrants is increasing. Kerala had witnessed an

increase in the outflow of emigrants till 2013. The stock of emigrants from Kerala had increased from 1.4 million in 1998 to 2.4 million in 2013. However, the survey estimated a decline in the number of emigrants to 2.27 million in 2016 and 2.12 million in 2018. The trends are probably an outcome of multiple factors both at the destination and the source region. The nationalization policies due to demographic pressures in the receiving countries, recession in the gulf countries, supply of cheaper labour from countries like Philippines, Srilanka, Nepal, Egypt, Bangladesh as well as from other states in India like Rajasthan, West Bengal and Telangana have contributed significantly to this decline in outmigration and increased pace of immigration. During the same time Kerala had witnessed rising wage rates and rising demand for skills with the emergence of new technology sectors. The decline in the number of emigrants is alarming owing to the fact that Kerala accounts for 20 percent of the total remittances to India and 36.3 percent of the State Domestic Product of Kerala. The role of remittance in the development trajectory of Kerala cannot be neglected.

Table 1: Number of emigrants, return emigrants and their Compounded Annual Growth Rate across various rounds of KMS from 2008-2018

	2008	2011	2013	2016	2018
Number of emigrants (EMI) (in millions)	2.19	2.28	2.4	2.27	2.12
Number of return emigrants (REM) (in millions)	1.15	1.15	1.25	1.27	1.29
CAGR of EMI	-	1.013	1.025	0.981	0.966
CAGR of REM	-	0.998	1.043	1.006	1.006

Source: Estimated from the KMS various rounds

b. Migration Destinations - First and Last Countries: Table 2 shows the country that the REM was living in before returning to Kerala. While 97 percent of the REM return from GCC region and mostly from UAE, Saudi Arabia and Oman, the interesting thing to be noted is the decline in the returnees from OECD countries. This could be indicative of the permanent migration opportunities that many of the OECD countries have. On the other hand, "Arabisation" policies, especially the Saudi nationalization policies introduced since 1994 to the recent Saudi Vision 2030's reforms, announced in 2016, reducing the number of unemployed Saudi nationals as a key element of the plan could be the reason for fluctuating emigration to Saudi Arabia and the GCC. The slowly increasing emigration to the various OECD countries of skilled Keralites have also contributed to slight decline in the emigrants to GCC. This is significant as reintegration into local economy should be the focus in the case of temporary or contractual emigration where return is inevitable in the migration process.

Table 2: Share of REMs in terms of Country from where the REM returned

Country share(In %)	2008	2011	2013	2016	2018
UAE	34.22	37.81	33.43	36.06	33.30
Saudi Arabia	33.38	28.92	35.73	29.87	38.12
Oman	12.67	11.9	9.89	11.94	12.02
Qatar	4.32	5.33	5.00	4.58	4.91
Kuwait	5.15	3.8	4.18	4.06	4.31
Bahrain	4.91	6.27	3.27	6.45	4.72
OECD	1.13	1.53	1.20	1.23	0.69
Others	4.22	4.44	7.30	5.81	1.93
Total	100	100	100	100	100

Source: Same as Table 1

Table 3 is a cross tabulation of the country of first migration and of return of an REM. Looking at the nature of migration, it can be noted that a majority of the return migrants had spent their period of migration in one country. Most return migrants who had arrived from a country in the GCC region had first migrated to the same country. This suggests that transition to different countries during the migration cycle is not that frequent. This was more or less consistent throughout the period 2008 to 2018. However, one notable exception is that most migrants who returned from the OECD region were not first time migrants to the OECD. These migrants had moved from some other country to the OECD before returning to Kerala. This could be due to the difference in the entry barriers in the GCC and OECD.

Table 3: Cross tabulation of country of first migration and of return

		Country of return							
Country of first migration	Year	UAE	Saudi Arabia	Oman	Qatar	Kuwait	Bahrain	OECD	Others
Same country	2008	89.53	94.27	88.76	86.36	81.9	88	64	89.16
	2016	94.63	88.12	91.35	92.96	95.24	90	84.21	86.67
	2018	89.12	89.65	85.5	85.05	87.23	80.58	46.67	76.19
Another country	2008	10.47	5.73	11.24	13.64	18.1	12	36	10.84
	2016	5.37	11.88	8.65	7.04	4.76	10	15.79	13.33
	2018	10.88	10.35	14.5	14.95	12.77	19.42	53.33	23.81
Total	2008	100	100	100	100	100	100	100	100
	2016	100	100	100	100	100	100	100	100
	2018	100	100	100	100	100	100	100	100

c. *Duration of Stay and Age of REM:* Duration of stay abroad is calculated as the difference between the years in which a person first migrated and returned. This accounts for the time spent by the REM abroad. This is an important factor

in knowing the years of work or experience that the REM carries upon return. Table 4 shows that majority of the REM have spent up to four years abroad. Among the return migrants the share of short term migrants seems to be declining while that of long term of migrants seems to be increasing over the years. In 2008, 41% of the returnees had spent four years or less in their destination before returning. In 2019, this share declined to 31.8%. The share of migrants returning after 5-9 years and 10-14 years remained at about 20% and about 13 % respectively throughout the period. However, returnees with 20 to 24 years of stay increased from 7.7% to 8.7%, while 30-34 years increased from 1.2% to 4.3%. The increasing percentage of REM who have stayed abroad for longer periods is indicative of their longer period of work abroad. This will have a significant impact on the experience and skill that they carry upon return.

Table 4: Duration of stay abroad

Duration of stay abroad	2008	2011	2013	2016	2018
	(In %)	(In %)	(In %)	(In %)	(In %)
0-4 years	41.19	46.59	38.76	36.26	31.83
5-9 years	21.7	19.4	21.85	20.77	19.59
10-14 years	14.19	12.78	11.82	12.97	13.81
15-19 years	8.74	8	9.8	10	10.37
20-24 years	7.76	6.27	8.69	7.55	8.76
25-29 years	4.27	3.7	4.71	4.97	6.61
30-34 years	1.28	1.88	3.07	3.68	4.31
35-39 years	0.49	0.74	0.82	2	2.8
40-44 years	0.1	0.25	0.24	0.97	1.01
45 and above	0.15	0.4	0.34	1.23	1.56
Total	100	100	100	100	100

d. Education level: Table (5) shows the education level of REM across various rounds of KMS. There is higher proportion of REM who has secondary school level education, about 50%. About a quarter who return have only middle school or lesser education. Thus more than 70% of the REMs have low levels of formal education. However, it can be noted than over the years there is some small change in trends. For instance, the share of middle school or less REMs declined from 25.8% to 20.6% during the period 2008 to 2018. While that of the share of REM with degree level of education is showing an increase. While the earlier trends in migration was of low skilled emigrants with low levels of education, this pattern is changing and becomes an important aspect in the reintegration of REM. Appropriate employment opportunities that match their skills, education, experience abroad should be given enough consideration while designing the re-integration strategies

Table 5: Education level of REM

	2011	2013	2016	2018
Middle School or less	25.81	26.48	20.7	20.64
Secondary School	49.26	46.66	52.12	49.82
Higher Secondary School	10.51	10.24	10.13	11.37
Degree (College/Univ)	11.64	13.19	14.07	16.29
Above Degree(College/Univ)	2.77	2.53	2.96	1.89
Total	100	100	100	100

e. Economic Activities of the REM - For the return migrant the most prominent economic activities post return were self-employment, and working as labourers in non-agricultural sector (Table 6). Both these sectors together accounted for about 52% of the total returnees. Other prominent activities included not working on account of pensions, and household works. During the period 2008 to 2018, this distribution remained more or less stable during the entire period. However, there is a marginal rise in employment in the private sector from 9.7 % to 11.8% during the same period. Self-employment as a preferred choice of employment type is mainly due to the ability of the return migrants to set aside part of their savings for establishing a small or medium enterprise. Yet, those returning without the savings to start an enterprise would become employees.

Table 6: Economic activity of REM

	2008	2011	2013	2016	2018
Salaried employed in public sector	2.16	1.08	1.78	1.74	1.15
Employed in Private sector	9.72	9.82	10.34	10.58	11.88
Self-employment	22.93	22.06	22.04	22	26.88
Unpaid family work	3.24	2.17	2.71	3.87	0.78
Agricultural labour	4.81	7.06	5.17	3.16	5.73
Labourers in non-agri	27.98	27.64	27.65	31.1	27.16
Job seekers	6.33	5.63	5.41	4.71	4.68
Students	2.6	3.06	2.08	2.13	1.01
Household works	7.41	7.06	6.33	4.71	3.76
Pensioners, too old to work	9.28	8.05	9.23	8.77	11.33
Others	3.54	6.37	7.25	7.22	5.65
Total	100	100	100.0	100.0	100.0

Table (7) gives an overview of the percentage share of REM in an economic activity before, during and post migration periods. It is observed that in the pre-migration period most of them worked as labourers in non-agricultural activities followed by salaried employed in private sector, self-employment and

a high proportion were jobseekers. The steady fall in the share of jobseekers during the migration phase indicates clearly that migration has been a promising source of livelihood and income generating mechanism for the state. During migration, there is a shift in the major economic activity to employment in private sector with half of the REM engaging in the same. Also a majority of them work as labourers in non-agricultural sector which pays four to five times of what they used to earn in Kerala for the low skilled workers. There is also a decline in the share of those who engaged as agricultural labourers.

Post migration it is evidently shown that the share of jobseekers is in a rise, pointing out at the importance of economic reintegration for the REM. As pointed out in several studies, the share of REM engaging in self-employment post migration is high. A major share of them engage in non-agricultural labour activities which accommodates a sizeable share during all the three phases of migration.

Table 7: Economic activity of REM before, during and post migration

Economic activity	Year	Pre- migration	During Migration	After rerturn
Employed in Private sector	2008	15.66	-	9.72
	2011	12.93	52.96	9.82
	2013	15.9	56.34	10.34
	2016	-	46.58	10.58
	2018	-	55.46	11.88
Self-employment	2008	14.53	-	22.93
	2011	9.33	2.17	22.06
	2013	14.17	3.94	22.04
	2016	-	4.13	22
	2018	-	5.83	26.88
Labourers in non- agri	2008	39.08	-	27.98
	2011	33.61	30.6	27.64
	2013	35.59	27.62	27.65
	2016	-	36.13	31.1
	2018	-	29.54	27.16
Job seekers	2008	11.78	-	6.33
	2011	17.28	1.48	5.63
	2013	16.38	2.45	5.41
	2016	-	3.03	4.71
	2018	-	1.01	4.68
Elderly, too old to work	2008	0.2	-	9.28
	2011	0.3	0.2	8.05
	2013	0.39	0.48	9.23
	2016	-	0.06	8.77
	2018	-	0.23	11.33

others	2008	18.75	-	23.76
	2011	26.55	12.59	26.8
	2013	17.57	9.17	25.33
	2016	-	10.07	22.84
	2018	-	7.93	18.07

Note: The missing values indicate data not collected for that particular variable in the given round

Table 8) provides a detailed analysis of the industry in which REM enters into before, during and after migration. Before migration, the share of people in industries like agriculture and allied activities, construction, wholesale and retail trade and transport, storage and communication constitutes more than 50 percent. During migration, share of people in agriculture falls significantly with a rise in the share in manufacturing, construction, wholesale and retail trade as well as in various industries in the service sector like education and health services, hotels and restaurants, personal services and in the transport and storage sector. Post migration, the share of people engaging in agriculture increases even more than to the level before migration. While the share of people in manufacturing, construction, wholesale and retail trade and few of the services like hotel and restaurant, personal services show a decline, services like transport and storage accommodates almost the same share of people in all the three phases.

It may be expected that REMs who return to their place of origin seek employment in industries that they had worked during their migration phase. Such preference may emerge from the skills acquired, the social network and lower search costs due to better information of the sector. However, getting employed in the same industry in the place of origin depends on demand conditions and skill requirements in place of origin. Table 12 below shows the share of current employment of REMs across different industries and the share of the workers who worked in the same industry during their phase of migration. As can be seen below during 2011 about 54.3% of the migrants who returned were able to find employment in the same industry as during their phase of migration. But in 2016 this share declined to only 46.3 % implying a lesser possibility of re-integration into the local economy through employment. These workers who are not able to find employment in the same industry may incur additional costs of integration. It can also be noted that while in industries that require low or medium skills the REMs are able to find jobs in the same industries, in the higher skilled industries such as education, health, finance etc. there is much less continuity of employment.

Table 8: Re-integration of REMs into local economy

Current industry	2011		2016	
	Share of current employment of REMs	Same Industry during migration	Share of current employment of REMs	Same Industry during migration
Agriculture, Forestry	18.1	70.6	3.7	15.8
Mining and Quarrying	0.6	66.7	0.2	0.0
Manufacturing	4.5	68.4	5.4	44.9
Electricity, Gas and water	3.6	75.0	3.8	60.0
Construction	27.1	78.4	26.6	65.2
Wholesale and retail	10.8	49.3	16.7	49.2
Repair of motor vehic	3.3	77.1	5.2	61.3
Hotels and Restaurant	4.9	61.1	6.6	44.4
Transport, Storage an	17.9	71.2	11.5	48.2
Financial meditation	0.4	20.0	0.3	11.1
Real Estate, relating	0.4	11.5	0.4	21.4
Education, health, so	2.3	44.8	3.2	32.6
Personal / other serv	3.6	42.4	5.4	23.6
Others	2.5	19.2	11.0	47.0
Total	100.0	54.3	100	46.31

The socio economic profiles of the returnees present a mixed bag with both educated and uneducated, skilled as well as semi-skilled, old as well as young, savers as well as non-savers, experienced as well as in-experienced. This points out the need to come up with an integrated reintegration strategy/policy that accommodates all of them instead of the existing ones that's not inclusive for all.

Collective formation among Return Migrants: The potential

While a sizeable minority of the migrants come back 'successful', having earned sufficient and now voluntarily return, majority of them arrive with unfulfilled dreams, often unable to clear off the debts that they incurred for their migration or on account of future expectations. For those who are returning to Kerala involuntarily, under distress, or even for those returning voluntarily looking for income earning options re-entering the economic space in Kerala is necessary. However, re-entry into Kerala's economic space may be constrained by various factors. Such as Stigma of labour, Skill and occupation mismatch, Poor capital base among some returnees, Lack of knowledge of local institutions. Given the above context, cooperation is an opportunity for re-entry to active economic life post return. Formation of cooperatives can act as a bridge for their smooth transition to the local economy. Furthermore, it can as a bulwark against social and economic risks faced by the returnees. Firstly, cooperation among return

migrants can work because there is a sense of collective identity among returnees, as having experienced similar cultural and economic life, but that stood different from the local. This collective identity is the informal bond that glues a formal collective together and sustain it. Their ability to empathise with their own and specific issues would be higher. Secondly, they arrive with skills and work experiences that are different and perhaps more advanced than the local economy. Even when they are re-integrated to the local economy these skills could be exploited if such products and services are developed. Thirdly, collectives could pool in resources, both capital and labour among the return migrants to produce. The fact that among returnees both these resources are available in some abundance can be suitably utilised if they are brought together. Fourthly, collectives bring in a sense of ownership among all the participants such that even if they are engaged in work, their stigma associated with work in the local economy would be now absent as they are the employers too. Fifthly, collective production of goods and services would also imply collective responsibilities and better risk bearing capacity.

The existing eco-system for cooperatives in Kerala provides a fertile soil for such collective formation among the return migrants as well. As described above the already existing institutional structure and history can enable the establishment and growth of cooperatives for return migrants. In fact, there already exist the “Kerala Samsthana Pravasi Kshema Vikasana Sahakarana Sangham Ltd (KSPVSS)’ and “NRI & RI Welfare Co-operative Societies” two federal cooperative bodies that looks at the interest of the return migrants. There are a number of credit and primary societies that are already working with the aim of improving the welfare of return migrants that are federated under these two federal bodies. According to the office holders of the KSPVSS there are around 200 Pravasi cooperative societies already of which 140 of them are functional.

Collective formation among return migrants: Lessons from case studies

In order to understand the potential, challenges, opportunities and threats for collective formation among return migrants we conducted case studies of seven cooperatives located in various parts of the State. We draw here lessons from these case studies. The issues and concerns are arranged below thematically.

(i) Goals set by Pravasi Cooperatives

The major aim of return migrant ‘Pravasi’ cooperatives was to rehabilitate returnees and to find different ways to rehabilitate them, to help rebuild their life back in their native place because 90% of returnees come back without a fall back mechanism. The solution they found was to collectivise those with savings and make them invest in new business and give them back the dividend received from it. The second is to create employment opportunities for those returnees who are able to do work.

(ii) Activities undertaken by Pravasi cooperatives

In general, the most common activity undertaken by Pravasi Cooperatives were investment and credit services mainly focusing on the current and return migrants. Our interactions with different cooperatives also maintained this as the most prominent and preferred activities undertaken by Pravasi Cooperatives.

Financial services usually include chit funds, deposits and loans. Only members are encouraged to take part in the financial activities though non-members do occasionally approach for gold loans. During discussions it was clear that the cooperative societies are able to provide higher interest on deposits and lower interest on loans from the societies due to the state subsidies. The interest rates act as a very strong attraction for both depositors and loanees to join as members in the societies. For the investor migrant this was a means to earn higher returns to his investment. Additionally, some of the cooperatives were able to take a lenient approach towards collateral for loans. The strong migrant social network works against loan defaulting. The highest profit generating activity is chit funds. The win- win situation for investors, loanees and cooperative members made this the most popular cooperative activity among the migrants. However, it also implied that the potential resources for productive investment were locked up as financial assets and not getting converted to productive assets.

Apart from financial services, a few large cooperatives had ventured into other productive activities. One cooperative in Malappuram had a large Information Technology Division where the main activity was development and maintenance of software applications for collection agents of chits and loans. Initially the IT division was opened to operate and manage the expanding set of collection agents for the chits and loans for the cooperative. Later, as the operation was getting larger, other agencies including Matsyafed have approached this firm for application support. This is an example of how skills and technology have been appropriately utilised by a cooperative, though in this case the skillset was locally sourced.

Other services provided include Pravasi Seva Kendra where all services required for Pravasis are provided at the Seva Kendras. Some cooperatives also conducted short term courses with an aim of providing employability to graduates. This includes employment opportunities like being a GST practitioner. These courses are aimed at providing early career opportunities for graduates who wish to emigrate to a foreign country in future. The Pravasi Academy is an illustration. Almost 12 courses that are affiliated with Skill India are provided at the academy. This is also done with an earning motive for the cooperative. Another motive of Pravasi academy is to recruit skilled talent to the Pravasi societies who are well experienced.

The cooperatives have also diversified into various activities and businesses like food production, fish mart, tours and travels. Two members of one cooperative have started a company with an investment of 2.5 crores. It sells household equipment in Ernakulam district and also to gulf regions.

Recently one of the cooperatives had organized a trade expo in Kaloor, Ernakulam from sept 21-26. It was to bring business all over Kerala together and to introduce them to the people who were having plans to start a business came there. They have decided to host this every year. This time it was sponsored by private companies and this platform acted as a platform for the advertisement of their companies. Next time they are planning to get it hosted through NORKA and the government.

A few cooperatives encourage people to form small groups of five to ten people (returnees) like SHGs to help them do self-employment like small business to generate income. The cooperative provides loans to these people for capital. The loan is paid back through the returns from their investment.

There are only very few which were engaged in labour contract. The kind of works done by the labour cooperatives are Panchayat construction works (road concreting, anganwadi building, and MNREGA works), Work for CAPEX (Kerala State Cashew Workers Industrial Cooperative Society). The cooperative has done 5-6 projects during 2021-22 and 10-11 projects during 2020-21.

From the above the diversity of activities undertaken by cooperatives could be appreciated. However, it must be noted that a large share of these cooperatives is operating financial services and all other activities are allied activities. It is also notable that the diversity of activities taken are limited.

(iii) Economic Sustainability of Pravasi Cooperatives

A few cooperatives are running profitably while most do not break even. There were many cooperatives that were facing loss as well. The cooperatives were able to run on no-loss but if they regularise salary to the staff then it cannot work in profit. Instead many staff are retained on consolidated pay (no DA and TA).

On interviews it was suggested that diversification of activities was a way out. In order to reach that stage, cooperatives were planning to create a consortium to do business. Cooperatives growth matters as profit making or maximizing is not their primary objective. And this growth is very important in ensuring the sustainability of the cooperative. Instead of looking at the profit, the focus is on working capital flow or the net worth rather than on the profits. Reserve fund or retained earnings is also included in calculating the net worth (Total assets- Liabilities). In the case of labour cooperatives the works done so far is not profitable. In most of the projects, the cooperative is just able to break even or get a very small margin of Rs. 2000-3000

(iv) Sources of finance for cooperatives

The principal source of finance was the share capital. And nearly all the expenses of the society are met internally itself. A three-lakh grant from NORKA was given to all pravasi cooperatives that proposed a project. Many cooperatives are not facing much difficulty with finance since they have enough initial investment. This investment helps them in paying rent, if it was not the same, the initial stages would have been a huge struggling period. From the beginning till now the fixed deposits and shares kept increasing and this was brought to the cooperative through the contacts of members and staff. Most cooperatives have not started dividend sharing. Many cooperatives are struggling to meet their ends and so there is no way to share dividends.

(v) Return migrants as members of cooperatives.

Our interviews revealed that people join cooperatives because it's easier to get access to credit. Cooperatives are not as stringent as commercial banks on the collaterals for loans, hence loans are easier. However, some of the recent incidents¹ have eroded the faith of Pravasis to join cooperatives for credit or for investment due to the poor functioning of some of the credit societies.

Joining as wage employees in their location is difficult for return migrants, but as cooperative members and working as members of the cooperatives provided a sense of ownership and hence some of the members were ready to join the workforce. In this context labour cooperatives can play an important role in economic reintegration through the employment route. The labour cooperative contributes to bringing more people into employment. In the cooperative the members are the owners who have contributed to the share capital and not just workers. So this ownership invokes a sense of belonging among the workers and helps people in working as it is for their own organisation. The stigma attached with returning migrants being workers in certain sectors upon return is eliminated to some extent using the ownership status.

(vi) Role of Migration experience in running the cooperative

Role of Migration experience in running the cooperative: Presidents of the cooperative strongly believe that migration experience has been instrumental right from forming the cooperative, making the bylaw and helping them in exercising their leadership role at the cooperative efficiently because they got an opportunity to interact with people from several nationalities and it has definitely shaped their perspectives and beliefs.

(vii) Marketing and distribution channels of cooperatives

For the credit societies, there's no need of marketing as the demand for loans are very high already. Even though there's a limitation in attracting deposits

through advertisements, small scale marketing strategies like printing notices providing information about the loans and PR works are done.

A few cooperatives advertise through social media platforms. This method helps them reach new members and canvassing through current members is also another marketing strategy.

One cooperative has a 7-member marketing team. Departmental help is taken to collect data and make presentations to potential clients. The values of being a cooperative is marketed especially with other cooperative societies. Previous client feedbacks bring new clients and a network is built. There are around 24,000 cooperatives which themselves will provide a huge clientship for the IT Division. Later, these can be expanded to other states and countries.

(viii) Cooperatives and Job creation:

The cooperatives had a plan of employing only pravasis but that's not practically possible now because highly qualified people generally don't come back. And the returnees are mostly above the age of 60.

In one of the cooperative 60 staff are employed in the mother society. Through franchisees of Seva Kendras, 1000 employment opportunities will be created. Additionally, NDPREM loans are provided to almost 160 projects so far. This also created various employment opportunities. The Pravasi academy is also started with the objective of training skilled personnel for the cooperatives' vision of generating 10,000 job opportunities by 2025.

The president of that cooperative anticipates that just in the finance sector one lakh more jobs can be created for people with qualification of higher secondary and above. More women from the neighborhood localities can also be provided employment opportunities as these finances prefer women employees who are from the same locality as it enhances credibility and security to hire them. The academy hence plans to provide them experiences in a time period of three months.

In case of labour cooperative currently there are 50 members who are workers for the projects. Among these there are 4 civil engineers who have expertise in the construction field. Other than that there are welders, plumbers, electrician and carpenters. Some of the members have re-migrated also after the COVID. Majority of the members are return emigrants and very few of them are emigrants.

(ix) Credit availability: Cooperatives versus Banks

The loanees take loans for some productive investments. Productive purposes that would at least give the loanee an employment is a criterion to decide who gets a loan. Loans that aim at productive investments that ensure the involvement of the loanee are being sanctioned. From a bank's point of view,

this won't be a botheration if the loanee has sufficient collateral. For an emigrant or a return emigrant, taking loans through the commercial banks is a difficult channel.

Since in cooperative societies the members are shareholders, the general body has to decide on the considerations for defaults in loans. The mindset of the loanees is that the interest rates will be completely waived. Normal NPA levels in the cooperative sector are 12-18 percentages. This is five times above the standard levels for commercial banks. Even the cooperatives are directed to limit their NPAs to 3-5 percentages.

The societies are sustaining only because their motive is not profit making, there is no compulsion on declaring the dividends, there is an expectation that they might get government aid in case they make a loss. The difficulties that arise for a private firm or a public limited company that makes losses are not there for the cooperative societies.

(x) Aspirations and Visions for future

A few cooperatives showed long term vision in terms of growth, diversification and sustainability. Many of them aspired to have regional, national and international presence. Some felt that the sectors with promise were Tourism, supermarkets, guest houses, poultry farming etc. Among the cooperatives studied very few had ventured into diversified activities though all of them felt that the future for sustainability is through diversification. There was also plans to establish a Pravasi consortium where pravasi cooperatives will be members. This consortium could start business together and this will be easier to get capital. Pravasi skills academy was planned and attaching to the Cooperative central university proposed by the Union government was also being planned by a Cooperative.

While the existing Pravasi cooperatives provide us a base model to build from, they faced several difficulties in achieving an efficient re-integration model. Inability to survive competition, narrow production base, poor capital base, legal barriers, procedural delays, inability to withstand shocks and the nexus between officials and private parties are some of the obstacles that they are facing.

Recommendations for policy action

Cooperatives offer a unique opportunity to build a part of the eco-system described above. The advantages of a cooperative system among returnees was described earlier. Below are recommendation for policy intervention to rejuvenate the cooperative system for reintegration of returnees.

1. Membership in cooperatives: Membership in Pravasi Cooperatives is limited to return migrants. Learning from the history of cooperative movement, workers'

cooperatives tend to be successful when workers' families are part of the cooperative. The incentive to contribute financially, take part in the decision making and activities of the cooperatives would be higher when family (who are not necessarily returnees) members are involved and the gains may be reaching other members of the family as well. Also, membership need not be restricted to return migrants alone. It must be possible for migrants in their place of destination to become members in the cooperative and contribute to its growth. This would allow for better growth of the cooperatives and also keep options for the prospective returnees open. Thus, while Pravasi Cooperatives would work for the benefit of returnees, the members could be current migrants, return migrants and their immediate family members as well.

2. *Converting credit societies to multipurpose societies:* Instead of pure deposit credit activities, they members can be encouraged to invest in production of goods and services. Members who have investible surplus could do this investment, while members without such surplus, but has the skills and experience to join the production process can join as members in these cooperative. This has the advantage of channelling remittances to productive activities, creating jobs for the returnees and also producing goods and services that can be value adding, probably entering the international export market.

3. *Leveraging Technology for Cooperation:* One of the limitations of forming cooperatives is the requirement of physical proximity of members in a location. The catchment area of a cooperative is delimited by its geographical reach. However, this location barrier can be overcome through the use of technology, both in terms of the governance of the cooperative and the productive activities of the cooperative.

- a. *Virtual Cooperatives:* If members can be present virtually and substantive part of the governance of the cooperative can be managed through virtual mode, leaving only the day to day activities to be done through physical presence, then migrants who are in their destination would be able to participate in the activities of the society. This would imply there could be more and active participation among the current migrants. Not only that, return migrants, usually tend to settle in a city environment, leaving back their place of origin. However, they are often interested in keeping and developing their ties to their places (villages or small towns) of origin. Virtual cooperatives would be a rich avenue to pursue such goals. This requires probably amendments to the Kerala Cooperative Societies Act 1969.
- b. *Platform Cooperatives:* Using the various technology platforms for production of goods and services would make the production and distribution more efficient, thus making these cooperatives more profitable as well. Platform cooperatives could source their inputs and sell

their outputs anywhere in the world. A whole lot of new services and products can be planned that could cater to global demand rather than restricting to the local demand. Also, continuous virtual interaction between cooperatives would lead to coordinated production and distribution thus generating economies of scale and scope.

4. Government support for improving competitiveness: Improving competitiveness requires two aspects, one is the quality of the product and other is the price of the product. Given that the Pravasi cooperatives would be able to meet the quality criteria very well their prime concern is price competition. Price competition is essentially due to the inputs purchased in the market and cost of production. Government can play important role in tilting the balance in favour of cooperatives by subsidising the production costs through various means.

5. Grants for infrastructure and large capital such as own building, purchase (lease) of land, access to basics such as electricity, road, water, internet etc are sunk costs that requires large investments and their recovery may take many years. Grants to meet these costs would give cooperatives the cost advantage that could make their production cheaper without affecting the quality of the product.

6. Coop Industrial Park: An alternative to the grants for infrastructure would be provide these facilities at nominal rates in an industrial park designated for cooperatives, especially Pravasi Cooperatives to work from. A Hi-tech Coop Industrial Park can be designed for the purpose. The park could also have a hybrid administrative office that would liason with various departments of the government such as the cooperation department, industrial development departments, export promotion departments, and the department for non-Keralite affairs. Eventually a single window clearance cell could be developed that would allow cooperatives to be set up with ease and within a short time.

7. Corpus fund to meet exigencies of cooperatives: Cooperatives run into financial loss with ease. Not having a fallback mechanism make them run into closure during crises. We had seen this during COVID, demonetisation, two floods, GST implementation etc. In order to strengthen the Pravasi cooperative system a corpus fund can be developed, which may be used for meeting emergencies or supporting weak cooperatives. It could work like an insurance scheme with contributions from the cooperatives and the government.

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Notes

¹ <https://www.thehindu.com/news/cities/Kochi/ed-seizes-assets-worth-30-crore-of-karuvannur-bank-scam-accused/article66226769.ece>

Factors affecting development of University-Based Innovation Ecosystems in developing Countries: A Case from Iran

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Abstract

The university is not only one of the main components of most innovation ecosystems, but also it can be the core of formation of an ecosystem. Identifying the factors affecting the formation and development of university-based innovation ecosystem is the main goal of this study. This qualitative study identifies the factors influencing the formation of university-based innovation ecosystems in developed countries and by comparing them with a sample of university-based innovation ecosystems in Iran as a developing country (Sharif Innovation Ecosystem), the specific challenges of this ecosystem and the alternative solutions used in it are identified and the formation pattern of this innovation ecosystem is explained. Data analysis is done using theme analysis and a theme network of factors affecting the formation of university-oriented innovation areas was formed and categorised. Based on the results of this research, the factors affecting the formation and development of the university-based innovation ecosystem have been classified into 4 main categories, including the type of collaborations, the way of institutionalization, activities and characteristics of the main actor.

Key Words: Innovation, Commercialization, Innovation Ecosystem, University-Based Innovation Ecosystem, Sharif University

1. Introduction

The evolution path of universities in the world shows that they are increasingly looking for ways to play a more active role in the economy and industry of the societies in which they are formed and developed. In this regard, the transfer of the knowledge and technologies to the industry, as well as searching for collaboration opportunities with other actors of the innovation ecosystem, have been seriously on the agenda of the universities. The concept of "innovation ecosystem" and "open innovation" promise new paths for universities to play the role of drivers in creating such opportunities that were not possible before in the framework of traditional models of university- industry interaction. The concepts of innovation ecosystem and open innovation are rooted in shared insights about how universities play a role in commercializing their research achievements and creating innovation. In the concept of innovation ecosystem, relationships and interactions between the main actors of local or national innovation systems are considered with the aim of strengthening innovation (León, 2013). Christensen and Eyring (2011) consider an innovative university as a university where higher education can interact with innovative forces and analyze them carefully and respond to their needs based on future plans.

Examining successful innovation ecosystems in the world shows that universities were either the axis of formation of many of them or were one of the main actors of the ecosystem (Mason & Brown, 2014). For example, the ecosystem of Silicon Valley has been formed in the vicinity of Stanford University, and in the innovation ecosystem of Cape Town, South Africa, two prestigious universities of Cape Town and Stellenbosch are located (Berman, Eesley & Blank, 2011).

An important question in this context is that in cases where the primary core of the ecosystem is a university and other factors of the ecosystem have gradually formed or gathered around it, what was the evolution process of the ecosystem and how was the university effective in its successful formation? From the policy point of view, the answer to this question can help universities to play a central role in the formation of local innovation ecosystems, to be supported by governments, and to provide the necessary infrastructure to turn them into driving engines in innovation ecosystems.

Several studies have addressed the characteristics of entrepreneurial universities or the role of universities in the ecosystem of entrepreneurship. For example, Graham (2014) has tried to provide indicators in three categories of input, process and output for the successful performance of universities in the entrepreneurial ecosystem. The results of Isenberg's research (2010) also indicate that three key factors are seen in the entrepreneurial ecosystem, the center of which is the university; A significant number of entrepreneurs and academic incubators, a dense network of relationships between entrepreneurs and start-ups, and an entrepreneurial culture that brings all these components

together. Although these studies can be a good guide to identify how universities play a role in interacting with the surrounding society in order to create and develop new businesses, but they do not refer to the innovative outputs of the university in general, and the behavior of the university as the core that forms the innovation ecosystem in particular.

Some studies have also examined the characteristics of universities that have been able to play a positive role in the innovation ecosystem around them, sometimes as the core of its formation (Abibo et al., 2022) and sometimes as one of its key players (Schiuma & Carlucci, 2018). In addition to the commonalities seen in these studies regarding the characteristics of university-based ecosystems, one issue is also clear; Each ecosystem is dependent on the characteristics of the socio-economic context in which it was formed and developed, so it can be said that each ecosystem has its own story, and for this reason, the findings of studies related to a university-based innovation ecosystem in a country or even a region is not easily transferable and generalizable to other ecosystems (Schiuma & Carlucci, 2018), therefore, most of the studies conducted in this field have been conducted in the in-depth case study method.

The creation and management of these areas in Iran is considered a new experience and not much scientific research has been done in this regard (Abili et al., 2022). Also, universities in Iran have grown significantly in the last few decades in terms of the number of students in post-graduate studies. In the past years, the number of associate and bachelor degree students was 90% of all students in the country, but now the number of master degree students has increased a lot. As a result, the scientific output of Iranian universities has also seen a significant growth, and the number of international articles published by Iranian researchers has increased from 1,000 articles in 2000 to 60,000 articles in 2019 (Islamic Republic News Agency, 2018). Despite the growth in scientific indicators, the technological and innovation outputs of the universities have not been commensurate with their scientific growth, and this issue has led to criticisms regarding the social and economic effectiveness of the universities in the country (Golhasani, Hosseini and Hassanzadeh, 2021). The establishment of the vice presidency for science, knowledge-based economy in the last decade has been a response to the concern of the country's science and technology policy makers to promote the role of universities and their graduates to solve the country's industrial and economic problems. Concepts related to innovation, including the ecosystem of innovation, have been the result of this change of approach in the policy space of science and technology. The creation of science and technology parks and growth centers since about two decades ago and the formation of innovation centers and accelerators in recent years have also been in line with the completion of the value creation chain of universities in promoting the country's industry and economy. Also, creating a

suitable legal infrastructure can facilitate these activities of the company and improve the business environment (Sultani et al., 2016).

Although Sharif University of Technology is younger than Tehran University and some other universities in Iran and has been established about 60 years ago, but it has always been known as the first university in the country in engineering fields and its graduates have received attention at the world level. Of course, the concern about the migration of the graduates of this university has always been raised and has been one of the concerns of science and technology policy makers in Iran (Qamrian, Fathi and Navabakhsh, 2019). The emergence of a local innovation ecosystem around Sharif University of Technology is a phenomenon that has attracted the attention of policymakers in the field of science and technology in the country, so that at the same time as the alarming trend of the migration of graduates of this university continues, the creation of a significant number of innovative businesses and technologically by the faculty members and graduates of Sharif University, promises the formation of a successful experience in the field of local innovation ecosystem centered on this university (timeshighereducation, 2022). The activity of more than 500 technology-based companies and the formation of dozens of accelerators, innovation centers, venture capital funds, shared workspaces, laboratories, etc. are prominent features of this ecosystem.

According to the mentioned cases, the current research seeks to explain how this successful experience was formed and developed on a national scale. Which actors and how have they played a role in its formation? What are the influential characteristics of the university itself as the primary core of the formation of this ecosystem? What external factors have affected the development of this ecosystem?

For this purpose, after reviewing the background of the studies and choosing the theoretical framework, through interviews and document review, the factors affecting the formation of this ecosystem were identified and categorized in the form of dimensions of the desired model.

2- Literature review and research background

2-1- University-based innovation ecosystem

Christensen and Eyring (2011) consider an innovative university as a university where higher education can interact with and analyze innovative forces and meet their needs according to future plans [14]. Graham (2014) studied the success factors of university-based ecosystems in a study conducted in collaboration with Umayyad University and the Russian Schultz Institute. In his study, experts were asked to identify the success factors of the best and most successful entrepreneurship and innovation ecosystems of the basic university in the world. Expert responses included these seven factors: entrepreneurial culture and innovation, university leadership strength, university research

capability, local or regional quality of life, government or regional support, effective organizational strategy, and ultimately the entrepreneurial strength of students. Graham (2014) also believes that there are five common success factors between the entrepreneurial ecosystems and innovation of the top emerging university: effective leadership of the university's senior management, academic culture in the faculties and units of the university, entrepreneurial activities and university-based innovation, entrepreneurial activity and student-centered innovation, and local entrepreneurship and innovation society. Another category discussed in the literature on the ecosystem life cycle has been developed by the Genome Startup Institute. In its analytical report in 2015, the institute considers the life cycle of startup ecosystems to have four stages: 1-Birth 2-Activation 3-Integration, and 4-Maturity (Berman, Eesley & Blank, 2011). Brito (2018) has a deeper understanding of the role of higher education institutions as dynamic promoters of growth and development. He utilized the University of Porto as a case study to explore how universities can act as leaders and integrators of innovation ecosystems. This study primarily demonstrates the key success factors. First, the talent to turn the knowledge produced by universities into valuable solutions for other companies and organizations. Second, the links between universities and industry must be long-term in nature and relational rather than intermittent and transactional. Finally, the success of campus-based ecosystems depends on a combination of actors, resources, and competencies. This means that a sustainable strategy of innovation and knowledge validation requires an approach that strengthens both internal and external networks. Levchenko et al. (2018) highlight the role of universities in shaping innovation ecosystems. To this end, they have also explained their analysis of the concept of the "innovation ecosystem". Based on their findings, the facilitators of innovation ecosystems are classified according to the following dimensions: resources, governance, strategy and leadership, organizational culture, human resource management, individuals, partners, technology, and clustering. They have also analyzed the main features of both types of ecosystems (industry-based and university-based) at different levels of the case.

2-2-Patterns of innovation ecosystems formation

Ghazinoory et al. (2021) in their research entitled "Innovation lives in ecotones, not ecosystems" have introduced a new concept called the "ecotone". According to his opinion, innovation takes place somewhere between the two ecosystems of knowledge and business, which is called ecotone of innovation. It is possible to analyze the university-based innovation areas based on this approach and as a place on the border of two ecosystems of knowledge and technology (university) and business ecosystems (society and industry). In fact, on the border of the mentioned two ecosystems, start-up companies based on technological innovations (knowledge-based) or innovation in the business model (startup) are formed, which can be considered academic-industrial or

academic-business amphibians, that benefit from the advantage of human resources, knowledge and technology of the university and operate in the economic and business frameworks governing industry and enterprise.

Also, in a research conducted with the participation of MIT University and Skoltech Institute of Russia, two models have been identified and introduced in relation to the formation of innovation and entrepreneurship ecosystems of basic universities (Graham, 2014). A) Bottom-up and society- based model: formed by students, graduates and entrepreneurs. This dynamic and comprehensive ecosystem is formed with a lot of trust between the local entrepreneurial community and the university. Investment is more focused on local capacities rather than institutional capacities. In this model, universities consider the intellectual property and dependence of startups to be of little importance and place these matters in the second degree of importance compared to the wider development of the ecosystem. b) Top-down and university-oriented model: which operates through established university structures. In this model, there is often a desire to generate income from academic research, and its entrepreneurship and innovation program is focused on capable technology transfer offices (or equivalent centers). This model, which is often based on the research strengths of universities, creates a stable and fully institutionalized approach. Beh and his colleagues also studied the state of the basic university ecosystem in 8 universities in America. They found that universities can be evaluated and categorized in two dimensions from this point of view.

The first dimension - systematic development versus organic development: some universities have systematically created a highly structured network for their entrepreneurship and innovation ecosystem, and on the other hand, some allow the innovation ecosystem around them to develop organically.

The second dimension - internal sources versus external sources: academic ecosystems differ in terms of their focus on internal communications versus external communications. Universities with an internal focus (such as the University of Arizona) focus on cultivating internal resources available to start-up and reproductive companies. On the other hand, universities with an external focus (such as Stanford, Harvard and Berkeley universities) consider the increase of their resources dependent on the external environment of the university. Some universities (such as the University of North Carolina) pay attention to internal and external sources at the same time (Boh, De-Haan & Strom, 2015).

Granstrand and Holgerson (2020) investigated different definitions of the innovation ecosystem and related concepts and presented a hybrid definition of the innovation ecosystem. They identified the three factors of complementarity, cooperation and actors in the received definitions and by including the three factors of competition, substitutes and artifacts in the conceptualization of

innovation ecosystems, they propose a new model that leads to the following definition: An innovation ecosystem is a set of actors , activities, artifacts, institutions and relationships, including complementary and alternative relationships, that are important for the innovative performance of an actor or population of actors. This definition is compatible with the concept of innovation systems and natural ecosystems, and its validity has been shown with three empirical examples of innovation ecosystems. Considering the purpose of the current study and summarizing the previous studies, the model presented by Granstrand and Holgerson is the primary basis of the current study, which is shown in Figure 1. In the following, according to the definition of the ecosystem from Oh et al. (2016), the university is placed as the core of the ecosystem, and also according to the characteristics of the university-based ecosystems, the two dimensions of this model have been removed at the end.

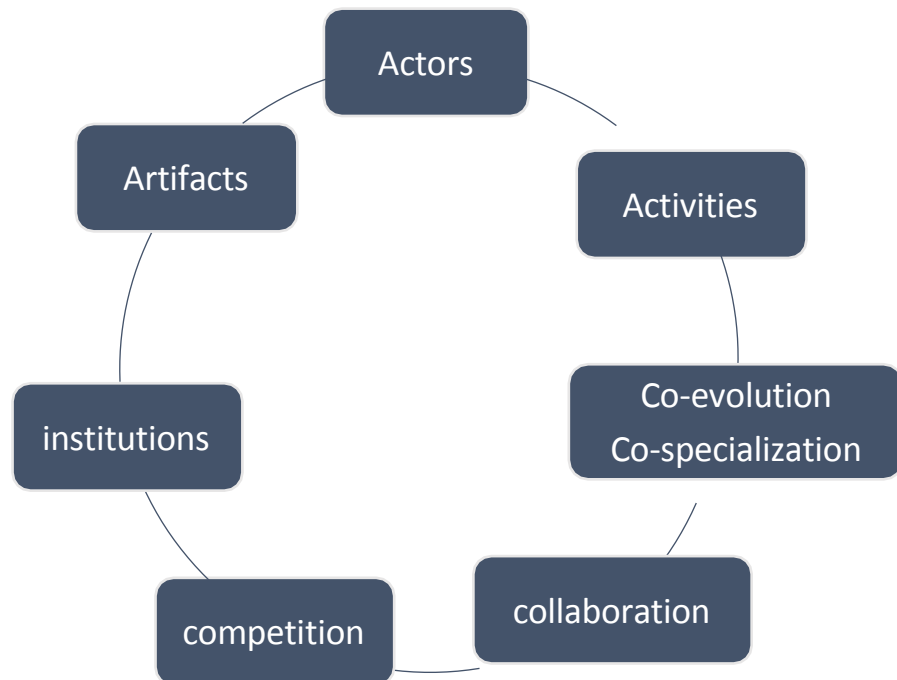


Figure 1: The model presented by Granstrand and Holgerson and the conceptual framework of the current research

3- Research method

The paradigm of this research is structural according to the nature of the field and its dependence on the researcher's ecological experience and the geographical area of the research. Its qualitative approach and research strategy is a case study (single case) because its logic is to provide a causal argument about how general social factors create consequences in specific environments.

The data collection tool in the present study is to interview experts and review documents. In the first stage, the interviewees will be selected from among the people active in Sharif Innovation zone at different organizational levels, including managers and senior experts, as well as faculty members and craftsmen present in Sharif Innovation zone, based on opportunistic and snowball approaches. In opportunistic sampling, the researcher uses the created opportunity to gather information. A particular behavior may occur in certain circumstances, and the researcher will select the next interviewee based on the circumstances. Thematic background and industry secondary data were also used during the interviews to create a complementary model. These resources were useful in order to validate and supplement the data collected in the interviews and to provide coherent and reliable analysis. At this stage, an attempt was made to design interview questions based on the fields of knowledge and expertise of the interviewee and to be derived from the initial classification extracted from the literature and current conditions of the experimental field of research, in order to collect the most relevant data from different sources and individuals. The data of this research are collected from primary and secondary data sources. Primary data are obtained through interviews and secondary data are obtained through various databases, brochures, reports, and evaluations, as well as noted experiences and the learned materials. In the case study approach to conduct a comprehensive and acceptable research, different data sources (interviews, documents, observations, etc.) should be used (Yin, 2009). In this study, a total of 40 well-known and experienced people in the field of Sharif innovation, academics, and craftsmen were interviewed. The interviewing process was stopped when the researcher did not reach a new finding (Creswell, 2013). In fact, the point of theoretical saturation in methodology indicates the reliability of the research method. During the interviews, backgrounds and data received from the university were also used to create a complementary pattern. These resources are useful for validating and supplementing the data collected in interviews and providing coherent and reliable analysis (Corbin, J; Strauss, A; 2008). Researchers then conducted interviews with knowledgeable individuals as described in Table 1 to obtain basic information about the research topic and to find the challenges and more accurate selection of the research topic.

Table 1: Interviewees' information including faculty members, managers of Sharif Innovation Institutions, and industry experts

Number	Field of activity or organizational responsibility of the interviewee	Number of interviews	Interview time (min)	Interviewee code
1	Head of Sharif Technology	2	90	A11-A12

	Services Complex			
2	Sharif Senior Specialist of Technology Services	4	90	A21-A22-A23-A24
3	The Expert of Sharif Technology Transfer Office	3	85	A31-A32-A33
4	Director of Sharif Science and Technology Park	1	45	A41
5	Director of Sharif	2	60	A51-A52
6	Sharif Accelerator Manager	1	45	A61
7	Director of Sharif Growth Center	2	70	A71-A72
8	Expert of Research and Development Unit of Industrial Company	5	135	A81-A82-A83-A84-A85
9	Researcher and specialist in the field of technology transfer	6	150	A91-A92-A93- A94-A95-A96
10	University faculty member with experience in industry relations	4	95	A101-A102-A103-A104
11	University faculty member with a history of activity in the governing body	3	105	A111-A112-A113
12	Students with plans in Sharif Innovation zone	3	90	A121-A122-A123
13	Managers and experts of the Office of Vice	4	120	A131-A132-A133-A134
14	Total	10	1180	

After the interviews were completed and the theoretical saturation was reached, the interviews were transcribed and coded. The coding process was

performed in MAXQDA software. Following this path, the criteria and dimensions of the formation of a university-based innovation ecosystem in developed and developing countries were extracted and the existing research gap was identified and research hypotheses were formed based on it. After analyzing the data, the results were provided to the experts to ensure that the results were consistent with reality. In this study, we attempted to have diversity in the selection of interviewees. In order to generalize the results of the research, three other experts who were involved in establishing technology transfer offices of other universities were also consulted. In fact, considering the validity and reliability of the research, this study followed the views of Lincoln and Guba. Based on their views, the study of the scientific accuracy of qualitative studies includes four criteria of reliability, transferability, reliability, and validity. Reliability means making a conscious effort to ensure that the meaning of the data is interpreted correctly. In order to gain the validity of this study, an attempt was made to select participants with the maximum variety of experiences. The internal validity of content analysis was assessed through face validity. In order to validate the content, the panel of experts (research team) is used to support the production of the concept or coding topics as well as the review by the participant. Table 2 shows the interview protocol. Based on the interviewee's background, some questions were further emphasized and others were omitted. For example, the main purpose of interviewing people who have worked as managers in Sharif Innovation Ecosystem was to discover the historical trends of this ecosystem, while the purpose of interviewing faculty members was to find the factors influencing the formation of the innovation zone, and depending on the purpose, the intended questions for interviewees were different. The duration of the interview also varies due to the nature of the

questions and the interviewee's enthusiasm and level of information. The recorded time reflects the effective exchange of information.

Table 1: Interview Protocol

Questions

What events changed the development of the Sharif ecosystem?
What challenges has the ecosystem faced over the years and what steps has it taken to address them?
What are the current problems and strengths?
What are the main stages in the formation of the Sharif innovation ecosystem?
What approaches have been taken at Sharif University to create an "innovation ecosystem"?

Figure 1 shows the implementation steps of the study. According to this figure, at first, the literature and research background have been studied and the research gap has been identified. After that, by studying the innovation ecology of the case under study and its historic evolution, the current status of the case was identified. The successful formation of an innovation zone requires a fundamental understanding of the current situation and the historical development of the ecosystem(Hwang, Victor &Horowitt,2012).

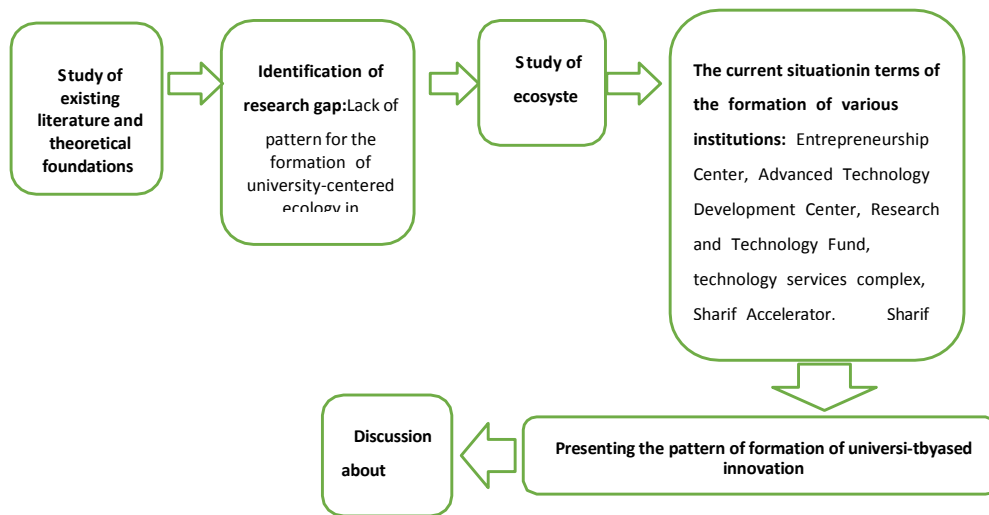


Figure 1: Executive steps of the present study

4- Findings

The findings are presented in three related titles. First, the historical evolution of the Sharif innovation ecosystem is presented. Then, a perspective of the current situation, obstacles, and innovation motives are extracted. In the next step, a network of factors affecting the success of the Sharif Innovation area is presented, and finally, according to the previous content, a model is provided to explain how the university- based innovation ecosystem is formed.

4-1 Historical evolution

Sharif University of Technology was established in November 1965. In October 1966, with 54 faculty members, began accepting 407 students in the fields of electrical, chemical, metallurgical, and mechanical engineering. During half a century of its activity, this university has been able to be considered the top university in Iran in the field of engineering and provides quality graduates in these fields to domestic industries.

The Sharif Innovation area was selected as a case study because the Sharif University of Technology seeks its mission in creating, disseminating and applying knowledge in a fully dynamic learning environment. This perspective promotes the quality of education, research, and service to society and solves its problems as much as possible. The graduates of this university have always

been among the strongest engineers and the highest scientific, technical, and executive managers in Iran. This university is one of the most important engineering universities in Iran with significant scientific and technological outputs during the last few decades, which has gained a global reputation for the quality of human resources. According to the Times Higher Education website, this university is ranked 200th in the world and first in Iran in the economy and business index (Times Higher Education, 2022). The reason for choosing Sharif University Innovation zone as a case study, in addition to being an index of the university, is the success of Sharif Innovation zone in creating business and registering knowledge-based companies, which according to statistics published by this university, more than 500 innovative businesses over the past decade, has been formed on the outskirts of the university by graduates and faculty members which is a significant record among Iranian universities.

Over time, many businesses have sprung up near the Sharif University of Technology. Hundreds of companies have been created by the young, elite and persistent graduates of this university and it has brought a lot of values and employments. With the establishment of Sharif University of Technology Science and Technology Park in 2016, the most important program of this identification and ecosystem development complex formed near Sharif University of Technology named "Sharif Innovation Zone", which accelerates the process of formation and quantitative and qualitative growth. Innovative companies have been established in this area. Sharif Innovation zone is located in an area of 250 hectares between Azadi Street and three highways of Shahid Jannah, Sheikh Fazlullah Nouri, and Yadegar Imam. Currently, more than 500 companies, 19 accelerators, 12 fund and investment companies and 13 innovation centers are located in it (Sharif science and technology park, 2021). With the aim of preparing a strategic development plan for this area, a comparative study has been conducted on 21 innovation zones in the world. Based on the successful experiences identified in this study, the necessary development measures and the role of different actors in the Sharif Innovation zone have been identified. One of the most important strategies adopted has been the development of the Sharif Innovation zone with a focus on the private sector and without the need for direct participation of government institutions. Accordingly, Science and Technology Park of the Sharif University of Technology, by playing its facilitating role and creating constructive interaction between the scientific body of the Sharif University of Technology, innovation ecosystem actors, and capable private sector, has paved the way for the emergence of talents and competencies of academics, elites and entrepreneurs in the field of innovation and is considered as a model in the field of sustainable development and value creation in Iran. In this study, based on the review of documents and interviews with various managers in different positions in this institution, a pattern of the historical development of this area has been developed. The following is an excerpt from what the interviewees have stated

about the historical evolution of the Sharif Innovation Ecosystem on which the historical categorization framework of this study has been based.

Table 3: An example of the interviewees' quotes about the historical process of formation of the Sharif Innovation Ecosystem

Important event	Citation	Interviewee Code
Establishment of Sharif Studies Office	<i>Technology study movements in Iran began at Sharif University and at the same time with the establishment of the Sharif Studies Office in 1998. First, an office and later a technology study center were established.</i>	A12
Establishment of Shahid Rezaei Research Institute	<i>The Shahid Rezaei Research Institute was established in 2003 and took a place outside the university - and many programs came from here. And it acted as an accelerator that many companies in the innovation zone came from the heart of this research institute, and in fact here was the interface of the university and government industries</i>	A41
Independent evaluation unit	<i>In early 2007 or 2008, we took over the building on the north side of the university, where the Sharif Fund is located, to give these units to individuals based on those privileges.</i>	A94
Establishment of Sharif Innovation Network	<i>In 2011, we created a project called Sharif Innovation Network. In this way, we collected the companies established by Sharif students and gave them concessions and provided them with services in return for the concessions. This was the initiation of establishing Sharif innovation zone.</i>	A22
Establishment of Sharif Technology Services Complex	<i>In 2013, we established an independent complex from the university. We created a space that was funded by receiving a charge from the users of that space. It was a separate complex for research. Sharif Service Complex 1 and later (Service Complex) 2 were created. We gave some offices to the professors and said that if (do not use business and) it is empty, we will take it back from you.</i>	A24
3 Private sector entry to the university	<i>In 2013, the first private company entered the university and ran an office to learn about ideas and invest. For them, only the university staff were attractive and there was no capacity for</i>	A93

	<i>cooperation yet. The biggest achievement was that we got six or seven Sharif University students for this group who brought the projects but were later recruited.</i>	
Establishment of a central laboratory	<i>A number of organizational innovations were also formed, for example, the central laboratory of Sharif University was established in 1993.</i>	A33
Leaving the university to establish a company	<i>Because in Sharfi University there was not plenty of space, professors and students who founded the company had to leave the university to establish a company and get offices in the surrounding areas that were easy to travel to the university, and this was the emergence of start-ups, and consequently the beginning of the innovation zone and it was a good thing because there was a kind of pessimism about the professors who worked for the company</i>	A95
Establishment of the center Entrepreneurship	<i>At Sharif University, we are good at technical specialties, but do we teach them soft skills as well? The student does not know how to write a business model and start a business, so the Entrepreneurship Center was established for this purpose. The work of the Entrepreneurship Center is culturalization and soft education.</i>	A11
Establishment of a growth center	<i>The increased number of ideas led to the formation of a growth center. Services relevant to the development of start-ups are provided for a period of up to three years. Hitherto, , 350 companies have been admitted to the growth center. The growth center provides positioning space, computers and consulting as well as training and financing. Every year, 50 events amounting to 26,000 h are held for 11,000 students. . In fact, the allocated time for each student equals a little more than 2 h which is comparatively 10 h in the world's leading universities.</i>	A21
Establishment of Research and Technology Fund	<i>Technology Research Fund: is the university's technology credit financial institution and provides everything which is needed by knowledge-based companies such as facilities, guarantees and venture capital. The fund led to high service delivery and increased demand. Many wanted to use the service without participating. Therefore, the technology services complex was formed in the heart of the university.</i>	A22

Establishment of accelerator	<i>The idea of establishing Sharif accelerator was that one of Sharif's students, who was a Canadian graduate, came and said that there was an institution called Accelerator and they served me and I was expelled after six months. He went and prepared a report on the American accelerators.</i>	A61
Establishment of employment school	<i>After that, the idea of starting an employment school was formed. The former schools had all kinds of entrepreneurship. But here this school develops skills and career path.</i>	A72
Establishment of Science and Technology Park	<i>Then, we saw that we have all the elements of the park, but we do not take advantages of its benefits. So we established this park. The park superordinates all these activities. The institution is in charge of innovation development at the university. The scope of activity is the university and its surroundings and has an independent budget line. In fact, this park is the conductor of this ecosystem. This is a soft institution that was created to coordinate. This park is like a soap molecule, one head dissolves in water, one in fat, one inside the university and one head dissolves outside of university</i>	A41
Development of institutions	<i>In 2018, the innovation zone was introduced as a concept, and we studied 21 important innovation zones in the world. We came to four characteristics: 1. It has to do with people's work and life and is in the city. 2. Innovation leaders have offices there. 3. Its urban landscape is different. 4. It has national and local support. Shari Innovation Zone was created organically, because the professors and students themselves decided to get offices around the university to be close to the university. University is the sun around which the stars revolve. These stars want to use the power of the sun. Meanwhile, the systematic communication between them is also more likely.</i>	A83

The summary of the statements made by the interviewees of the historical analysis has created this formation in accordance with Figure 2:

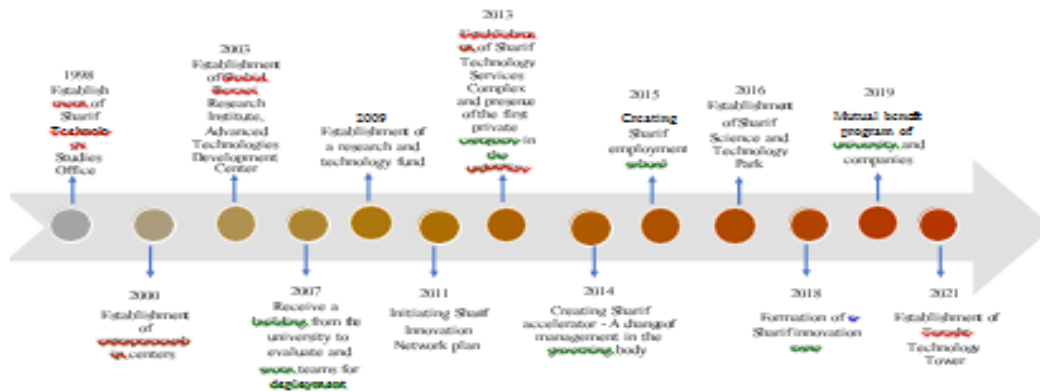


Figure 2: The historical evolution of the formation of the Sharif innovation ecosystem

The analysis of this historical course categorizes the evolution of the Sharif Innovation zone into three time periods. This category is shown in Table 3 which is over the period from 1991 to 2001, the beginning of the technology studies movement in Iran and the establishment of the Sharif Office of Technology Studies. The years from 2001 to 2011 was the beginning of the organic formation of innovation networks around Sharif University, due to the dynamic atmosphere and the ruling elite of this university and the presence of elite professors and students. After this initial formation, the need-based institutionalization began and this institutionalization continued, and in fact, the need-based institutionalization and continuity were the two key points in the formation of the Sharif innovation zone. In the third period, the appointment of senior managers and decision- makers in the governing body took place. These managers, who were familiar with the literature of innovation and entrepreneurship and had sufficient knowledge of this area, were also very influential in this process.

Table 4: Time classification of Sharif ecosystem evolution based on milestones

1991 - 2001	2001 - 2011	2011 - 2021
Initiating technology study movements	Initiating Sharif Innovation Network	Managerial change in the government body
Initiating technology study movements	Initiating Sharif Innovation Network	The entry of private sector into the area

4-2- Factors affecting the formation of the university-based innovation ecosystem

Implementing and analyzing the interviews with the mentioned experts has identified a set of factors as effective factors for the formation and empowerment of activities in this area, and by summarizing the mentioned factors, a network of factors affecting the success of a university- based innovation ecosystem is presented in Figure 8. In this model, the factors affecting the formation of Sharif Innovation zone as a successful example of innovation zones in developing countries, which is ranked 200th in the world in terms of business and economy and 1st in Iran(timeshighereducation, 2022). has been classified in four main categories. This model helps university administrators and officials of academic innovation institutions to ensure the success of technology transfer to the industry by considering all these factors and creating a suitable platform for their realization. The following are some of the views of the interviewees regarding the factors influencing the formation of the innovation ecosystem of Sharif University of Technology, on which the framework presented in Figure 4 is based.

Table 9: An example of interviewees quoting factors affecting the formation and development of the Sharif Innovation Ecosystem

Factor	Quotation	Intervi ewee code
The scientific atmosphere of the university	Sharif University was the repository of high-quality and cheap personnel, and this is how we built the body of communication with industry. The faculty members were not ntered. For example, in the technology program, we gave a budget to those who had a blueprint. This could not be done with the university staff. There is no monetary or legal environment among students and they are motivated to work.	A11
Macro policies of the university	Some managers of this innovation zone knew a certain type of behavior for each taste and created an informal atmosphere that has been effective in relationships and vancement of work, for example, they go mount climbing and have family and travel plans, etc.	A22
Macro policies of the university	During this period, the manager of Sharif Park managed the environment of social skills development well, which had vreated motivation.	A23
The scientific atmosphere of the	There is not much difference between IQ of Sharifi students and that of the sixth	A32

university	university of Iran, but what makes Sharif different is something apart from IQ and it is education in the context of understanding social skills	
Macro policies of the university	Before the formation of this ecosystem, most of the students of this university had the prospect of migration, but with the formation of this space, an alternative vision was <i>created for them and they stayed in the country</i>	A61
Macro policies of the university	The well-thought-out manager of the park during this period is a program entitled "What is your plan for the future?" that played a role in shaping students' future orientation	A72
Need-based institutional ization	The next turning point was the establishment of the park, which created an independent budget line x	A73
The scientific atmosphere	The return of students to Iran who have lived, studied or worked abroad has led to positive developments. In addition to learning, they had good relationships with world-enowned professors and elite students at other universities, which has been effective	A74
Need-based institutionalization	Financial institutions located in the park are an effective factor. Some funds like Sharif and Attar have come there. Sharif Fund is the second fund in the country after the ovin nd. It was interesting that a university established a fund. The personality traits of the manager of this course were very important and influential	A11
University Policies	One of the university programs is the establishment of Sharif Business Institute, which teaches emotional intelligence programs to children	A22
The scientific atmosphere of the university	Cheap, high-quality and specialized workforce at Sharif University is one of the most important reasons for the success of this ecosystem	A91
Accompany ing the policy-making body	With its support, the Deputy Minister of Science and Technology has a pivotal role in the development of the innovation	

	ecosystem throughout the country and this region	
Managerial changes	A good thing about Sharif University was that it did not have much of a political aspect and the scientific aspects outperformed others. From 1997 to 2009, the president of the university was an experienced person of Sharif University professors who, due to his different attitudes towards the previous management of the university and his long presidency, underwent a great change in the university innovation environment. In 1993, with the election of one of the graduates of Sharif University as the Vice President for Science and Technology, another change took place in the university ecosystem	A52

By summarizing and analyzing the material stated by the experts (some of which were mentioned above), the framework of factors affecting the formation of the Sharif innovation ecosystem is presented in Figure 4.

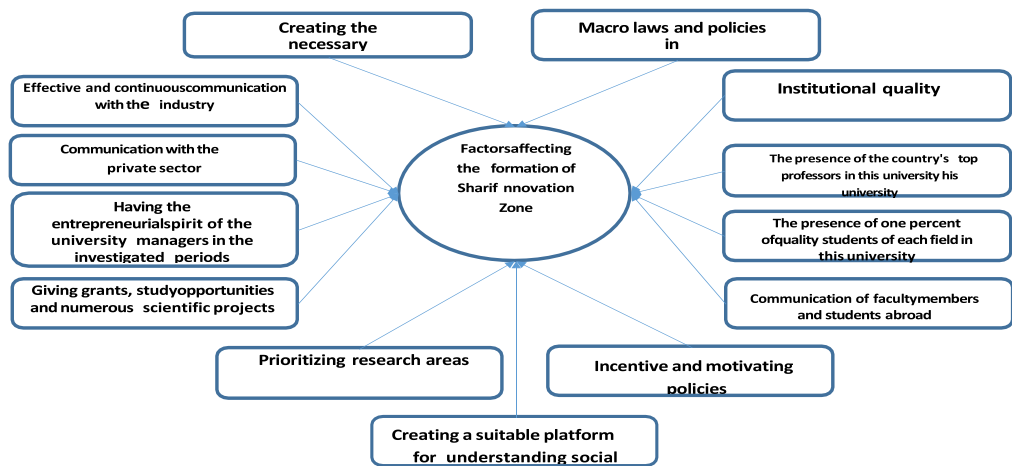


Figure 4: Framework of Factors Affecting the Formation and Development of Sharif Innovation Ecosystem

4-3- A pattern for explaining the university-based innovation ecosystem

In this section, the factors influencing the formation of the Sharif innovation district, which were extracted through interviews with experts and presented in the previous section, are categorized by considering the model presented in the review study by Granstrand and Holgerson. Due to the fact that Granstrand and Holgerson's study generally studied innovation ecosystems and not university-based innovation ecosystems, some of the dimensions raised by them were not discussed in this study, so they have been omitted. Also, based on Phillips and Park's study, the difference between a system and an ecosystem is the existence of a core in the center of the ecosystem (Oh et al., 2016) and considering that in this study, the study of local life centered on the university, at the center of this model is the university as The central core of the ecosystem has been introduced.

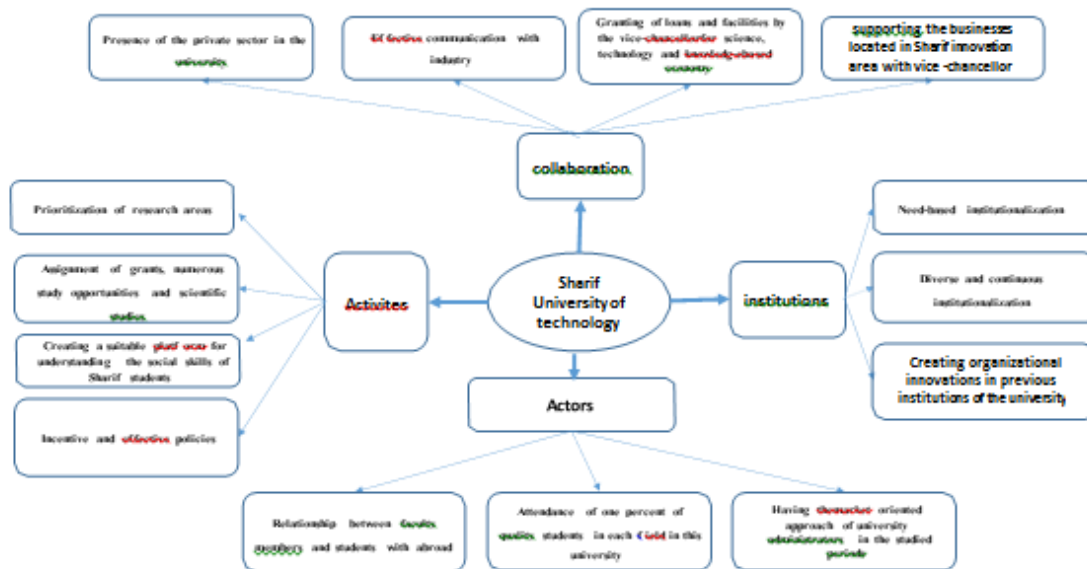


Figure 5: The proposed framework of the current research

4- Discussion

The pattern presented in this study, which is a compilation of conducted interviews and is based on Granstrand and Holgerson's study, has four main dimensions that the authors have put the university as the central core of the ecosystem in the center of their proposed pattern. The four main dimensions in this research include actors, activities, institutions, and collaborations, and other dimensions mentioned by Granstrand and Holgerson, such as competition, which is important for corporate ecosystems, are not mentioned in the university, which has a supporting role.

In the first dimension, which is related to the characteristics of the ecosystem's main actor, Graham (2014) identified one of the success factors of university-based ecosystems as the culture of entrepreneurship and innovation, the strength of university leadership, the university's research capability, the quality of local or regional life, government or regional support, the effective organizational strategy and finally the entrepreneurial strength of the students has been expressed. In fact, the scientific quality of the university is one of the effective dimensions in the innovation ecosystem of the university (Nuzhari and Asadi Fard, 1400). According to the experts of this research (A21, A32, A41, A52, A63), one of the most fundamental reasons for the success of Sharif's innovation ecosystem in Iran is the benefit of top talents and actually one percent of smart people in each field. This potential has actually provided the skilled, high-quality and cheap workforce to advance and develop projects and ideas, which is very important. In addition, some of these people will later teach as faculty members in the same university, and their knowledge will be passed on to the new generation. Therefore, it can be said that based on the research findings of Graham (2014), the formation pattern of this ecosystem was from the bottom to the top. Also, due to the migration of a large number of honorable students and their studies in prestigious universities of the world and the establishment of communication between the prestigious professors and capable students of those universities with honorable students and professors, this university has always been in contact with the international scientific community and is aware of modern science. It should be mentioned here that although other good universities such as Tehran and Amirkabir also have this feature, but based on the findings of this study, the efficiency of managers with experience in the company and knowledge of the industry and market and facilitation of affairs for entrepreneurs is the strength and distinction. This is an area of innovation with others. Also, the existence of a suitable platform for understanding the social skills of students in Sharif University is another distinguishing feature of this university-oriented innovation area with other universities such as Amirkabir.

In the second dimension, which is activities, it should be said that the success of an innovation ecosystem depends on a set of factors, activities and infrastructure. This multi-faceted dependence is also shown by the findings of Jafar et al.'s research (2019). They stated that the emergence of an innovation cluster in the university is not possible only with an infrastructure approach and a set of hard factors, and in fact, it needs a kind of complementary approach. The set of factors that are effective as stimuli in the emergence of innovation clusters and are called soft factors. According to the interviewees of this research, identifying the needs of the industry, communicating and being able to translate the demands of the industry into the language of the university, having a specialized team in different fields are the characteristics of Sharif Innovation District. In the areas of innovation, the staff should have flexible working hours and be present when the researchers are present

(Gholami et al., 2017) and preferably, if the technology transfer and commercialization projects are successful, they should enjoy its benefits in some way. Among the success factors of Sharif University, the stability of the management of Research and Technology Vice-Chancellor has been mentioned as the subject of the present study.

In the third dimension, which is related to institution building and its quality in the university- centered ecosystem, and the interviewees of the present study also emphasized it a lot (A41, A51, A61) is the way of institution building in this ecosystem. Usually, in developing countries, institution building is done in imitation of developed societies and without paying attention to the real need, which on the one hand causes the waste of resources and on the other hand causes the desired result not to be obtained (Nozari and Asadi Fard, 1400). In this ecosystem, institutionalization is completely based on needs and is created organically over time, and based on the findings of Beh et al. (2016), it is an organic development type and not a systematic one. Up-to-date knowledge of managers in creating diverse institutions and continuity in creating these institutions and their development are other features of institution building in this university (A92, A112, A131). Also, according to what the interviewees have mentioned, one of the important responsibilities of various institutions in the area of Sharif innovation should be to inform and inform researchers about the process of services and support of the university, because currently many faculty members and students are not aware of the activities of various institutions of the university. Holding synergistic meetings between faculty members to exchange knowledge and networking to connect with the industry is another task. The ability to maintain the forces that have been present and worked in this chain and are considered as organizational assets is one of the other organizational duties. These forces, who have been trained over the years, will take most of the relevant information with them when they leave the university.

The fourth dimension refers to the way of cooperation in the ecosystem. In this study, the cooperation of the industry with the university and the use of the findings of the university by them were mentioned, and the interviewees stated (A92, A63, A121, A122, A112) that: "Industry should go towards risky investment on the findings of academics and Invest in businesses that are in their core competency or side businesses that may be important to them in the future. In fact, the industry should trust the university, and of course, institutions should help the industry and the university to speak the same language." This finding is also confirmed by the study of York and Ahan (2012). In his study, he stated that the maturity and strength of the relationships that the technology transfer office has with industry, investors and other potential groups are effective in the success of technology transfer. Also, according to the research of Oshie et al. (2005), the success of the technology transfer office depends on the successful interaction with the industry. The interviewees of

this study believe (A91, A102, A82, A71) that having a professional research and development unit in industrial units is a procedure that is usually implemented. Meanwhile, it is more important to have a unit that is skilled in communicating with the university and using the university's research projects and technologies. Previous studies have also emphasized the positive effect of having a single window in large industrial companies to communicate with university technologists in benefiting these companies from the technological achievements of universities and knowledge-based companies (Esadi Fard and Khalidi, 2018). Using the potential of a university like Sharif University, which is the center of elites and talents of the country and whose mission has long been to solve the problems of the industry, is far more important than having a separate research and development unit. In addition, the industry should invest in the university and solve its existing problems and future needs through the cultivation of university talents and investment there.

Also, Hellerstedt (2014) believes that the cooperation of the policy-making body is also necessary in formulating a coherent policy in these areas of innovation at the national, regional and university levels. In the interviews, they stated (A112, A131, 133): "In our country, the topic of technology and innovation has been the focus for several years. In the first years, each organization's research budget was given to itself. Later, it was collected in the scientific deputy of technology. Presidency and said that everyone should get funds from there. But little by little, they realized that with this centralized system, government organizations do not participate and the concepts are separated from the systems. Therefore, they came and played the organizations. For example, the Innovation and Prosperity Fund and the Scientific Vice-Chancellor and The presidential technology started the industrial centers to play with the machines. Therefore, the politician can make big policies during the budget concentration. For example, what happened when the budgets were concentrated was that if a machine did not work, his own share another device could take his share, therefore, a competition would be created to attract resources. In general, the experts of the current research stated (A112, A133) that the policy maker's relationship with the institutions of the innovation ecosystem is by no means a one-way communication and the policy maker should always communicate and interact directly with people in addition to communicating laws and policies and developing the necessary educational infrastructure. To be present in the ecosystem of innovation and by creating positive competition, universities or organizations make more efforts to obtain research funds. In this regard, they also stated (A132,133): "Biosphere also has discussions other than financing, for example, human resources training programs, such as the programs carried out by the Presidential Vice President for Science and Technology, such as Sadaf, Chemistry, the works of the researchers' fund. Although another good policy that can be put is to say that if research activity or technological cooperation or technological activity is formed between several groups instead of being within one system, a certain percentage will be added

to the allocated resources, and these are policies to encourage the growth of the ecosystem. Is". Finally, it can be said that macro-educational policies, in addition to financial issues, can create a suitable platform for promoting and facilitating the activities of the innovation ecosystem. In fact, it can be said that the companionship of senior governance managers and their approach to innovation issues has been another effective factor. In this regard, appropriate infrastructures and macro plans have been made to realize the goals of this approach (A111, A112, A113). Therefore, according to the said contents and based on the research findings of Collomboli et al. (2019), the type of governance of this ecosystem at the current stage is of both relational and hierarchical types and is in the transition stage.

6- Policy implications

This study has tried to study the historical evolution of the university-based innovation ecosystem, by examining the current situation and through numerous and in-depth interviews and with an innovative perspective, to identify all the factors influencing the formation of the Sharif Innovation Zone and present it in a framework. Considering these findings, the following policy suggestions are also presented:

In the next activities, it is suggested that the research vice-chancellor of Sharif University of Technology should create motivation for academic staff members and students by having support policies for researchers and clarifying these policies. One of the other important discussions in this field is the determination of ownership of research achievements that have been created by faculty members and university students using the infrastructure and financial resources of the university. Also, considering that the difference between Sharif University and other top universities is the presence of a suitable platform for understanding the mentioned social skills, it is suggested that a process to create such a platform should be carried out in other university- based innovation ecosystems as in this ecosystem.

In the second dimension, which is related to the quality of institution building, it is suggested that the institution building in the university should be in accordance with the existing needs. What is now the routine of many universities in the country is illogical modeling of developed countries without understanding the true nature of local needs. In Sharif University, which is one of the most successful ecosystems of innovation in Iran, depending on the need and over the years, this institutionalization has been carried out in accordance with the evolution of the innovation area and commercialization of the university. In addition, it is suggested to overcome the monotony and exhaustion of institutions with organizational innovations.

In terms of cooperation, it is necessary to accompany the policy-making body in order to create infrastructure, material support, large-scale educational

programs, support the return of immigrant elites, and create soft and hard platforms for the creation and development of innovation ecosystems. Also, trying to take advantage of the experiences of students educated in developed countries who have returned to the country and communicating with people who live abroad and using their experiences, especially if they have experience working in innovative foreign companies. Accelerating the growth and development of local ecosystems is very effective.

Finally, it can be said that the formation of a university-oriented innovation ecosystem depends on a set of factors inside and outside the university, both at the micro and macro levels. In order to form and develop the ecosystem of innovation, it is necessary to accompany and coordinate all different actors.

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What makes a metro city fall in love with a female entrepreneur? An Indian perspective

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Abstract

The main objective of this paper is to investigate the economic determinants of female-owned proprietorship for 52 metro cities in India. The National Sample Survey (NSS) unit-level data on unincorporated non-agricultural enterprises, employment and unemployment, and consumption expenditure are used for the analysis. The descriptive results show that women's proprietorship is much lower than its counterpart. The Probit regression results at the individual level show that women entrepreneurs do not have a bank account or computer but use the internet, are not registered under any act or authority, do not pursue mixed activities, and do not expand considerably. They mainly operate within household premises with a limited number of months and duration of a day undertaking mainly contract basis. They also face several problems that hinder their activities. City-level factors such as work participation rate, the magnitude of consumption expenditure, higher level of general and technical degrees, and vocational training are essential for creating female owner entrepreneurship. City-level poverty and inequality also adversely affect it. State-level Human Development Index, Gender Development Index, and Gender Inequality Index are also significant. Finally, we propose important policies to enable the city environment to improve women's entrepreneurship activities for higher and sustainable economic development.

Key Words: Female, entrepreneurship, agglomeration, poverty, inequality, development, India

JEL Classifications: J16, L26, O10, R00, R12

1. Introduction

Entrepreneurship creates economic opportunities, contributes to higher economic growth, and reduces poverty. A large number of classical studies, such as Knight (1921), Schumpeter (1934), Baumol (2002), Acs and Armington (2006), and Phelps (2007), emphasized how entrepreneurship is crucial for economic growth. Glaeser and Gottlie (2009) and Glaeser et al. (2010) showed that entrepreneurship is crucial behind the growth of cities. For developing countries, cities are the engine of economic growth. It indicates that a higher level of entrepreneurship is growth-promoting.

The increasing female workforce participation rate, which comprises half of the world's potential workforce, is one of the main factors behind the current higher economic development (Landes, 1999). It also empowers women and has significant economic benefits beyond promoting gender equality (Duflo 2005, World Bank 2013).

The Global Entrepreneurship Monitor (GEM) 2020 survey, an estimated 274 million women globally are involved in business startups. Globally, only 1 in 3 businesses are owned by women. However, South Asia has the lowest share (18%) of women's business ownership.¹ The GEM report in 2018-19 showed that globally, the Total Entrepreneurial Activity (TEA) rate for women is about 10.2%, approximately three-quarters of that seen for men.² However, low-income countries show the highest rates of women's TEA at 15.1%. The global average for women's intentions to start a business within the next three years is 17.6%, only about four points less than for men. This discussion suggests that women's entrepreneurship is very low compared to men. However, it is expected to be an increasing trend in developing countries.

Despite rapid economic growth, gender disparities in women's economic participation have remained low and persistent in India. For instance, Mehrotra and Parida (2017) argued that women's labour force participation declined in India due to the growing mechanization in agriculture and rising capital intensity in manufacturing sectors that limited the opportunity for females because of their low education and skill and due to other cultural constraints. World Bank data shows India has one of the world's lowest labour force participation rates. It was only about 19%, lower than 35% in Bangladesh and 31% in Sri Lanka in 2020. Based on four measurements: economic participation and opportunity, educational attainment, health and survival, and political empowerment, the World Economic Forum's Global Gender Gap Report

2018 Ranks India 108th out of 149 countries worldwide. The 2018 Mastercard Index of Women Entrepreneurs ranked India 52 among 57 countries.³ Only about 14 per cent of Indian women own or run businesses, according to the

Sixth Economic Census, conducted in 2014. It shows that India is one of the failed countries in the world in the context of employing its huge female population and helping them to become an entrepreneur. Therefore, increasing women's participation in the workforce by escalating entrepreneurial activities is essential for India's economic development and accomplishing more remarkable economic growth and gender equality.

The unincorporated sector in India includes a large number of enterprises of varying sizes and spread.⁴ The most developing sectors of the Indian economy, such as manufacturing, trade, and other services, are the part unincorporated units. It is also the primary source of employment opportunities for many unskilled/ semi-skilled/ skilled persons. The sector also contributes a hefty share of the Gross Domestic Product. Aggregated Gross Value Added (GVA) by the unincorporated non-agricultural enterprises was estimated at Rs. 11,523 billion in 2015-16. In this amount of GVA, the highest contribution came from the trading sector (39%), followed by other services (38%) and the manufacturing sector (23%), respectively. The GVA per worker for the urban area was Rs. 1,31,754 during the same period.

The seventy-third round of the National Sample Survey (NSS) in 2015-16 is devoted exclusively to the survey of economic and operational characteristics of unincorporated non- agricultural enterprises in manufacturing, trade, and other services sector (excluding construction) at the all-India level.⁵ The survey revealed that about 111.3 million workers were engaged in unincorporated non-agricultural enterprise activities (excluding construction) in 2015-16. Within that, female workers constituted roughly 23.91%. The share of female workers was highest in manufacturing (52.67%), followed by other service sector enterprises (25.91%), and enterprises engaged in trade (21.42%). Among the states, West Bengal had the highest share of female workers (16.35%), followed by Tamil Nadu (12.14%) and Uttar Pradesh (10.27%).

Data shows that about 96 % of unincorporated non-agricultural enterprises are owned by proprietary enterprises (i.e., enterprises owned by a single household). Moreover, only 20% of these were owned by females. The highest share of female-headed proprietary was in manufacturing (45%), followed by trading (9%) and other services (7%).⁶ The share of female workers in own account enterprises (OAEs) and establishments was 28.5% and 16.5% of the total workers.⁷

The current development of India is transforming a traditional rural-based economy into an urbanized industry and service lead economy. For instance, the share of the urban population in the total increased from 17.97 % in 1961 to 31.16 % in 2011. Though the urbanization rate in India is shallow, promising evidence came out in the latest available Census data in 2011. For the first time since Independence, the absolute increase in population is more in the urban areas than in the rural areas. Many of India's urban population historically lived in large cities (Tripathi and Mitra, 2022). The percentage share of the

urban population in class I cities (with a population of more than 0.1 million) increased from 51.42 in 1961 to 70.2% in 2011. The 74th Amendment to the Indian Constitution defines a metropolitan area as an area having a population of 10 Lakh or 1 million or more, comprised in one or more districts and consisting of two or more Municipalities or Panchayats or other contiguous areas, specified by the Governor by public notification to be a Metropolitan area. In India, the size of metropolitan cities has increased noticeably along with their numbers. As per the 2011 Census data, fifty-two metropolises are located in 16 states and one union territory.

In this context, our main objective is to investigate the economic determinants of female-owned enterprises in Indian metro cities. We consider unit or individual level data of three major surveys conducted by the NSS in different years. Our main contributions are as follows: First, using a unique data set to investigate the determinants of female-owned proprietorship is new. The data set detailed various essential aspects of entrepreneurship activities that are not explicitly used. Considering state or district-level reported data, the construction of city-level data was a challenge for us and made the best contribution to the related literature. Second, though several studies (e.g., Khanna, 2012; Ghani et al. 2012a, 2012b, 2013, 2014a, 2014b) in India sheds light on female entrepreneurship activities at the cross-country or country level, city-level analysis is entirely missing. One of the essential seminal papers on this issue by Rosenthal and Strange (2012) considered agglomeration and distance variables for the analysis.

Nevertheless, they did not consider city/agglomeration-specific variables. Therefore, our investigation at the city level is very crucial. Third, it is crucial to find out the reason behind the lack of less female-friendly entrepreneurs. Therefore, we consider individual-level micro factors and city-level macro factors for the analysis. Our consideration of various economic factors also contributes significantly to developing related literature. Finally, our research also has a considerable contribution to policy formulation. Which kind of city-specific level policies are required to make a city not only an engine of economic growth but also ascertain female-friendly, less uneven economic development? Finally, the lessons can benefit India's sustainable development prospects and many other developing countries.

The rest of the paper is organized as follows. Sections 2 and 3 present a brief literature review and conceptual framework. Section 4 illustrates the data and methods used for the analysis. Empirical results are presented in section 5. Finally, discussions and conclusions are made in 6 and 7, respectively.

2. Review of literature

Several international studies, such as Parker (2009), Klapper and Parker (2011), Rosenthal and Strange (2011), and Kobeissi (2010), consider gender differences

in entrepreneurial activities. Parker (2009) and Klapper and Parker (2011) reviewed literature on gender differences in entrepreneurship systematically. Cross-country level studies on gender ratios in entrepreneurship are done by Minniti (2010) and Minniti and Naudé (2010). Most importantly, Rosenthal and Strange (2011) worked on sorting for female entrepreneurs in the United States. The study highlighted the spatial mismatch within the metropolitan area for female entrepreneurs similar to that found earlier on racial lines.

Kobeissi (2010) considered 44 developed and developing countries to examine the impact of five gender-related variables on the magnitude of female entrepreneurial activities. The paper found female education, the extent of female economic activities, female earnings ratio, and fertility rate to be significant in all estimations, with two dependent variables representing female entrepreneurial activities. Alene (2020) established that educational level, previous entrepreneurial experience, access to business training, access to finance, access to business information, government support, land ownership, and tax are significant in explaining women entrepreneurs' performance (measured by if the women-owned business is profitable) in Gondar city, Northwest Ethiopia.

There is also a growing literature on female entrepreneurship, especially in India (Khanna, 2008; Ghani et al. 2012b, 2013, 2014b), attempting to identify factors more specific to female entrepreneurship. Khanna (2008) examined how entrepreneurial forces drive China's and India's development trajectories. The author probes essential differences between China and India in areas such as information and transparency, the roles of capital markets and talent, public and private property rights, social constraints on market forces, attitudes toward expatriates abroad and foreigners at home, entrepreneurial and corporate opportunities, and the importance of urban and rural communities.

Ghani et al. (2012b) analyze the spatial determinants of female entrepreneurship in India's manufacturing and services sectors. Good infrastructure and education predict higher female entry shares. There are strong agglomeration economies in both manufacturing and services, where higher female ownership among incumbent businesses within a district industry predicts a more significant share of subsequent entrepreneurs will be female. Ghani et al. (2013) show that a substantial share of the persistence in India's unorganized manufacturing sector is due to the rapid increase in female-owned businesses. Ghani et al. (2014b) quantify the link between the timing of state-level implementations of political reservations for women in India and women's role in India's manufacturing sector. While overall employment of women in manufacturing did not increase after the reforms, they found significant evidence that more women-owned establishments were created in the unorganized/informal sector.

A comprehensive study on India by Daynard (2015) argued that female human capital, both general human capital through education and specific human

capital through labour force participation, is the driver of female entrepreneurship in India. The population density positively affects both types of entrepreneurs, but it is found to be gender neutral. Variables such as access to bank credit, provision of credit, or income per capita, were not recognized as essential barriers or facilitators of female entrepreneurship. Gupta and Phillips (2019) found that men still negatively viewed female entrepreneurship in India. However, women were broadly positive and confident about their skills and abilities, whereas men's views were more polarised toward female entrepreneurs.

Nirjar (2011) emphasized that women lacked organizational skills but were very good at service and timely delivery management. A competition mindset sometimes exists between the genders, thus developing obstacles for women entrepreneurs in their activities. Vinesh (2014) attributed that advanced education, modifying social and cultural systems, and the necessity for an additional source of income are the change factors for many homemakers to become entrepreneurs. Kumari (2014) suggested that support from family and friends, adequate education and training, easy availability of finance, and family occupation, to achieve economic independence are essential for women's entrepreneurial activities in India. Roomi and Parrott (2008) and Vijayakumar and Naresh (2013) found that deep-seated conventional prejudiced socio-cultural standards and ethics such as the caste system, female businesspersons are given a secondary treatment compared to their male counterparts with male power embedded politically and religiously in many cases.

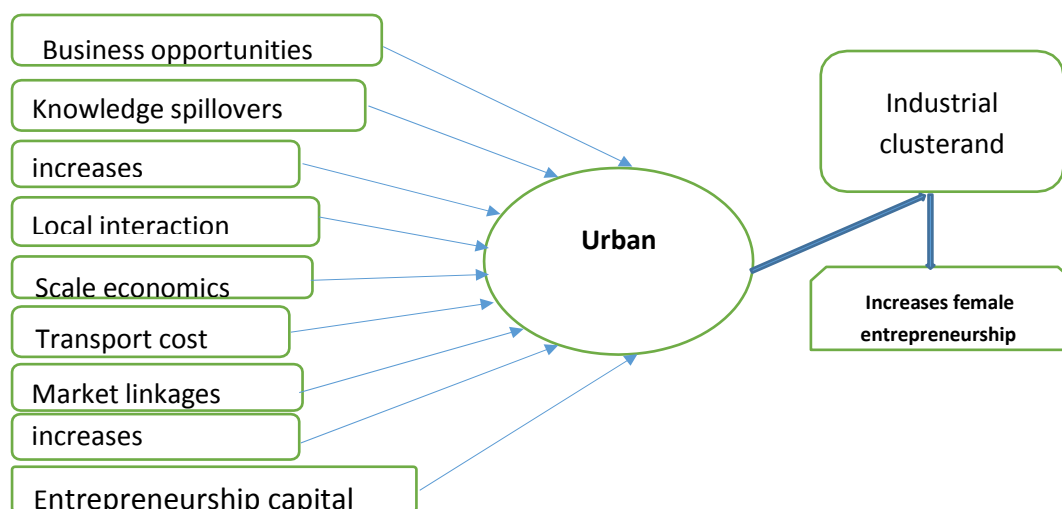
3. Conceptual framework

Our main conceptual framework is mainly driven by Rosenthal and Strange (2012), Ghani et al. (2014b), and Hasan (2020). Cities, where agglomeration of activities is generated, are linked with industrial clusters and entrepreneurship, especially female entrepreneurship. Industries are geographically concentrated in large cities. The basic ideas behind this industrial agglomeration are mainly driven by proximity and reducing transport costs (Marshall, 1920). The idea is also emphasized in the more general "new economic geography" framework by Fujita et al. (1999). The second reason to agglomerate is to take advantage of scale economies associated with a large labour pool (Ellison et al., 2010). Other critical studies, such as Duranton and Puga (2004) and Rosenthal and Strange (2004), discussed local interaction that gives rise to agglomeration economics.

The positive benefits of agglomeration economies stimulate economic growth. The entrepreneurial activity is one primary agent that helps reap the real benefits from the positive spillovers of agglomeration economies that build up to a certain extent on knowledge spillovers (Porter, 1990). Economic growth has a particularly positive impact on entrepreneurial activities by creating business opportunities that lead to the commercialization of innovative ideas through the creation of successful startups. On the other hand, knowledge spillovers by the new enterprises may spur economic growth. The idea is similar to circular

causation and market linkages (Krugman, 1991). Entrepreneurship, therefore, can be conceptualized as both the cause and the effect of urban economic growth (Hasan, 2020).

Figure 1: The relationship between urban agglomerations and female entrepreneurship



Source: Author

On the other hand, cities support entrepreneurial activities in general as they provide public services such as a large number of educational institutions, banking and financial activities, health and transportation, and higher employment opportunities with high income. Cities are open economics as they involve fewer restrictions on factors and intellectual mobility (Glaeser et al., 2010). Cities also have higher entrepreneurship capital, i.e., a collection of social networks supportive of starting new firms. Therefore, the urban institution framework is considered to promote women's entrepreneurship by easing out the educational, financial, and regulatory system. Figure 1 indicates that urban agglomeration that increases business opportunities, knowledge spillovers, labour pooling, local interaction, scale economics, market linkages, public services, entrepreneurship capital, and transport costs positively impacts industrial clusters and entrepreneurship, especially women entrepreneurship.

4. Data and methods

4.1 Data

None of the NSS data provides city-level data. However, district-level information is provided mainly after 2004-05. Therefore, we consider the city district (where the sample city is located) as a proxy of a city. There are two reasons behind selecting these metro cities (one million or more population) as the unit of analysis. First, larger cities are a good proxy for a city district as they cover a more significant portion of a district than smaller cities. To make it more appropriate, we consider only the urban sample of the city district. However, it cannot be used as a proxy for small cities and towns; districts encompass

multiple cities and towns. Second, as India's 71 % share of urban population is mainly concentrated in Class I cities (with a population above 100,000), these cities also belong to Class I cities. According to 2011 Census data, India had 52 metro cities that absorbed about 42.3% of the total urban population. It indicates that our selected sample cities represent almost half the total urban population. Appendix Table 1 provides the name of the metropolitan cities and states where they are situated.

Various factors influence becoming female entrepreneurship. In this study, we consider mainly two types of factors in this regard. These are micro and macro-level factors that determine female entrepreneurship choices. The choice of these factors is mainly based on a review of the literature and data availability.

Micro-level factors are mainly drawn from unit/individual-level data of the National Sample Survey (NSS) on economic and operational characteristics of unincorporated non-agricultural enterprises in manufacturing, trade, and other services sector (excluding construction) at the all-India level in 2015-16. Though the data set is quite extensive, it does not provide many other important variables such as the population size of a city, city-level employment information, city-level inequality, etc. Therefore, we use NSS data on consumer expenditure, employment, and unemployment in 2011-12.

The latest Household Consumer Expenditure Survey (CES) conducted by the National Statistical Office (NSO) during 2017-2018 was not released given "data quality issues". The CES is traditionally a quinquennial (recurring every five years) survey data. Therefore, we could use only the CES survey data for 2011-12. On the other hand, the survey on employment and unemployment by the National Sample Survey Office (NSSO) (now NSO) was quinquennial. Both were conducted in the same years with similar methodologies. However, NSSO's survey on employment and unemployment has now been replaced by the Periodic Labour Force Survey (PLFS) from 2017-18, and it has been conducted annually since then. To make data more comparable, we consider NSSO's employment and unemployment survey (EUS) data for 2011-12. It is not comparable to EUS data with PLFS. Therefore, we consider NSSO's survey on consumer expenditure, employment, and unemployment for 2011-12. Also, we are using Census data for some variables, including city population size and growth rate.

As per the data available, we can only use the latest 2011 Census data.⁸ Appendix A presents the definition and data source of each variable used for the regression analysis.

4.2 Methods

In the binary Probit model, the female owner proprietorship choice was taken as 1, while a male runs the proprietorship as 0. As our objective is to promote women entrepreneur activities, we assume that our utility will be maximized if an enterprise is run by a female rather than a male. Therefore, the probability of

choosing any alternative over not choosing can be expressed as in equation (1), where Φ represents the cumulative distribution of a standard normal random variable.

$$P_i = \text{prob}[Y_i = 1 | X] = \int_{-\infty}^{X_i\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt \quad (1)$$

$$= \Phi(X_i\beta)$$

The means of the marginal effect that accounts for the partial change in the probability is calculated to find out the relationship between a specific variable and the outcome of the probability. The marginal effect associated with continuous explanatory variables X_k on the probability $P(Y_i = 1 | X)$, holding the other variables constant, can be derived as follows:

$$\frac{\partial P_i}{\partial X_{ik}} = \Phi(X_i\beta) \beta_k \quad (2)$$

where ϕ represents the probability density function of a standard normal variable, the marginal effect on dummy variables can be calculated from a continuous variable. An alternative to the marginal effect can be estimated by considering discrete changes in the predicted probabilities when evaluating the influence of a dummy variable. This effect can be derived from the following:

$$\Delta = \Phi(\bar{x}\beta, d = 1) - \Phi(\bar{x}\beta, d = 0) \quad (3)$$

The marginal effects provide insights into how the explanatory variables shift the probability of frequency of occurrence of the female entrepreneur. Using the econometric software STATA 14, marginal effects were calculated for each variable while holding other variables constant at their sample mean values.

As we discussed before, micro- and macro-level factors are used to investigate the determinants of female owner entrepreneurship. Micro-level factors mean factors that can be used at the individual level, and macro-level factors are those obtained at the city level. It is important to note that all data/variables are available at the unit/individual level, but they may not be used at the individual level for our analysis. For example, consumption data are available at the individual level, but poverty figures can be used only at the district level. As we are using different NSS rounds to construct different variables, getting all information for the same persons in the same period is impossible. Therefore, based on data available in different survey rounds and periods, we divide and consider micro and macro-level data for the analysis.

Micro level data consists of various information such as activities, banking, location, nature of the operation, number of hours in a day and month operated, use of a computer, use of the internet, government assistance, the status of enterprises, work on contract basis, infrastructure availability, and facing any problems etc. All these variables were used at an individual level in 2015-16. In addition to that, other important variables such as Gender

Inequality Index (GII), Gender Development Index (GDI), and the Human Development Index (HDI) for females are also used. Though these variables are still available at the state level, we have used them. These gender-based development measurements are essential to any gender-based analysis as data for these variables at the state level in India are now only available for 2011-12 and 2017-18. In this case, we use data for 2017-18 to measure these variables that are not similar to the NSS methodology, and we want to use as much as the current scenario of gender inequality in India.

On the other hand, macro-level data consists of several essential variables such as female workforce participation rate, number of female casual workers, slum population, city population, and its growth rate, land holding status, poverty, inequality, level of general education, technical education, vocational training, per capita consumption expenditure, and placement agency, etc. Though all these data are calculated based on unit/individual-level information, as the period of survey and unit/individual are different, we could only use them at the city level.

As discussed in section 2, Kobeissi (2010) considered female entrepreneurship to be influenced by female education and the extent of female economic activities. Alene (2020) found several related variables, such as educational level, access to business training, access to finance, access to business information, government support, and land ownership that influenced women entrepreneurs' performance. In the case of India, Ghani et al. (2013, 2014) also found that good infrastructure and education are essential in this regard. Daymard (2015) emphasized bank credit, provision of credit, or income per capita for this purpose.

5. Empirical results

The NSS survey on "Unincorporated Non-Agricultural Enterprises (Excluding Construction)" in 2015- 2016 estimated that the unincorporated non-agricultural enterprises (excluding construction) were 6.34 crore. The survey has conducted on a total of 290113 unincorporated non-agricultural enterprises (143179 enterprises in rural and 146934 enterprises in the urban sector). Table 1 shows that male proprietorship was about 76%, whereas female proprietorship was 20% at all Indian levels. It is seen that both male and female proprietorship consists of almost 96% of the total ownerships. All India-level rural and urban distinction shows that female proprietary ownership in rural areas is a little higher (i.e., 21%) than in urban areas (i.e., 18%). There are no differences among female proprietary ownership in all Indian urban areas with metro cities. It indicates that metro cities do not pose special attention as another urban areas in terms of attracting female proprietors.

Table 1: Type of ownership

Ownership	All India				Metro cities	
	Total		Rural	Urban	Frequency	Percent
	Frequency	Percent	Percent	Percent		
Proprietary (male)	221,718.21	76.43	74.15	78.82	49,856.32	81.85
Proprietary(female)	56,696.49	19.54	21.2	17.8	11,056.677	18.15
Others	11696.30	4.03	4.65	3.37	0	0
	290,111	100	100	100		100

Note: It includes proprietary (transgender); partnership with members of the same household; partnership between members not all from the same household; self- help group; trusts; others.

Source: Author's calculation using NSS data on Unincorporated Non-Agricultural Enterprises (Excluding Construction) in 2015- 2016.

Summary statistics for each variable used in the regression estimations are presented in Table

2. The dispersion around the mean is higher for enterprises that receive any assistance from the government during the last three years, enterprises as franchisee outlets, and enterprises that undertake any work on a contract basis. It implies a less symmetrical distribution for these variables. However, as the coefficient of variation is lowest for the values of GDI, the enterprise pursues mixed activity, nature of operation of an enterprise, etc.

Table 3 shows that female ownership has a positive correlation with the location of the enterprise, if they undertake any work on a contract basis, the enterprise has access to toilet facilities and solid waste management. On the other hand, it negatively affects the number of hours the enterprise usually worked in a day, if accounts are maintained, and if registered under any act/authority. The results show that the correlation coefficients are very small. The correlation between enterprise use computer and the enterprise use internet is highest, i.e., 0.84. However, we did not find any multicollinearity problems as the variance inflation factors (VIF) presented in Table 4 are much less than 10.

Table 2: Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	C.V.
Whether proprietorship run by a female? (yes - 1, no - 0)(owner)	60,913	0.136178	0.34298	0	1	251.86
Whether pursuing mixed activity? (yes - 1, no - 0) (mixed)	60,911	1.9594	0.197364	1	2	10.07
Whether the enterprise maintain any bank account/ post officesavings bank	60,912	0.699862	0.458322	0	1	65.49

account? (yes - 1, no - 0) (bank account)						
Location of the enterprise (within household premises =1,outside household premises = 0) (location)	60,913	0.256202	0.436538	0	1	170.39
Nature of operation (perennial - 1, seasonal/ casual - 0)(operation) (nature)	60,913	0.989378	0.102514	0	1	10.36
Number of months operated during the last 365 days(operated)	60,913	11.48835	1.842926	1	12	16.04
Number of hours the enterprise normally worked in a day during the reference month (day)	60,860	8.854108	2.81331	1	24	31.77
Whether accounts maintained? (yes-1, no-0) (account)	60,913	0.233825	0.423266	0	1	181.02
Did the enterprise use computer (s) during the last 365 days?(yes- 1, no -0) (computer)	60,913	0.140134	0.347129	0	1	247.71
Did the enterprise use internet during the last 365 days? (yes- 1,no -0) (internet)	60,913	0.117742	0.322305	0	1	273.74
Did the enterprise receive any assistance from the government during last three years? (yes-1, no-0) (assistance)	60,912	0.007092	0.083917	0	1	1183.26
Status of the enterprise over the last 3 years (expanding - 1, stagnant/ contracting/ operated for less than three years - 0) (status)	60,913	0.303416	0.459737	0	1	151.52
Whether registered under any act/ authority? (yes-1, no-0) (act)	60,913	0.471591	0.499196	0	1	105.85
Does the enterprise undertake any work on contract basis (yes -1, no -0) (contract)	60,913	0.049612	0.217143	0	1	437.68
Is the enterprise a franchisee outlet? (yes -1, no -0) (franchisee)	60,913	0.012904	0.11286	0	1	874.61
Did the enterprise face any problem in its operation during last 365 days? (yes -1, no -0) (problem)	60,913	0.333738	0.471551	0	1	141.29
Does the enterprise have access to toilet facility? (yes -1, no -0)(toilet)	60,913	0.689229	0.462813	0	1	67.15
Does the enterprise have provision for solid wastemanagement? (yes-1, no-0) (waste)	60,913	0.570322	0.495034	0	1	86.80

Gender Inequality Index (GII)	60,913	0.45781	0.088203	0.34	0.741	19.27
Gender Development Index (GDI)	60,913	0.890635	0.083627	0.55	0.984	9.39
Human Development Index for female (HDI)	60,913	0.707566	0.083033	0.551	0.839	11.74

Source: Author's calculation

Table 3: Correlation coefficients

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
Owner (a)	1.00																				
Mixed (b)	0.01	1.00																			
bank account (c)	-0.14	0.01	1.00																		
Location (d)	0.33	0.04	-0.13	1.00																	
Nature (e)	-0.02	-0.01	0.02	-0.04	1.00																
Operate d (f)	-0.04	0.00	0.04	-0.01	0.34	1.00															
Day (g)	-0.29	-0.07	0.15	-0.30	0.05	0.04	1.00														
Account (h)	-0.10	0.01	0.27	-0.17	0.01	0.03	0.16	1.00													
Comput er (i)	-0.07	-0.05	0.18	-0.14	0.02	0.00	0.10	0.38	1.00												
Internet (j)	-0.06	-0.04	0.17	-0.12	0.02	0.00	0.08	0.35	0.84	1.00											
Assistan ce (k)	0.01	-0.01	0.04	-0.01	0.00	-0.01	0.02	0.03	0.05	0.04	1.00										
Status (l)	-0.05	-0.01	0.08	-0.03	0.02	0.14	0.07	0.11	0.08	0.07	0.01	1.00									
Act (m)	-0.10	-0.00	0.22	-0.03	0.05	0.07	0.23	0.38	0.28	0.25	0.05	0.14	1.00								

	8	3		1																
Contract (n)	0.03	0.02	0.01	0.07	-0.02	-0.02	-0.03	0.02	-0.01	0.00	0.01	-0.03	-0.03	1.00						
Franchisee (o)	-0.01	-0.01	0.05	-0.04	0.00	-0.01	0.03	0.10	0.13	0.12	0.02	0.01	0.08	-0.01	1.00					
Problem (p)	-0.04	-0.04	-0.01	0.01	-0.03	-0.02	0.03	0.00	-0.02	-0.01	0.02	-0.07	-0.04	0.07	0.00	1.00				
Toilet (q)	0.14	0.03	0.14	0.21	0.01	0.02	-0.02	0.19	0.16	0.15	0.00	0.05	0.11	0.07	0.05	-0.05	1.00			
Waste (r)	0.05	0.00	0.14	-0.05	0.04	0.03	0.09	0.14	0.10	0.09	0.00	0.04	0.15	0.03	0.02	-0.05	0.28	1.00		
GII (s)	-0.06	0.01	0.02	0.08	-0.02	-0.02	-0.02	-0.09	-0.05	-0.04	0.00	-0.01	-0.04	0.00	0.01	-0.02	-0.08	0.20	1.00	
GDI (t)	0.04	-0.02	0.02	-0.11	0.03	0.02	0.05	0.08	0.06	0.06	0.02	-0.04	0.20	-0.01	0.02	-0.07	0.18	0.22	-0.70	1.00
HDI (u)	-0.01	-0.01	0.16	-0.15	0.02	0.03	0.06	0.11	0.08	0.08	-0.01	-0.05	0.15	0.03	0.02	-0.04	0.23	0.26	-0.59	0.17

Note: See Table 2 for variable definitions. The correlation coefficients are based on 60,856 observations. Source: Author's calculation

Table 4 and 5 present the binary Probit regression models. Table 4 considers the micro-level factors, whereas Table 5 considers macro-level factors. Regression models 1 and 3 presents the estimated results of the full model, which includes all variables. Regression models 2 and 4 list results for a parsimonious model, excluding controls that are not found to be statistically significant or matched with the expected sign of the regression parameters. Parsimonious models use the correct number of predictors to explain the model well. The likelihood ratio chi-square values for regression models 1 and 2 are 10254 and 2910, respectively, and statistically significant at the 1% level. It indicates that our model is statistically significant, i.e., it fits significantly better than the model with no predictors.

The regression model 1.1 (or 2.2) presents the marginal effects of the Probit regression 1 (or 2) model. The results show that enterprises that pursue mixed activity are 3% less likely to be run by women than men.⁹ The enterprises that maintain any bank account/ post office savings are 7% less likely to be owned by women. It is also evidenced that women who own enterprises operate less during the reference year compared to men. Similarly, women entrepreneurs

are less likely to use a computer for business purposes. It is also evidenced that female owners work fewer daily hours during the reference month. Female owner enterprises are less likely to expand; they are stagnant, contracting, or operated for less than three years. They are less likely registered under any act or authority. Enterprises that face any problem during the reference year are 2% less likely to be run by women (in comparison with men).¹⁰ The higher the value of GII indicates 21% less likely an enterprise is run by a woman.¹¹ However, the higher value of HDI has a mixed effect on the female ownership's enterprises.¹²

Table 4: Probit regression coefficients of micro factors affecting female ownership enterprises

VARIABLES	Model 1	Model 2	Model 1.1	Model 2.2
	Dependent variable			
	<i>Whether proprietorship run by a female? (yes - 1, no - 0)</i>			
	<i>Estimated coefficients</i>		<i>Marginal effects of the overall expected value</i>	
Whether pursuing mixed activity? (yes - 1, no - 0)	-0.167*** (0.0369)		-0.0279*** (0.00617)	
Whether the enterprise maintain any bank account/ postoffice savings bank account? (yes - 1, no - 0)	-0.238*** (0.0162)	-0.337*** (0.0142)	-0.0397*** (0.00272)	-0.068*** (0.00285)
Location of the enterprise (within household premises =1, outside household premises = 0)	0.673*** (0.0170)		0.113*** (0.00293)	
Nature of operation (perennial - 1, seasonal/ casual - 0)	0.179** (0.0693)		0.0299** (0.0116)	
Number of months operated during the last 365 days	-0.0265*** (0.00383)	-0.021*** (0.00330)	-0.00443*** (0.000640)	-0.004*** (0.0007)
Number of hours the enterprise normally worked in a day during the reference month	-0.125*** (0.00295)		-0.0209*** (0.000496)	
Whether accounts maintained? (yes-1, no-0)	-0.0284 (0.0214)		-0.00475 (0.00358)	
Did the enterprise use computer (s) during the last 365 days? (yes- 1, no -0)	-0.0725* (0.0426)	-0.156*** (0.0402)	-0.0121* (0.00713)	-0.032*** (0.00812)
Did the enterprise use internet during the last 365 days?(yes- 1, no -0)	0.0710 (0.0446)	0.109** (0.0424)	0.0119 (0.00746)	0.022*** (0.00856)
Did the enterprise receive any assistance from the government during last three years? (yes-1, no-0)	0.411*** (0.0806)	0.371*** (0.0750)	0.0688*** (0.0135)	0.075*** (0.0152)
Status of the enterprise over the last 3	-0.0845***	-0.054***	-0.0141***	-0.011***

years (expanding – 1, stagnant/ contracting/ operated for less than three years – 0)	(0.0166)	(0.0151)	(0.00278)	(0.0031)
Whether registered under any act/ authority? (yes-1, no-0)	-0.286*** (0.0178)	-0.547*** (0.0149)	-0.0479*** (0.00297)	-0.111*** (0.0029)
Does the enterprise undertake any work on contract basis (yes -1, no -0)	-0.0404 (0.0319)	0.123*** (0.0287)	-0.00676 (0.00534)	0.025*** (0.0058)
Is the enterprise a franchisee outlet? (yes -1, no -0)	0.115* (0.0664)		0.0193* (0.0111)	
Did the enterprise face any problem in its operation during last 365 days? (yes -1, no -0)	-0.116*** (0.0158)		-0.0195*** (0.00265)	
Does the enterprise have access to toilet facility? (yes -1, no -0)	0.322*** (0.0189)		0.0540*** (0.00315)	
Does the enterprise have provision for solid waste management? (yes-1, no-0)	0.239*** (0.0157)		0.0400*** (0.00263)	
GII	-1.253*** (0.133)		-0.210*** (0.0223)	
GDI	1.095*** (0.184)		0.183*** (0.0308)	
HDI	-0.817*** (0.144)	0.736*** (0.0816)	-0.137*** (0.0241)	0.149*** (0.0165)
Constant	0.262 (0.204)	-0.932*** (0.0673)		
Observations	60,856	60,911	60,856	60,911
Pseudo R ²	0.2117	0.0600		
Mean VIF	1.66	1.58		
LR chi ²	10254***	2910***		
Log likelihood	-19094.62	-22785.7		

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1 Source: Author's estimation

On the other hand, women owning enterprises are 11% more likely to locate within household premises than men. Also, the female who owns enterprises is 3% more likely to operate perennially. Enterprises that use the internet (or receive any assistance from governance) are 2% (or 8%) more likely to own by women than men. Enterprises that own by females are more like undertake any work on a contract basis and enterprise a franchisee outlet. The availability of infrastructure variables such as access to toilet facilities and provision for solid waste management also encourages becoming a female owner enterprise. Finally, higher GDI values encourage 18% more likely to be a female owner enterprise.¹³

The regression models 3.1 and 4.1 in Table 5 present the marginal effects of the Probit model of regression 3 and 4, respectively. Results show that the city

wises a higher workforce participation rate, and women casual workers are more supportive of female owner entrepreneurs. The higher city slum population are 0.12% more likely to become female owner or entrepreneurs (in comparison to man). The growth rate of the city population also promotes female entrepreneurship. City wise higher percentage of people with a technical degree and diploma or certificate (below graduate level/ graduate and above level) are more likely to become female entrepreneurs than males. Education variables such as percentage of persons with literate and middle, and literate and upper middle render more chance for a female to own an enterprise. The increasing female ownership is also more likely to depend on the city-wise percentage of persons receiving/receiving any vocational training or registered with any placement agency. In a city with higher per capita consumption expenditure, women in that city are 5.8% more likely to become an entrepreneur than men.

In contrast, in a city with higher average land owned by a person, women in that city are 0.005 % more likely to become entrepreneurs than men. City-wise, a higher level of poverty and inequality also discourages a woman from becoming female entrepreneurs. Most importantly, a city's large population also reduces the chance of producing female entrepreneurship

Table 5: Probit regression coefficients of macro factors affecting female ownership enterprises

VARIABLES	Model 3	Model 4	Model 3.1	Model 4.1
	Dependent variable			
	<i>Whether proprietorship run by a female? (yes - 1, no - 0)</i>			
male workforce Participation Rate (WPR) in 2011-12 (in %)	0.00704*** (0.00184)		0.0014482*** (0.0003783)	
ty-wise % of women work as casualworker in 2011-12	0.00738*** (0.00139)		0.0015173*** (0.000285)	
City-wise % of city slum population 2011	0.00596*** (0.000870)		0.0012254*** (0.0001787)	
Growth rate of city population from 2001 to 2011	0.00870*** (0.00303)		0.0017891*** (0.0006235)	
ty-wise average land owned by a person in 2011-2012	-0.0003*** (7.54e-05)	-0.0003*** (6.49e-05)	-0.0000518*** (0.0000155)	-0.0001*** (0.00001)
Technical degree in agriculture/engineering/technology/medicine, etc in 2011-12	0.0304*** (0.00990)		0.0062459*** (0.0020368)	
ploma or certificate (below graduate level)	0.0218*** (0.00631)		0.0044918*** (0.0012989)	
ploma or certificate (graduate and above level)	-0.00371 (0.00687)	0.0621*** (0.00747)	-0.000764 (0.0014125)	0.0129*** (0.00155)
ty-wise % of persons literate and middle in 2011-12		0.00783*** (0.00190)		0.0016*** (0.000396)

ty-wise % of persons literate and uppermiddle	0.00925*** (0.00285)		0.0019029*** (0.0005863)	
ty-wise % of persons receiving/received any vocational training in 2011-2012	0.00507*** (0.000852)		0.0010432*** (0.000175)	
ty-wise % of persons currently registered with any placement agency of the age of 15 to 45 years in 2011-2012	0.00386*** (0.00130)		0.0007937*** (0.0002666)	
City inequality level in 2011-2012	0.0630 (0.204)	-0.580*** (0.183)	0.0129665 (0.0418732)	-0.1209*** (0.03817)
Log of city-wise mean per capita consumption measured by Modified Mixed Reference Period (MMRP) 2011-12	-0.0831 (0.0527)	0.276*** (0.0535)	-0.0170856 (0.0108472)	0.0575*** (0.01114)
Log of city population size in 2011		-0.127*** (0.00866)		-0.0265*** (0.001797)
ty-wise poverty head count ratio 2011-12		-0.0047*** (0.000887)		-0.0009*** (0.00018)
Constant	-1.543*** (0.324)	-1.499*** (0.419)		
Observations	48,721	48,721		
VIF	2.91	2.32		
Pseudo R ²	0.0206	0.0108		
LR chi ²	775.49***	404.55***		
Log likelihood	-18407.477	-18592.945		

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1 Source: Author's estimation

6. Discussion

The micro-level factors that impact the creation of female entrepreneurship show that female-owned entrepreneurs do not pursue a mixed activity do not have bank account/post office savings bank accounts, and mainly operate within household premises. However, the nature of the operation is perennial. They also operate very few months a year and fewer hours a day. Also, they do not use a computer but use the internet from other mobile devices. The status of the enterprise over the last three years is not expanded and is not registered under any act/authority. The female-owned enterprises mainly undertake work on a contract basis. It indicates that female-owned enterprises are basically very

small and not very much prospering. It seems that females are not also fully engaged with entrepreneurial activities but on a part- time basis. The National Sample Survey (NSS) in 2015-16 on economic and operational characteristics of unincorporated non-agricultural enterprises at the all-India level shows that nearly one-fifth of the enterprises were proprietary and headed by a female.

Most importantly, their share in comparatively bigger enterprises is only about 4% to 5 %. The female proprietary enterprises had a share of 45% among the manufacturing enterprises, whereas their share was 8.7 % in trading and 7.4 % in other services. This specifies that female- owned enterprises are not well-established compared to males. Mainly, they have very less share in trading and services. Therefore, current development policies have to consider effective policies such as the inclusion and encouragement of female ownership in entrepreneurial activities, mostly trading service enterprises. Female-owned enterprises seem to take less risk and work on a part-time basis. This has to consider in the current development policies. It urges the government's support not only in assistance in financing but also in various other aspects related to the initial establishment of entrepreneurship and developing it in more competitive ways to make it large and mature.

The results also indicate that problems associated with entrepreneur activities such as erratic power supply/ power cuts, shortage of raw materials, shrinkage /fall of demand, non- availability / high cost of credit, non-recovery of financial dues, non-availability of labour as and when needed, non-availability of skilled labour as and when needed, and labour disputes and related problems mainly deter females from being an entrepreneur. However, assistance from the government and higher availability of infrastructures such as toilet facilities and solid waste management encourage female entrepreneurship. On the other hand, a higher value of GII that indicates higher gender inequality reduces the chance of being a female entrepreneur. Higher values of GDI and HDI indicate lower gender inequality, and higher economic development encourages female entrepreneurial activities. Currently, Indian cities lack the quantity and quality of infrastructure and services. The Report on Indian Urban Infrastructure and Services (GOI, 2011; Tripathi, 2018) argued that cities and towns in India must meet the service norms set out by the Ministry of Urban Development in 2008 to retain and augment the contribution of cities to economic growth.

On the other hand, Indian society is very much unequal. According to the HDI calculations, only six, namely Chandigarh, Goa, Himachal Pradesh, Mizoram, and Sikkim, showed high equality (less or equal to 2.5%). The other 31 states and union territories are mostly less equal or less friendly towards women. Therefore, policies must direct towards increasing the efficient availability of infrastructure and inclusion of women in different policies and programmes so that they feel the confidence to start entrepreneurial activities.

The macro level analysis suggests that female work participation rate, employment, per-capita consumption, technical degree in agriculture/engineering/technology/medicine, certificate in different level of education, general education level, access to vocational training, and registered with placement agency increases the chance of creating a women entrepreneur. On the other hand, higher city-level inequality and poverty discourage it. It calls for systematic, specific, and targeted policies for women to make them successful entrepreneurs. Nikore (2021) stated that 88.5 million in India are not in education, employment or training. Vocational training over the past decade increased from 6.8% in 2011-12 to 6.9% in 2018-19. Still, it is much lower than a man that has recorded an increase from 14.6% to 15.7% during the same period. Therefore, training is essential and needs to be put in place with top priority.

Most importantly, metro cities in India do not seem to be encouraging for women. The higher population size has a negative effect on the chance of an enterprise led by a woman. This could be because of several problems. First, currently, metro cities in India are experiencing the problem of diseconomies of scale and higher externalities: associated with a higher cost of doing business (Tripathi and Kaur, 2018; Turok and McGranahan, 2013). Haque and Patel (2017) found an 'agglomerated trend' of metropolitan development in India as the population drifted towards the periphery of the core city areas. Tripathi (2018) also found that improving the infrastructure in metro cities does not seem to encourage population concentration. Therefore, the agglomeration effect that is supposed to be beneficial for female entrepreneurship seems unrewarding. Mukhopadhyay and Majumdar (2007) argued that the absolute size of the male population is always higher than the female population in both rural and urban areas. The gaps in absolute sizes between male and female populations have been increasing since the 1921 census for rural India and overall India, most significantly in urban areas. The latest Census data showed that the urban sex ratio was 926, much lower than 946 in rural areas in 2011.

So, this could be one of the main reasons behind the male domination in entrepreneurial ownership in metro cities. Third, unfortunately, the most common reason for migration in India is not employment or education but marriage. In 2011 Census data showed that 46% of total migrants relocated because of marriage, and 97% were women. The rural to urban migration accounted for about 20%. Though the rural to urban shift for women is a little higher (55%) than for men, they seem to be out of entrepreneurship activities. We also endorse the findings of Rosenthal and Strange (2012) that female entrepreneurs may be less networked than their male counterparts and derive less benefit from agglomeration.

India has initiated the Support to Training & Employment Programme for Women (STEP), which was launched in 1986 to provide employability and competencies and skills that enable women to become self-employed/entrepreneurs. About 64 thousand women benefited from the programme from 2014-2017. However, recently it has been dropped as the

objective of this programme are more similar to the objectives of 'Skill and Training programme'. A similar scheme, the Swayam Sidha, known as Integrated Women Empowerment Programme, was launched in 2001 and ended in 2008. The Trade Related Entrepreneurship Assistance and Development (TREAD) for Women aims at increasing access to credit for female entrepreneurs in non-agricultural activities. It provides fixed assets and working capital, training and consultancy fees, and participation in product exhibitions. The schemes and programmes seem to be outdated and overlapped. It is also noticed that they are likely to have a smaller section of female entrepreneurs in small-scale activities.

Also, there is no accurate data available to assess these schemes. Therefore, we suggest to policymakers that the schemes and programmes need a fresh to revamp. It has to be divided according to rural and urban requirements differently. Each should have a different goal but should be maintained under one umbrella. There is also a need for effective coordination between state and central governments.

7. Conclusions

Using the National Sample Survey (NSS) unit level data in 2015-16 on 'economic and operational characteristics of unincorporated non-agricultural enterprises in manufacturing, trade and other services sector (excluding construction)', we investigate the relevant determinants of female entrepreneurship in 52 metro cities in India. We also use other important NSS unit-level data such as 'employment and unemployment' and 'consumption expenditure' for the analysis. All factors are broadly divided into two major categories; micro and macro. Micro-level factors are factors that are considered at the individual level. On the other hand, the macro-level factors are considered at the city level. However, the differences are also made by considering data availability in different years. We employ the Probit regression models for the analysis.

The descriptive analysis suggests that women's proprietorship is much lower than that of males. Female proprietorship locations are slightly higher in rural areas than in urban areas. Moreover, their location in metro and non-metro urban areas does not differ much. The regression results of micro-level factors suggest that women entrepreneurs do not pursue mixed activities, do not have a bank account, do not use computer but use internet, are not registered under any act or authority, and are not expanding much. They mainly operate within household premises only a few months in the year with fewer daily hours. Their entrepreneurial activities are mainly undertaken on a contract basis. Different kinds of problems related to operating an enterprise discourage it, whereas the availability of infrastructure encourages it.

Among the macro-level factors, female work participation rate, employment opportunities, per-capita consumption expenditure, technical degree in various

advanced level studies, higher general level education, knowledge in vocational training, and registration with a placement agency are crucial for creating a women entrepreneur. In contrast, city-level higher poverty and inequality deter it. State level higher levels of HDI and GDI are also supportive of making female entrepreneurship, whereas higher GII has an adverse effect on it.

The larger population size of a metro city also discourages it. However, once more data are available, refinement and consideration of several other important variables such as different categories of employment, profits of enterprises, and city level per capita income are left for future research. Considering different advanced levels of econometrics models such as time series and panel data models are also topics for future work.

Appendix A: Variable sources and definitions (As given in the National Sample Survey Organization):

Female work-force participation rate (WPR): The number of females employed in usual status (ps+ss) per 1000 persons is referred to as female work force participation rate (WFPR) or female worker population ratio (WPR) in usual status (usual principal activity status+ usual subsidiary economic activity status). Source: Unit level data of NSS 68th Round on Employment and Unemployment in 2011- 12.

Female casual worker: The number of females worked as casual labour in public works (for usual status approach), worked as casual labour in public works other than MGNREG public works (for current weekly/daily status approach), worked as casual labour in Mahatma Gandhi NREG public works (for current weekly/daily status approach), worked as casual labour in other types of works, did not work owing to sickness though there was work in household enterprise, did not work owing to other reasons though there was work in household enterprise, did not work owing to sickness but had regular salaried/wage employment, did not work owing to other reasons but had regular salaried/wage employment.

City-wise average land owned by a person: This includes land owned by the household, land held under special conditions, sometimes a plot may be possessed by local chieftains or village/district council, the land possessed by the household is owned by the head of the family. Source: Unit level data of NSS 68th Round on Employment and Unemployment in 2011- 12.

Persons currently registered with any placement agency: This includes persons registered only in government employment exchanges, only in private placement agencies, in both government employment exchanges and private placement agencies. Source: Unit level data of NSS 68th Round on Employment and Unemployment in 2011-12.

Persons receiving/received any vocational training: This includes persons who were receiving formal vocational training, received formal vocational training,

and received non- formal vocational training through hereditary, self-learning, learning on the job, and others. Source: Unit level data of NSS 68th Round on Employment and Unemployment in 2011-12.

City population and its growth rate: Total city population in 2011 and growth rate of city population over the period 2001 to 2011. Source: Census of India 2011, Government of India (GOI).

City inequality level: Gini coefficient of the large city districts by considering urban sample persons of that district. Source: Unit level data of NSS 2011-12 on consumer expenditure.

City-level poverty: We use the state-level urban poverty line as suggested by Rangarajan Committee to estimate the city level poverty by considering the urban sample persons of that district. Poverty head count ratios of the large city districts are calculated to measure the city level poverty. Source: Unit level data of NSS 2011-12 on consumer expenditure.

Poverty headcount ratio: Head count ratio (HCR) is the proportion of a population that exists, or lives, below the poverty line. For measuring city poverty rate, we use the Rangarajan committee recommended poverty line in 2011-2012 by considering monthly per capita consumption expenditure based on MMRP. However, as India's official estimates do not provide the city-level poverty line, state-specific urban poverty lines have been used for measuring district-level (which is used as proxy of a city) urban poverty for the districts located in the corresponding states. Source: Author's calculation using unit level data of the NSS 68th Round on consumption expenditure of 2011-2012.

Percentage of city slum population: Ratio of city slum population to total city population in 2011. Source: Census of India 2011, GOI.

Diploma or certificate received: Below graduate level (or graduate and above level) includes diploma or certificate received in agriculture, engineering/technology, medicine, crafts, and other subjects in 2011-12.

Technical degree received: It includes degrees received in agriculture/engineering/technology/medicine, etc in 2011-12.

Education level: If a person has received education up to classes V, then it is defined as middle. If a person received education up to classes VIII, then it is defined as upper middle.

Appendix Table 1: name of cities and state/Union territory

State/Union territory	Metropolises	No. of metropolises
Kerala	Kochi, Kozhikode, Thrissur, Malappuram, Thiruvananthapuram, Kannur, Kollam	7
Uttar Pradesh	Kanpur, Lucknow, Ghaziabad, Agra, Varanasi, Meerut, Allahabad	7
Maharashtra	Greater Mumbai, Pune, Nagpur, Nashik, Aurangabad	5
Gujarat	Ahmadabad, Surat, Vadodara, Rajkot	4
Madhya Pradesh	Indore, Bhopal, Jabalpur, Gwalior	4
Tamil Nadu	Chennai, Coimbatore, Madurai, Tiruchirappalli	4
Andhra Pradesh	Hyderabad, Visakhapatnam, Vijayawada	3
Jharkhand	Jamshedpur, Dhanbad, Ranchi	3
Rajasthan	Jaipur, Jodhpur, Kota	3
Chhattisgarh	Raipur, Durg-Bhilainagar	2
Punjab	Ludhiana, Amritsar	2
West Bengal	Kolkata, Asansol	2
Bihar	Patna	1
Haryana	Faridabad	1
Jammu & Kashmir	Srinagar	1
Karnataka	Bangalore	1
Chandigarh	Chandigarh	1
Delhi	Delhi	1
India		52

Source: Author's compilation

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Notes

¹ <https://blogs.worldbank.org/opendata/women-entrepreneurs-needed-stat>

² The TEA represents the percentage of the adult working-age population (18–64) who are either nascent or new entrepreneurs

³ The index looks at financial access, advancement outcomes, and ease of doing business.

⁴ An enterprise is an undertaking engaged in the production and/ or distribution of some goods and/ or services meant mainly for sale, whether wholly or partly. An enterprise may be owned and operated by a single household or by several households jointly, or by an institutional body.

⁵ The Unincorporated Non-Agricultural Enterprises Survey covers all enterprises not registered under the Companies Act 1956. It is analogous to the Unorganized Manufacture Survey, except that it extends its coverage to the trade and service sector (Daymard, 2015).

⁶ Other services include waste collection, treatment and disposal activities, materials recovery, remediation activities and other waste management services, other Land Transport (excluding 49212, 49213) 50 Water Transport.

⁷ Own account enterprises run without any hired worker employed relatively regularly.

⁸ From 1881 when India conducted its first full Census to 2011 when it conducted its last decennial census, the exercise had never been deferred. But 2021's exercise was postponed citing the Covid-19 pandemic and the latest reports suggest that it may not be taken up even in the first half of 2022. So, in this case, India will not have its decadal census for 2021 any time soon. So, we could not update our results based on data from 2021

⁹ Mixed activity includes several activities performed simultaneously by an enterprise

¹⁰ The problem includes: erratic power supply/ power cuts, shortage of raw materials, shrinkage /fall of demand, non-availability / high cost of credit, non-recovery of financial dues, and non-availability of labour as and when Needed, non-availability of skilled labour as and when needed, labour disputes and related problems, and others

¹¹ The GII is based on following variables: Maternal Mortality Ratio (Maternal Death per 100000 live birth), Adolescent Birth Rate (Birth per 1000 women ages 15-19 years), Women's share of seats in Parliament (%), Population with at least some secondary education age 25+ years (%), and Labour Force Participation Rate (%). The GII is computed using the association-sensitive inequality measure suggested by Seth (2009). Higher GII values indicate higher gender inequality

¹² The HDI calculation is based on Life Expectancy (years) Knowledge, Expected Years of Schooling (years) Mean Years of Schooling (years). Higher HDI values indicate higher development

¹³ The Gender Development Index (GDI) measures gender inequalities in achievement in three basic dimensions of human development: health, measured by female and male life expectancy at birth; education, measured by female and male expected years of schooling for children and female and male mean years of schooling for adults ages 25 and older; and command over economic resources, measured by female and male estimated earned income. Higher GDI values indicate lower gender disparities

Do Wage Levels affect Self-Employment? Evidence from Indian Pseudo-Panel Data

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Abstract

The paper aims to empirically examine if variation in casual employment wage levels leads to differences in non-farm self-employment across time and space in India. Using pseudo-panels constructed from the National Sample Survey Organization's (NSSO) Employment- Unemployment Surveys over a 20-year period, the results suggest that wage level in casual employment has a negative impact on non-farm self-employment. Furthermore, the results shed light on the heterogeneous nature of self-employment in a developing country by demonstrating the differential impact of the casual wage rate on self-employed individuals at lower end of the distribution and those belonging to the higher income groups.

Key Words: Self-Employment, Casual Employment, India, Pseudo-panels

1. Introduction

The occupational choice to become self-employed is often influenced by several factors, including personal preferences, financial considerations and the overall situation of labour market. The body of literature on self-employment in developing countries is multi-faceted and focused on various aspects such as the determinants of self-employment, the characteristics of self-employed individuals and their enterprises, the role of institutions, and the links between self-employment and economic development (Tamvada et al., 2022; Pietrobelli et al., 2004; Margolis, 2014; Gindling and Newhouse, 2012; Audretsch et al., 2013). However, self-employment in relation to other segments of labour markets in developing countries has not received much attention. There are studies that have looked at the relationship between self-employment with different labour market indicators like unemployment and wage-levels (Parker, 2018; Poschke, 2019; Berkhout et al., 2016; Nyshadham, 2014). The results broadly suggest that prevalence of self-employment is higher if there are poorer wage-employment opportunities. Most of these studies are based on developed countries, and the labour markets vary fundamentally between developed and developing countries.

Developing countries are dominated by low-productive informal employment, the opportunity cost of self-employment is low due to low wages and low productivity in wage employment. Moreover, self-employment is relatively unregulated and easily accessible, which makes it a safer option in poorer countries. It is argued that people choose to be self-employed in developing countries due to lack of better alternative wage-employment available (Fields, 2019; Margolis, 2014). The expected utility theory suggests that people choose self-employment when expected returns are higher in self-employment compared to wage employment (Rees and Shaw, 1986; Parker, 1996). NCEUS (2007) report highlights that most of the NFSE in India are working as own-account workers, and many of them are closer or marginally above casual workers in terms of earnings. One of the key factors influencing the decision to be self-employed can be the alternative employment opportunities available. Casual employment constitutes 23.6% and non-farm self-employment 23.3% of total workforce in India¹ (PLFS, 2018-19). Given a higher prevalence of both casual employment and subsistence-based self-employment in developing countries, wages in casual employment can be a suitable indicator of employment opportunities in these countries. A higher wage level may make self-employment less attractive, and a lower wage may make it more attractive. The paper attempts to analyze whether differences in average casual wage across time and space explain differences in non-farm self-employment in India. The micro-analyses linking self-employment with other labour market segments in developing countries are sparse mainly because of non-availability

of panel data. We overcome this challenge by offering a novel approach of constructing the cohorts of individuals that are tracked over time using repeated cross-sectional data (Deaton, 1985).

Self-employment in agriculture is mainly different categories of farmers who derive their income from own cultivation rather than wage labour. As such, self-employment in agriculture is mainly conditional upon access to land ²Due to different dynamics of agricultural self-employment, we focus only on non-farm self-employment. The focus of the paper is to analyze, at a macro-level, the impact of wages in casual employment on the levels of non-farm self-employment. We analyze own-account self-employment in this paper, particularly due to the different characteristics and the motivations of the own-account self-employed compared to employers. The relationship between wages and self-employment could be multifaceted and will depend on the relative economic position of self-employed individuals in the earnings distribution. Therefore, the paper examines the effect of wages across different groups of self-employed.

The study contributes to the existing literature on occupational choice in the following ways. Firstly, it analyzes the link between non-farm self-employment and wages in casual employment, giving insights about the link between self-employment and other labour market segments in developing countries. In particular, it shows that wage level in casual employment has a negative impact on the non-farm self-employment, suggesting that lower-wage levels in casual employment increase non-farm self-employment in the region. Secondly, the paper provides further insights into the heterogeneity within self-employment by exploring the differential impact of wages on subsistence versus non-subsistence self-employment. The paper examines the impact of wage levels on different groups of self-employed categorized based on household income. It is mainly the self-employment in the low-income class which changes in response to wages in casual employment.

In this paper we use pseudo-panel data derived from four National Sample Survey Organization's (NSSO) Employment-Unemployment Surveys from 1993-94 to 2011-12. The results support the claim that part of self-employment in developing countries is subsistence based and people are pushed into it due to lack of more productive wage employment opportunities. High earning self-employed individuals fundamentally differ from low-earning subsistence driven self-employed individuals. However, due to non-availability of earnings data of self-employed, we categorize the self-employed based on the household income classes. Self-employed at the lower end of income distribution are found to be impacted by wages in casual employment.

The rest of the paper is organized as follows. The construction of data for pseudo-panel estimation is constructed in the next section. In the third section, we describe the construction of the dataset. The descriptive statistics are

presented in section 4. Empirical results are presented in section 5 followed by conclusion in section 6.

Wage-employment, Wage levels and Self-employment

Given most of the self-employment opportunities in the developing countries are easily accessible and not entrepreneurial, heavy investment costs are not required to start an own-account self-employment enterprise. Individuals make a decision to open their own enterprise if the expected present value of the private returns is higher than the present value of the private costs incurred (Anderson, 1982). Since own-account self-employed work for a substantial portion of their time running the enterprise, the wages in the alternative employment that a person foregoes is an opportunity cost for a self-employed person (Poschke, 2008). Higher wages in the alternate employment available imply a higher opportunity cost, and thus increasing the perceived private costs of the self-employed. Therefore, opportunity cost is at the core of the decision of occupational choice between self-employment and wage-employment.

There are studies that have investigated the hypothesis of change in self-employment levels due to the situation of opportunities in wage-employment (Parker 2018, Poschke, 2019; Fristch and Sorgner, 2014; Parker and Robson, 2004; Blanchflower (2000); Steinmetz and Wright, 1989). These studies have used unemployment as an indicator of the lack of wage-employment opportunities in the region. It is assumed that higher unemployment rates are indicative of poor employment opportunities, driving people to switch to own-account self-employment. The evidence of the relationship between unemployment and self-employment is mixed. The argument is that the high unemployment could result in the growth of self-employment, as people are forced to start an enterprise of their own to avoid the loss of employment and income. On the other hand, the opportunity cost of self-employment is higher when there is good employment prospect in wage employment. However, unemployment may not be an appropriate indicator of the labour market situation in developing countries especially India where self-employment is high. Low levels of unemployment may mask high rates of low-quality employment. The main problem in many developing countries is not unemployment but lack of decent and productive work indicated by underemployment, low income, and low productivity (Pietschmann et al., 2016).

Poshke (2019) argues that it is the labour market frictions that cause higher unemployment relative to wage-employment and promote self-employment as an alternative to difficult job search. He finds a positive relationship between the difficulty of job search and levels of self-employment across countries, and negative relationship between wage-employment and self-employment. Due to high firm entry costs, labour market frictions lead to higher unemployment in developed countries while it leads to higher self-employment due to cheap firm

entry costs in poorer countries. Therefore, strong labour market frictions push people to take up low productivity self-employment in developing countries. Sorgner and Fristch (2018) analyze how occupational environment affects the choice of people between self-employment and wage employment. It finds that the probability of switching to self-employment is higher for people working in occupations that are characterized by high unemployment and earnings risk.

Another strand in the literature on self-employment has explained the levels and patterns in self-employment through variations in wage levels. Haggblade et al (2010) argues that increase in real wages increases the opportunity cost of labour, thus rendering low-return non-farm activities such as low-return craft and household manufacturing unprofitable. Nyshadham (2014) provides evidence in Thailand that households enter entrepreneurship based on the comparative advantage. People choose entrepreneurship when they have lower counterfactual earnings in the default sector, that is, agriculture sector or wage labour in urban areas. It suggests that it is due to comparatively higher productivity as entrepreneurs that people stay in, or switch to, self-employment. Wage employees with lower wages have a higher tendency to move to self-employment compared to employees with higher wages (Amit et al., 1995). Milasi and Mitra (2022) also show that workers move to own-account self-employment in response to poor wage-employment opportunities. The prevalence of own-account self-employment is higher (lower) when there is poor (better) labour market prospect in traditional wage employment. Berkhout et al (2016), in case of Netherlands, find that the likelihood of entrepreneurship increases if there is lower mean and higher variance in the wage distribution. They consider the mean wage of the labour market segments as the opportunity cost and find that lower average wage in a labour market segment leads to higher entrepreneurship.³

Most of the above discussed studies are based on developed countries. Developed countries have high share of formal employment opportunities and a low share of subsistence-based self-employment⁴. Most of the self-employment in these countries is out of choice, entrepreneurial, aimed at growth of their business, rather than due to lack of productive wage employment opportunities (Maloney, 2003). On the other hand, in low- and middle-income countries, there are limited formal employment opportunities and a large proportion of people are engaged in subsistence self-employment and casual daily wage work (Valenzuela, 2003). In India, casual employed constitute more than 60% of the wage-employment in India (ILO, 2018). People enter informal self-employment with inadequate capital, not to grow their enterprises, but due to the shortage of productive wage-employment opportunities (Merfeld, 2020). As such, higher wage levels may decrease the attractiveness of subsistence-based self-employment because a higher wage will increase the opportunity cost of self-employment. In line with this, Merfeld (2020) finds in India that non-farm self-employed who are driven by

subsistence reasons are more likely to leave following an increase in the wages or when more stable employment opportunity becomes available. However, there are evidence that a proportion of self-employment in these countries is entrepreneurial and highly productive. It is found that self-employment in the non- farm sector has been dynamic in India, comprising both distress driven and remunerative employment (Binswanger-Mkhize, 2012). Similarly, Borchhardt and Sorenson (2022) finds in India based on the CPHS data that self-employed earn higher incomes than others with similar characteristics in the wage-employment. As such, the argument that higher wages and better employment opportunities can bring people out of self-employment could be true about that part of self-employment that is subsistence based and has low returns.

Due to lesser regular salaried employment opportunities, the alternate employment opportunity to choose from, for most of the self-employed people, could therefore be the casual wage employment. The availability of work and the wages in casual employment could thus be perceived as the opportunity cost of self-employed people at a macro regional level. The average wage in casual employment in a region will be used as a proxy for the opportunity cost of self-employment.⁵ Higher wage levels will indicate better employment opportunities and higher productivity in the alternate employment. The higher wage in the casual employment is thus expected to reduce the level of self-employment in a region and vice versa. However, depending on whether self-employment is subsistence-based or entrepreneurial, the impact of wage levels in casual employment on self-employment is expected to vary. The impact could also vary depending on the motive of the self-employed individual. If a person is self-employed mainly driven by non-pecuniary gains, the impact of wages could be different compared to the ones who have chosen self-employment due to non-availability of better wage-employment opportunities. However, due to data limitations, we are not able to categorize self-employed individuals based on the motives for self-employment. Therefore, we introduce our hypothesis as:

- 1: Increase in wages in casual employment is associated with reduction in the non-farm self-employment in a region.
- 2: It is the subsistence-based self-employment that reduces with the increase in wage-levels in casual employment.

2. Pseudo-panel estimation

Given that the objective of the study is to analyze the impact of wages in casual employment on non-farm self-employment, it is useful to track the individuals over time using panel data. In the absence of panel data, it is not possible to use the standard fixed effects approach to estimate the unobserved individual

characteristics in a linear model. Deaton (1985) proposed the use of pseudo-panel when same individuals are not tracked in multiple cross-sectional surveys. He suggested dividing the population into the number of cohorts based on similar characteristics that remain stable over time. For every cohort, mean value of each variable is calculated during a particular period and the intra-cohort averages for each time period replace the individual observations. As such, the intra-cohort means become the new observations in the pseudo-panel data. According to Deaton (1985), since the attributes based on which cohorts are formed are stable over time, the difference in intra-cohort means between periods estimates the change in behavior of cohort members. The cohort means are used for the estimation of fixed effects through pseudo-panel analysis if a large number of observations is available for each period. Such models that are based on cohorts rather than individual data are identical to instrumental variable methods where group indicators are used as instruments (Verbeek, 2008 for discussion). It further explains by saying that instruments require to be uncorrelated to the error term in the equation but correlated with the explanatory variables. In the pseudo-panels, explanatory variables of the groups that form cohorts change differentially over time, thus making the cohorts identical to instrumental variable.

It is not the case that pseudo-panel analysis will give inferior results due to the absence of panel data. Deaton (1985) argues that since new samples are drawn each year, the attrition problem characterized by the decrease in the length of the sample in the panel data is absent in the pseudo-panel method. The absence of attrition problem in pseudo-panel method maintains the representativeness of data. Using both panel data and the pseudo-panel data to estimate the income elasticity, Gardes et al. (2005) find that the estimations are quite close.

Following Verbeek (2008) and Deaton (1985), consider the following linear model with fixed effects.

$$y_{it} = x_{it} \beta + \alpha_i + u_{it} \quad (1)$$

for $i = 1, \dots, N$ and $t = 1, \dots, T$; α_i is the individual fixed effect ; β is the vector of parameters

We assume here that the observations on N individuals are available for each time period. If the individual fixed effects α_i are uncorrelated with , regression coefficients β can be estimated consistently by pooling the repeated cross-sections. However, in most situations, individual effects are likely to be correlated with some of the explanatory variables such that K moment conditions given by $\{(y_{it} - x'_{it} \beta) \} = 0$ is not satisfied. In this case, repeated cross- sections cannot be pooled. If the data is genuine panel data, fixed effects approach which treats α_i as fixed unknown parameters and thus satisfies K moment conditions can be used to capture the effect individual characteristics

that are fixed over time. This strategy can however not be applied if repeated observations on the same individuals are not available.

Deaton (1985) proposes the use of cohorts formed by aggregating the individuals with similar characteristics if repeated cross-sectional data is available. In this case, variables are aggregated to cohort level averages. The resulting model takes the following form.

$$\bar{y}_{ct} = \bar{x}_{ct} \beta + \alpha_c + u_{it} \quad (2)$$

for $c = 1, \dots, C$ cohorts and $t = 1, \dots, T$ time period; α_c is the cohort fixed effect, where $\bar{y}_{ct}$ is the average value of all observed y_{it} 's in the cohort and in time period t . However, the likely dependence of α_c on t and the correlation of $\bar{x}_{ct}$ with α_c can lead to inconsistent estimation of β . In case α_c is treated as fixed over time, equation (2) can be consistently estimated. Therefore, cohort effect is itself taken as fixed effect. This is more plausible if cohort size is large and average cohort size $n_c \rightarrow \infty$. In this case, natural estimator for β is the within estimator of the pseudo-panel which is given by

$$\beta_W = \left(\sum_{c=1}^C \sum_{t=1}^T (\bar{x}_{ct} - \bar{\bar{x}}_c) (\bar{x}_{ct} - \bar{\bar{x}}_c)' \right)^{-1} \sum_{c=1}^C \sum_{t=1}^T (\bar{x}_{ct} - \bar{\bar{x}}_c) (\bar{y}_{ct} - \bar{\bar{y}}) \quad \dots (3)$$

where $\bar{\bar{x}}_c = T^{-1} \sum_{t=1}^T \bar{x}_{ct}$ is the time average of the observed means of the cohort c .

The asymptotic behavior of estimator depends among any things on the asymptotic sequence employed (discussion in Verbeek, 2008). In type 1 sequence as employed by Moffitt (1993), Verbeek and Vella (2005) and Tamvada et al, (2022), it is assumed that the number of individuals $N \rightarrow \infty$ with number of cohorts (C) fixed, so that number of observations within a cohort $n_c \rightarrow \infty$. On the other hand, in second type, Deaton (1985) and Verbeek and Nijman (1993) considers the asymptotic sequence of the case in which $N \rightarrow \infty$ and $C \rightarrow \infty$ with n_c fixed. There is a tradeoff between number of observations within a cohort and the number of cohorts. The small number of cohorts allocated for individuals will give large number of observations in each cohort. It could lead to heterogeneity within the cohort resulting in inefficient estimation due to aggregation. On the other hand, depending on sample size, large number of cohorts will leave smaller number of observations within cohort which could lead to biased estimation.

In this paper, we assume the asymptotic sequence of type 1 in which case fixed effects is consistent estimator for β , provided that

$$plim_{CT} \frac{1}{CT} \sum \sum (\bar{x}_{ct} - \bar{x}) (\bar{x}_{ct} - \bar{x})' \quad (4)$$

is finite and invertible and

$$plim_{CT} \frac{1}{CT} \sum \sum (\bar{x}_{ct} - \bar{x}) \alpha_0 = 0 \quad (5)$$

The above conditions are automatically satisfied if the number of observations per cohort tends to infinity ($nc \rightarrow \infty$) because cohort fixed effects converge to a constant over time, that is, $\alpha_{ct} \rightarrow \alpha_c$ (Moffitt, 1993). Deaton (1985) relies on the asymptotic sequence of the first type that does not necessitate having a large number of observations per cohort. This can be attained if cohort averages are considered as the error ridden measurements of the population averages of the cohorts. With the assumption that measurement errors are distributed with zero mean, it is easy to adjust the moment matrices of the within estimator to correct for the measurement error. Tamvada et al (2022) argues that asymptotics of type 2 rarely get satisfied when cohorts are based on age groups because the number of cohorts is fixed. In this paper, we have large cohort sizes in the sample. As such, we assume asymptotics of the first type to estimate β consistently.

3. Construction of dataset

Our empirical analysis is based on pseudo-panel constructed for four rounds of NSSO's Employment-Unemployment surveys (EUS) (1993-94, 1999-00, 2004-05, 2011-12). The quinquennial EUS were discontinued by NSSO in 2011-12 and replaced by annual periodic labour force survey (PLFS) from 2017-18. Since NSSO's employment-unemployment surveys do not track the employment status of individuals over time, we create a 'pseudo panel' based on the cohorts that are stable groups of individuals. The cohorts are defined by using groups of individuals sharing common characteristics that are stable over time. In pseudo-panel estimation, year of birth is commonly used criterion to define a stable group of individuals in a cohort. The generation of individuals can be followed using the 'Year of birth' criterion. However, there are other criteria used in the literature to construct cohorts⁶

Given a large sample size and heterogeneity across different Indian states in terms of labour market indicators, we allocate individuals to cohorts defined by state and year of birth interval of five years. As such, pseudo panels are constructed using four rounds of cross-sectional databases by defining cohorts of individuals based on year of birth interval of five years interacted with state of residence. For example, individuals who are born during 1950-54, 1955-59....2005-09 in each Indian state populate separate cohorts. Since the focus of the analysis is economically active individuals, the sample is restricted to individuals between 15 and 70 years of age. We include in the analysis those

cohorts that have at least 500 observations in each of the surveys due to the asymptotic reasons as described earlier.⁷

The individuals attending educational institutions and those classified into other miscellaneous occupational categories⁸ are also excluded from the analysis. The resulting data set is a pseudo- panel with repeated observations over time period T across cohorts C. The sample consists of those who are either self-employed, regular salaried, casual employed or unemployed in the sample.

We use logarithm of the per-capita state domestic product as an indicator of level of economic activities. State level per-capita domestic product has been collected from the Central Statistics Office, Ministry of Statistics and Program Implementation. We convert per-capita state domestic product to 1999-00 base year prices. The average daily wage in casual employment by current weekly status has been calculated from different rounds of EUS at the state-level for rural male, rural female, urban male and urban females separately. The weekly wages received by the casual employed wage earner is divided by the number of days worked in the reference week to compute the daily wage. The given wages rates in different states are deflated by using the state specific price indices - Consumer Price Index (CPI) for industrial workers (CPI-IW) and CPI for agricultural labour (CPI-AL)⁹ in 2001 base to convert the nominal wage rates into real wage rates. Household monthly per-capita consumption expenditure (MPCE) is also deflated using the CPI-IW and CPI-AL in 2001 to convert MPCE into real terms. We divide the households into three groups by Year of survey and state of residence based on real MPCE. This is done to examine the impact of wage in casual employment on NFSE across different income groups. The household MPCE is also used by Gindling and Newhouse (2012) to classify the self-employed into successful and unsuccessful.

4. Descriptive Statistics

In our analysis, we consider only the primary economic activity or primary occupation of an individual. The subsidiary status activity is not considered in the analysis as some of the individuals working as both self-employed and wage-employed will complicate the analysis. As such, we are using self-employed and wage-employed based on usual principal status (UPS)¹⁰ approach. NFSE is defined as the ratio between self-employed people in non-agriculture sector relative to total workforce (both in agriculture and non-agriculture) in a particular year.

Table 2 presents the descriptive statistics from the four cross-sectional databases. The sample after dropping persons above 70 and below 15 and those out of labour force consists of 803815 individuals. We find that non-farm self-employment as percentage of total workforce has increased over the years.

Table 2: Descriptive statistics (Full Sample)

	1993-94	1999-00	2004-05	2011-12
Dependent Variable				
NFSE (own account)	0.14	0.16	0.19	0.22
NFSE (employer)	0.01	0.01	0.01	0.01
Independent Variable				
Age	35.61	35.89	36.36	37.95
(Std. dev.)	13.11	12.93	12.92	12.60
Female	0.24	0.24	0.27	0.22
Married	0.74	0.74	0.74	0.76
high school & higher sec	0.29	0.34	0.35	0.42
Tertiary Edu	0.08	0.09	0.11	0.16
Technical Edu	0.04	0.04	0.05	0.04
Urban	0.35	0.36	0.32	0.37
Hindu	0.80	0.79	0.76	0.75
Muslim	0.09	0.11	0.11	0.13
ST	0.12	0.13	0.15	0.15
SC	0.15	0.16	0.16	0.15
Others	0.73	0.71	0.69	0.70
Land < 0.2 hectares	0.27	0.37	0.42	0.48
0.2<land<0.4	0.06	0.06	0.07	0.06
0.4< land <0.4	0.26	0.24	0.27	0.23
Land >2	0.33	0.14	0.24	0.22
MPCE level 1	0.33	0.33	0.33	0.33
MPCE level 2	0.33	0.33	0.33	0.33
MPCE level 3	0.33	0.33	0.33	0.33
Per capita SDP	12581	15946	22697	57737
(Std. dev.)	4117.83	6111.80	8699.28	24859.89
Avg. wage in casual emp	38.40	48.57	52.67	79.33
(Std. dev.)	15.20	17.80	20.21	26.28
Sample size	203368	211724	226129	162594

Table 3 presents the summary statistics of the cohorts that are constructed from four cross- sectional data bases.

Table 3: Descriptive Statistics (cohorts)

	1993-94	1999-00	2004-05	2011-12
Dependent Variable				
NFSE (own account)	0.17	0.20	0.24	0.29
NFSE (employer)	0.01	0.01	0.01	0.01
Independent Variables				
Age	35.08	35.61	35.26	35.86
(Std. dev.)	12.78	12.64	12.39	11.13
Female	0.27	0.26	0.29	0.22
Married	0.73	0.73	0.72	0.76
high school & higher sec	0.25	0.30	0.14	0.13
Tertiary Edu	0.04	0.05	0.04	0.05
Technical Edu	0.02	0.02	0.03	0.02
Urban	0.26	0.27	0.25	0.30
Hindu	0.84	0.83	0.81	0.81
ST	0.11	0.11	0.10	0.08
SC	0.17	0.18	0.06	0.05
Others	0.72	0.71	0.72	0.74
Land < 0.2 hectares	0.27	0.38	0.42	0.50
0.2<land<0.4	0.07	0.07	0.04	0.03
0.4< land <0.4	0.27	0.25	0.09	0.07
Land >2	0.32	0.16	0.10	0.08
MPCE level 1	0.30	0.30	0.31	0.32
MPCE level 2	0.32	0.32	0.34	0.34
MPCE level 3	0.37	0.37	0.35	0.34
Log (Per capita SDP)	9.36	9.58	9.92	10.83
(Std. dev.)	0.30	0.34	0.40	0.42
(Std. dev.)	0.37	0.29	0.46	0.38
Log (Avg. wage in casual emp)	3.52	3.78	3.89	4.29
(Std. dev.)	0.28	0.26	0.26	0.26
Number of cohorts	126	129	154	126

Figure 1: Distribution of own-account non-farm self-employed in cohorts

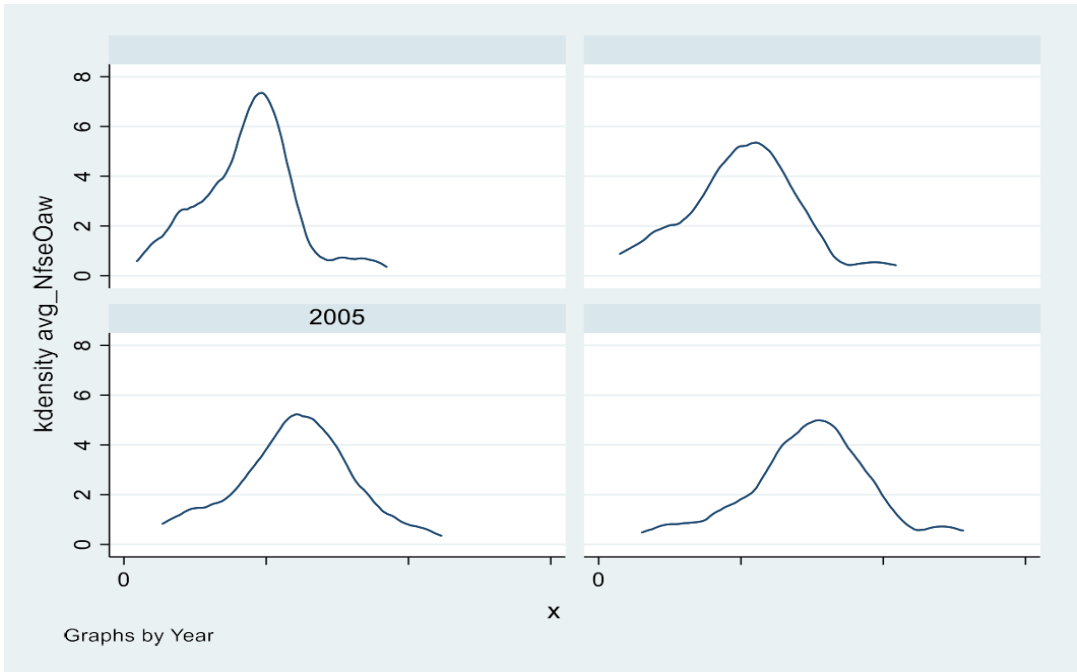
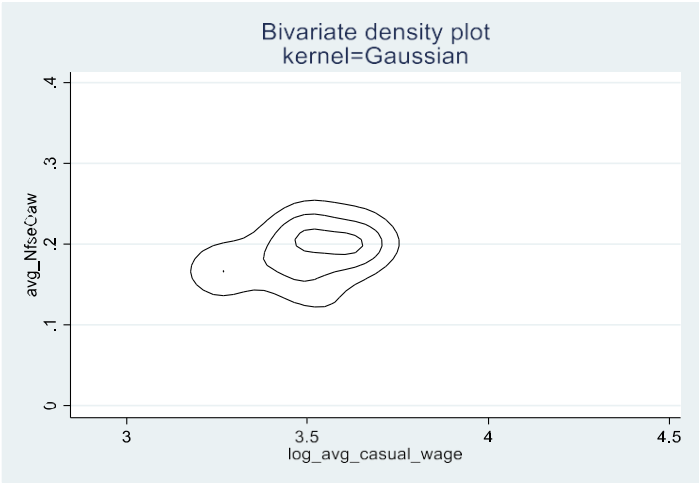


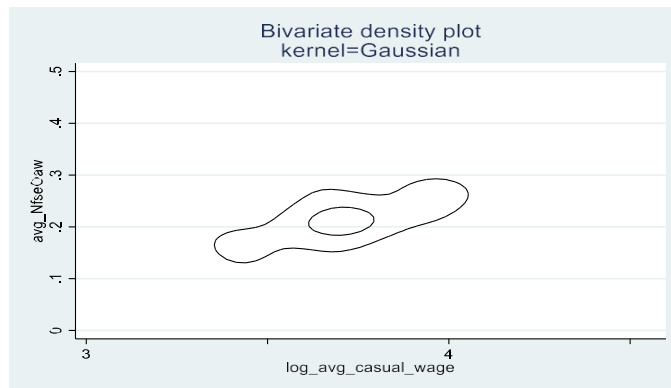
Figure 1 shows the kernel density for the dependent variable, the proportion of own account self- employed in non-farm sector, for all the four periods. The kernel density function is used to describe the randomness of the observations in the data. We find the observations along both left and right side of the distribution. The distribution may look like a normal distribution because of a large number of cross-sectional observations in each cohort.

Figure 2: Bivariate distribution of own-account non-farm self-employment and average daily wage in casual employment

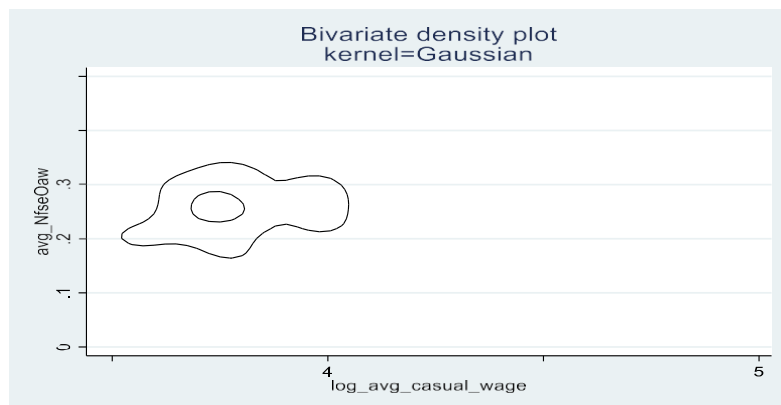
1994



2000



2005



2012

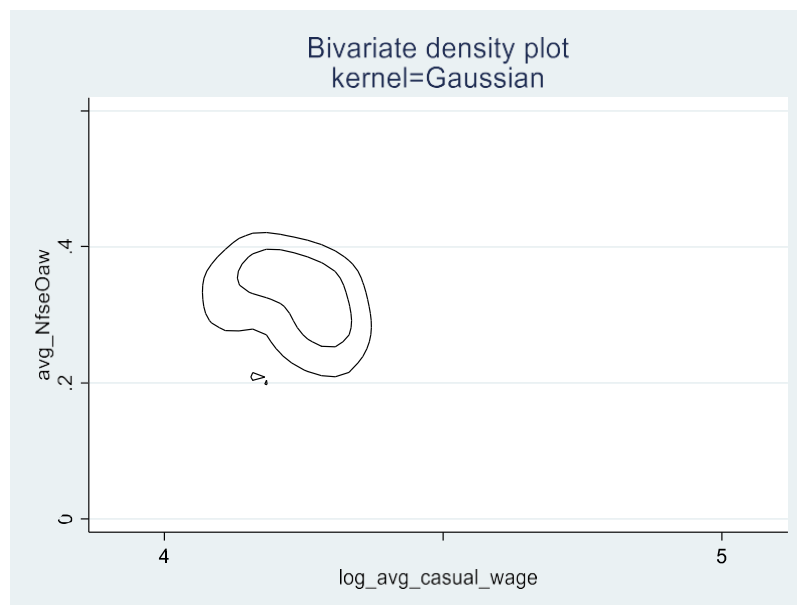


Figure 2 shows the bivariate Kernel density using a Gaussian kernel and graphs surface plot of own-account non-farm self-employment and state-wise average daily wage in casual employment for years 1994, 2000, 2005 and 2012. The surface of the joint density gives the pictorial representation of the relative concentration of the proportion of own-account self-employment along the range of state-wise average daily casual wage. The figures show the fixed contour area indicating some level of association between the two variables.

5. Econometric Results

The fixed effects of explanatory variables on own-account non-farm self-employment are estimated using pseudo-panel regression for the cohorts. Since there are many other factors that influence the decision of a person to be self-employed, we have used them as control variables in the estimation. Analysing determinants of self-employment in India, Tamvada (2015) finds that spatial variations disappear to a large extent as personal, demographic and education variables explain most of the variation in NFSE. A meta-analysis study of impact of education on entrepreneurship finds that more educated workers choose wage-employment over non-farm self-employment in developing countries (Sluis et al, 2005). Furthermore, wealth is an important factor that affects the chances of a person to choose to become self-employed. The occupational choice of individuals is largely determined by the distribution of wealth (Banerjee and Neuman, 1993). Greater wealth reduces the financial constraint in starting one's own business and reduces the downside risk by being safety net for people in self-employment. Blanchflower and Oswald (1991) finds that inheritance increases a person's chance to be self-employed. We use household landownership as a proxy for wealth and introduce landownership as a variable to control for these effects. However, landownership also reflects the higher capital to invest and ability to bear some risk in investing in non-farm enterprise. As such, access to land is considered as an important factor determining the occupational choice.

Caste and religion play a role in affecting labour market outcomes in India. Scheduled caste (SC) and Scheduled Tribe (ST) are less likely to be in self-employment in the non-agriculture sector (Das, 2006; Tamvada et al, 2022; Audretsch et al., 2007). SCs, who are most often landless, are predominant in casual work while STs tend to be in subsistence farming in their own small plots (Das, 2006). On the other hand, due to landlessness, Muslims are more engaged in non-farm sector and a higher proportion of Muslims work in manufacturing and retail trade as self-employed compared to other socio-religious groups (Basant, 2012). Therefore, we control for effect of religion and social group by using these controls in the estimation.

We also use Monthly per-capita expenditure as a control variable. MPCE is a widely used proxy indicator of the household income. In urban areas where landownership may not be an accurate proxy for wealth and assets, higher MPCE may fairly represent higher income and higher resources in the absence of data on wealth and assets. However, there is a possibility of correlation between log of mean monthly per-capita consumption expenditure (MPCE) and other independent variables. Using 2SLS (Two-stage least squares) approach, log of MPCE is regressed on other variables in the first stage. The predicted values of the first stage are used as independent variable along with other relevant variables in the second stage. The approach resolves the problem of correlation between average MPCE and other independent variables and allows us to examine a more accurate estimate of the effect of one variable on another.

The determinants of self-employment have been tested by controlling for the stage of economic development. Kuznets (1966) put forward a hypothesis of negative relationship between development performance and the share of self-employment in the labour force. Some studies empirically establish the Kuznets hypothesis by finding a negative association between per- capita GNP and self-employment rate (see Acs et al., 1994; Foelster, 2002; Pietrobelli et al., 2004). We are including per-capita state domestic product as an indicator of stage of economic development.

5. Empirical Results

Table 5: Pseudo-panel regression results

Log real casual wage	-0.0619***
	(0.0190)
avg Female	-0.158*
	(0.0800)
avg_Urban	0.241***
	(0.0862)
avg_age	0.0123***
	(0.00106)
avg married	0.122***
	(0.0186)
avg hrsec	0.0294
	(0.0336)
avg tertiary edu	-0.182*
	(0.0953)
avg techedu	0.0400
	0.118)
avg ST	-0.292***
	(0.0899)

avg SC	-0.120
	(0.108)
avg hindu	-0.0348
	(0.0885)
0.2< Land< 0.4 Hectares	0.000699
	(0.153)
0.4<Land<2 Hectares	0.184***
	(0.0680)
Land> 2 Hectatres	0.0758***
	(0.0231)
log PCSDP	-0.0374***
	(0.00955)
log predicted MPC	-0.00689**
	(0.00285)
Constant	0.379***
	(0.119)
Observations	356
R-squared	0.897
Number of cohort	147

Table 5 presents the pseudo-panel regression results of the cohorts. The negative coefficient of average daily wage in casual employment suggests that the average daily wage in casual employment has a negative impact on the own-account self-employment (OASE) in the non- farm sector. The higher/lower average wage in the casual employment in the region decreases/increases the non-farm OASE in the cohort. For the control variables, the coefficient of female is negative and significant. In urban areas, people are more likely to be self-employed in the non-farm sector compared to rural areas. It may be because rural areas are predominantly based on agriculture activities. Tertiary education has a significantly negative impact on self- employment in the non-agriculture sector. The coefficient of ST is negative and significant. It suggests that belonging to ST decreases the chances of people to be self-employed in the non- agriculture sector. The coefficients are positive and significant for mid-sized per-capita landownership (0.4<Land<2 Hectares) and the largest land size variable. The negative coefficient of low landownership (0.2 to 0.4 hectare) suggests that individuals with low land ownership, on average, do not choose self-employment in the non-agriculture sector. The result is intuitive given that low land ownership also means low assets and limited access to capital. As such, people with lesser land ownership are less likely to be self-employed in non-agriculture sector while larger land ownership seems to enable people to enter self-employment in the non- agriculture sector.

There is a negative impact of predicted average MPCE on non-farm self-employment indicator that people from richer households are less likely to be self-employed in the non-farm sector. However, the relationship may not be linear, and the effect could vary across different income levels. It can be captured using MPCE classes instead of MPCE as a continuous variable.

Given the heterogeneity of non-farm self-employment, the impact of wages in the casual employment in a region will not be same for all the self-employed in the region. If the earnings in self-employment are higher than the prevalent wage levels in casual employment in the region, people are less likely to leave self-employment to join the wage-employment. Since the earnings data of self-employed are not given in the data, it is not possible to categorize the self-employed based on level of earnings to see the impact of wage levels in a region on these different categories of self-employed. As consumption expenditure is widely used as a proxy of household income due to unavailability of income data, the per-capita household consumption can convey the economic position of the self-employed. Gindling and Newhouse (2012) also use per-capita household consumption expenditure to classify the self-employed as successful and unsuccessful. We divide the sample based on three levels of monthly per-capita expenditure in each year to see how wage-levels in casual employment impact the self-employed belonging to three different classes of consumption expenditure. Before estimating the fixed effects, we see the distribution of non-farm self-employment in three classes of income.

Table 6: Percentage of non-farm own-account self-employment in total workforce for three MPC classes

Level MPC	1994	2000	2005	2012
1	9.7	10.1	11.6	12.0
2	12.4	12.9	15.3	17.3
3	14.8	16.4	19.8	21.6
Total	12.3	13.1	15.4	16.6

Note: Own-account NFSE is defined as the ratio between own-account self-employed people in non-agriculture sector relative to total workforce (both in agriculture and non-agriculture) in a particular year.

Table 6 shows that non-farm self-employed are not particularly concentrated among any one income class. Richer households have higher percentage of their workforce engaged as non-farm self-employed. NFSE as percentage of workforce has increased for all the three income groups and the increase is higher for higher income groups. Table 3 gives the pseudo-panel estimates by introducing the interaction between MPCE class and average wage in casual employment.

Table 7: Pseudo-panel regression results with interaction effects

Log real casual wage	-0.0425***	0.0141	-0.0581	-0.0743**
	(0.0148)	(0.0366)	(0.0568)	(0.0327)
avg_MPC2	0.0319	-0.663	-0.154	0.0321
	(0.0720)	(0.412)	(0.666)	(0.0722)
avg_MPC3	-0.198***	-0.893**	-0.200***	-0.565*
	(0.0414)	(0.421)	(0.0408)	(0.325)
c.avg_MPC1#c.log casual wage		-0.175*		
		(0.104)		
c.avg_MPC2#c.log casual wage			0.0466	
			(0.173)	
c.avg_MPC3#c.log casual wage				0.0932
				(0.0801)
Constant	0.235**	0.702**	0.299	0.356***
	(0.0992)	(0.274)	(0.249)	(0.136)
Observations	535	535	535	535
R-squared	0.879	0.880	0.879	0.879
Number of cohort	197	197	197	197

In the column 1, we use three levels of MPCE instead of using MPCE as a continuous variable. The impact of average casual wage continues to be negative. However, the coefficient of MPCE level 2 is insignificant while the coefficient of MPCE level 3 is negative and significant. It suggests that belonging to high income level decreases the chances of people to be self-employed in non-agriculture sector. In columns 2, 3 and 4, we have interacted the MPCE levels with log of average MPCE to examine their joint effect on non-farm self-employment. The interaction is done to see the effect of average wage-level on the non-farm self-employment of cohorts at three levels of MPC. The interaction term of average wage in casual employment and MPC class 1 is negative and significant while the coefficients of interaction between average wage and MPC class 1, and between average wage and MPC class 3 are not significant. It suggests that the effect of the average wage level on non-farm self-employment in a cohort varies across income classes. The relationship of average casual wage and the non-farm self-employment depends on the levels of MPCE. In other words, the effect of average casual wage depends on the level of MPCE which an individual belongs to. In column 2, we find that the coefficient of average casual wage is insignificant but the coefficient of its interaction with MPCE level 1 is negative. However, the coefficients of interaction of log of casual wage with MPCE level 2 and 3 separately are not

significant. The average casual wage has a negative effect on the non-farm self-employment of the people who belong to the lowest income class. It seems that there is no impact of average casual wage on people who belong to the higher income groups.

In the table 8, we test for the robustness of our empirical results by interacting the MPCE level with the dependent variable in separate regressions. In this analysis, the effect of independent variable on dependent variable is estimated separately for different sub-groups of people. While the number of cohorts of individuals remain the same in these fixed effect models, the dependent variable is the percentage of NFSE in particular income group in a cohort in three models. This approach allows us to estimate the effect of average casual wage on NFSE for three MPCE levels separately. The dependent variable is NFSE belonging to MPCE level 1 in first column, to MPCE level 2 in the second column and to MPCE level 3 in the third column. The coefficient of average casual wage indicates the effect on NFSE for a particular income group. The results show that average casual wage has a negative effect on NFSE in lower MPCE levels. There is no impact of average casual wage for people as NFSE in top MPCE level. It shows that the negative impact of casual wage is driven mainly by those with lower incomes.

Table 8: Pseudo-panel regression results

	NFSE in MPC1	NFSE in MPC2	NFSE in MPC3
Log real avg casual wage	-0.0146*	-0.0255**	-0.0103
	(0.00821)	(0.0100)	(0.00791)
Constant	0.120**	0.200***	0.000696
	(0.0587)	(0.0574)	(0.0663)
Observations	356	356	356
R-squared	0.755	0.834	0.849
Number of cohorts	147	147	147

The results could be explained as follows. People belonging to lower MPC levels are poor. As such, it is expected that the self-employed belonging to poorer income groups are engaged in subsistence-based self-employment rather than entrepreneurial self-employment. A higher wage level can pull subsistence-based self-employed towards wage employment while a lower wage level in casual employment might push people to engage in self-employment due to lower opportunity cost in self-employment. In the separate regressions in last table, we find the impact of average casual wage as negative

and significant on non-farm self-employment in MPCE level 2. In the interaction effects in table 7, the effect of interaction of average casual wage and MPCE level 2 was not significant. It could be due to the reason that the negative effect of casual wage was moderated by the positive effect of income level on non-farm self-employment. However, in the table 8, the effect of average casual wage is higher for NFSE in MPCE class 2 than the first MPCE class.

Non-farm self-employment involves a certain level of investment and risk, and individuals with lower incomes may not have the resources to start or sustain a non-farm self-employment venture. As such, their low-income levels could sometimes be a barrier to self-employment even when the wage-levels in the alternate employment are lower. People in MPC level 2 belong to relatively higher income groups and they could find it easier to start self-employment compared to people from the poorest class. Thus, belonging to the medium income group might be a stronger enabling factor for the people to choose self-employment if the wage-levels in the alternate casual employment is lower. The negative impact of average wage level is moderated by the impact MPC level 3 as given by insignificant coefficient of average wage level for NFSE in MPCE level 3. The increase or decrease in the average wage-levels does not affect the self-employment levels of people belonging to the highest income class. It could be the case that self-employed among people of highest income class are not pushed into self-employment due to limited wage employment opportunities and lower relative earnings in wage work. The higher household income could be an indication of a remunerative self-employment and reflective of the ability to bear some risk. Therefore, change in the wage-levels in casual employment does not affect the self-employment levels among higher income groups.

6. Discussion and Conclusion

Self-employment in the non-farm sector is an important source of employment in developing countries. The phenomenon of self-employment in these countries is related with the informal economy which is often portrayed as residual employer providing employment to those excluded from the formal sector (Slonimczyk, 2022; Ranis and Stewart, 1995). It is argued that most of the self-employment in developing countries is driven by necessity rather than a voluntary decision to grow a business (Fields, 2019). However, there are studies in developing countries arguing that self-employment is a desirable sector, and people choose to be self-employed voluntarily (Bosch and Maloney, 2010; Gurtoo and Williams, 2009; Falco and Haywood, 2016).

The literature on determinants of non-farm self-employment in the developing countries have mostly been focused on individual characteristics. There are few studies that have discussed various macro-level factors determining self-employment in developing countries (Pietrobelli et al., 2004; Margolis, 2014; Gindling and Newhouse, 2012). We contribute to the literature by analyzing a

link of non-farm self-employment with other labour market segments such as casual employment in India using micro data. In a developed country, entrepreneurs choose between entrepreneurship and long-term employment, which is often not the case in developing countries where alternative may not be permanent employment but casual employment. In India, most of the self-employment in non-farm sector is informal in nature¹¹ and it is argued that a vast majority of these informal self-employed are low-end survivalists and not entrepreneurs (Chen and Carre, 2020 p 15, Chen and Raveendran, 2012). Given casual employment as a dominant form of employment, examining a link between casual employment and non-farm self-employment provides insights into the linkage of different segments of the labour market in developing countries. It specifically examines impact of wages in casual employment on the occupational choice of individuals.

In this paper, we used pseudo-panel analysis to empirically analyze whether macro-economic factor such as state-level average wage in casual employment has an impact on the non-farm self-employment. The results show that while individual factors like gender, marital status, education, social group and landownership play a role in determining the choice for non- agricultural self-employment, macro-level factor such as average wage in casual employment also affect the levels of non-farm self-employment in the region. Our analysis suggests that wage level in casual employment has a negative impact on the non-farm self-employment of cohorts. The lower wage levels in the alternate casual employment brings an increase in the non-farm self-employment, and the higher wage levels are associated with the decline in non-farm self-employment. The paper also highlights that the economic position of a self-employed individual matters in the relationship between wage rates and NFSE. The wage-level impacts the self-employment of cohorts differently across different income groups. It is mainly the individuals belonging to lower income groups that enter self-employment due to lower wage-levels in the alternate employment. Wage levels do not seem to affect the entry into self-employment for individuals belonging to higher income class.

Our analysis highlights the importance of considering the heterogeneity within broad category of self-employment when examining the impact of wage levels on self-employment. The effect is more pronounced among those who belong to poorer income classes. Individuals with lower income levels are more likely to engage in NFSE activities such as street vending, food processors, rag-pickers, rikshaw puller and other home-based work which has lower earnings potential. These low-income self-employed earn income similar to or marginally above casual workers (NCEUS, 2007). As such, an individual's decision to be self-employed could partly be driven by the comparison between economic returns from self-employment and the available casual wage-employment. On the other hand, some of the examples of high income own- account self-employed in non-agriculture sector are independent professionals, shop owners, small workshop

owners, brokers of real estate and commission agents. Their occupational choice of self-employment may not be affected by the wages offered in casual employment.

Our analysis also emphasizes the importance of taking into consideration the different options available for a potential self-employed. By examining the dynamics of NFSE across different income groups, we can indirectly identify some of the factors that shape the occupational choice of self-employment in different income groups. More specifically, it sheds light on factors driving the push-pull dynamics of self-employment in the context of India. It emphasizes the importance of taking into consideration the different options available for a potential self-employed. Individuals at the lower end of income levels are more likely to be pushed to become self-employed due to unfavorable conditions such as low wage. Higher wages in casual employment leading to lower prevalence of NFSE also suggests that these individuals are engaged in self-employment for their subsistence reasons and not entrepreneurial ambitions. When people are faced with low-productive alternate employment, as indicated by wages in casual employment, they find self-employment as a safer option. They can leave self-employment if they find better employment opportunities in wage employment. Most own-account self-employed in India do not seem to have the luxury of working as self-employed for non-pecuniary reasons such as being one's own boss which is often the case for self-employed people in US (Hamilton, 2000). On the other hand, self-employed individuals at the higher end of income level unaffected by wage in casual employment suggests that these individuals are not pushed into self-employment due to subsistence reasons. They are not likely to enter or leave self-employment due to the conditions in casual employment. They seem to be pulled towards self-employment by higher returns, greater autonomy and entrepreneurial ambitions.

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Appendix

Table 1: Distribution of self-employment across different land-ownership categories.

	SE % in total workforce	Percentage in total self-employment	
		SE in Agri	SE in Non-Agri
Household land	1993-94		
<=0.2	33.08	22.67	77.33
0.2 <L<= 0.4	48.97	74.01	25.99
0.4 <L<= 2	70.57	88.97	11.03
>2	57.4	74.1	25.9
Total	51.82	68.06	31.94
	2011-12		
<=0.2	35.74	18.02	81.98
0.2 <L<= 0.4	57.42	73.68	26.32
0.4 <L<= 2	75.49	87.33	12.67
>2	54.51	69.97	30.03
Total	50.29	57.95	42.05

A1: Variable Description

Dependent Variable	
NFSE (own account)	1= own account self-employed in non-agriculture, 0= all other activity status in labour force
Independent Variables	
Age	Age in years
Female	1= female, 0= male
Married	1= currently married, 0= not currently married
high school & higher sec	1= above primary upto higher secondary level educated, 0= otherwise
Tertiary Edu	1=Educated above higher secondary level, 0= otherwise
Technical Edu	1= Technical Educated, 0= no technical education
Urban	1= Urban residence, 0= Rural residence
Muslim	1= Muslim, 0= Others
ST	1= Scheduled Tribe, 0= Others
SC	1= Scheduled Caste, 0= Others
Land ≤ 0.2 hectares	1= Having household land ownership ≤ 0.2 hectares, 0= otherwise
$0.2 < \text{land} < 0.4$	1= Having household land ownership > 0.2 and ≤ 0.4 hectares, 0= otherwise
$0.4 < \text{land} < 2$	1= Having household land ownership > 0.4 and ≤ 2 hectares, 0= otherwise
Land > 2	1= Having household land ownership > 2 hectares, 0= otherwise
Log (Per capita SDP)	Log value of state per-capita domestic product
Log (Avg. wage in casual emp)	Log value of state-level average daily wage in casual employment in all sectors

Notes

¹ Own calculation based on PLFS 2018-19

² Self-employment in the agriculture sector is primarily dependent on the land-ownership (Tamvada et al, 2022; Das, 2003). We have shown it in Table 1 in Appendix

³ They define the labour market segments by the degree and curriculum of the tertiary educated individuals

⁴ the activities that are engaged primarily for survival, rather than for growth of their business

⁵ We consider in our analysis average casual wage in all sectors as opportunity cost assuming that individual has an option to work as casual employee in any sector.

⁶ Bodier(1999) constructs cohorts based on Year of birth and higher education. Glocker and Steiner (2007) use year of birth and gender to construct cohorts.

⁷ Three new states have come into being in 2000. The pseudo-panel data has harmonized using the state boundaries as they existed in 1994

⁸ Those who have usual principal status codes as 91, 92, 93, 94, 95 and 97

⁹ CPI Agricultural Labour (CPI-AL) (on base 1986-87=100 converted to 2001 base) is used for rural areas and CPI- IW (on base 2001-100) is used for urban areas. Due to unavailability of state specific price indices (CPI-AL-IW) for few states, we have used the national price indices for those particular states.

¹⁰ UPS approach relates to the activity status of a person for the majority of the time during the preceding year of the survey. In this case, a person is self-employed based on UPS if the person spent majority of the days as self- employed during the last year

¹¹ who mainly work in unincorporated small or unregistered enterprises

