



Radboud University



DFID Research Project:
*'Enabling Innovation and Productivity Growth in Low
Income Countries (EIP-LIC)'*

Country Report India



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<http://www.tilburguniversity.edu/dfid-innovation-and-growth/>

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In 2013, the Department for International Development (DFID) awarded a grant to Tilburg University and Radboud University Nijmegen for a 4-years research project ‘Coordinated Case Studies – Innovation for Productivity Growth in Low Income Countries’ (PO 5639)¹. The sizeable research project, implemented in cooperation with academic institutions in African and Asian countries, resulted in an extensive series of scientific papers and reports, databases and more practical policy oriented documents.

On behalf of Tilburg University and Radboud University Nijmegen I would like to thank the British people and DFID, in particular the Growth Research Team, for the support in this project.

This present report present the findings of the research activities in India. The research output on India was amongst others the result of a fruitful cooperation with the Indian Institute of Management Ahmedabad (IIMA). In particular Prof. Vishal Gupta and Rama Mohana R, Turaga from the Organizational Behavior Area. We also thank Prof. Devanath Tirupati, Dean of the Amrut Mody School of Management (AMSOM) of Ahmedabad University, our partner in the qualitative research, for making the fruitful collaboration possible. Special thanks to co-researcher Dr Abrar Ali Saiyed for organising and participating in the data collection, and sharing his valuable observations and thoughts.

We hope that this report is informative for policy makers within governmental agencies, donors and NGOs involved in the promotion of innovation in manufacturing SMEs in India and the region. It is also targeted at SME owners and SME branch organisations who could use the report as reference material for reflecting on and formulating the management and business strategies. For the academic community with similar research interests, it may provide useful insights to providing ideas or supporting them to identify and/or validate research questions and hypotheses.

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Disclaimer

This material has been funded by UK aid from the UK government; however the views expressed do not necessarily reflect the UK government’s official policies.

¹ The research project was later renamed into ‘Enabling Innovation and Productivity Growth in Low Income Countries’ (EIP-LIC).

Basic data of the project

Project title	‘Enabling Innovation and Productivity Growth in Low Income Countries’ (EIP-LIC). Formerly: ‘Coordinated Case Studies – Innovation for Productivity Growth in Low Income Countries’.
DFID RP reference number	PO 5639
Project objective	To fill research gaps in the understanding of factors, institutions and policies that can increase innovation and productivity in low-income countries in Africa and Asia.
Project period	1 May 2013 – 30 September 2018
Lead partner	Tilburg University Project Director: Prof. Lex Meijdam (e-mail: a.c.meijdam@tilburguniversity.edu) Coordinator: Jaap Voeten (e-mail: j.voeten@tilburguniversity.edu)
Partner	Radboud University Nijmegen Prof. Patrick Vermeulen (e-mail: p.vermeulen@fm.ru.nl)
Countries of study	Kenya, Tanzania, Vietnam, Ethiopia, Uganda, Ghana, South Africa, India, Indonesia, Bangladesh
Project website	www.tilburguniversity.edu/dfid-innovation-and-growth

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Executive summary

From 2013 to 2017, the British Department for International Development (DFID) funded a research project on innovation and productivity growth with special reference to low income countries (LICs), implemented by Tilburg University and Radboud University Nijmegen. The project focused on understanding the factors, institutions, and policies that can increase business innovation and productivity growth, particularly in manufacturing small and medium sized enterprises (SMEs). The research was organised within two thematic areas: ‘Innovation Systems’ and ‘Finance for Productivity Growth’. Research teams conducted the field work in ten low and (lower) middle income countries in Africa and Asia, including Kenya, Tanzania, Vietnam, Ethiopia, Uganda, Ghana, South Africa, India, Indonesia and Bangladesh. Various academic institutions and World Bank offices in these countries were actively engaged as partners in the research.

A key feature of the project is the combined quantitative and qualitative research approaches involving enterprise surveys, randomised control trials (RCTs) and case studies. The collection of original data resulted in a series of scientific papers, reports, policy briefs and open-access databases. The research output is targeted at academics in development research as well as at innovation policy makers within governments, businesses and development agencies, with a view to valorising research outcomes and promoting evidence-based policy making.

The research was structured around the following set of research questions, initially formulated by DFID to frame the research:

- What firm-level and regional-level factors hinder or foster the engagement of firms in innovative activities and commercialise the outcomes of their innovative activities?
- What is the impact of in-house innovation activities versus collaborative innovative activities or technology acquisition activities on the innovative performance of firms in developing countries?
- What is the role of economic spillovers within clusters of firms in fostering economic growth and innovation?
- What are the most critical barriers to the process of innovation and the diffusion of technology?
- What types of links between the public/private sectors, universities, governments, NGOs and the private sector are most conducive to innovation activity?
- What is the role of demand side versus supply side policies?

In the course of the project implementation, new research questions emerged. Both original and emerged research questions were addressed in the various scientific outputs.

This ‘India Country Report’ presents an overview of the scientific output and policy implications relating to India. Since the number of studies and papers is different for each country of study, the report include some additional studies of other countries as well because they contain relevant and useful insights for India. In Annex 1, a comprehensive list of all research working papers written in the framework of EIP-LIC is presented. The key joint DFID/World Bank survey findings for India are presented in Annex 2 addressing the original DFID questions. The scientific output further comprises a qualitative research report, four papers within the ‘Innovation Systems’ theme, and three papers within the ‘Finance and Productivity Growth’ theme.

Qualitative research

The qualitative research findings of the project are written down in a report accessible via the project website. It is based on data collected through open semi-structured interviews with owners and managers of SMEs in

Gujarat as one example of an Indian state. The qualitative report provides context to the other research activities to validate, compare and complement existing theory in literature and research design and hypothesis development with contemporary bottom-up realities on the ground in India, as perceived by manufacturing SME owners and managers. Specifically, the case descriptions illustrate the different ways in which companies in Gujarat introduce new products, processes, technology, or machinery.

The cases show that the innovations in the Indian cases are not ‘new to the world’ high tech innovations. The set of Indian cases explored fits best in the economic stage classification of an *efficiency-driven* economy. The companies interviewed are competing less on factor endowments, unskilled labour and natural resources, as many African countries do. Compared to the earlier qualitative explorations in other countries in the framework of EIP-LIC, the owners of the companies in India seem much more aware of the importance of introducing new products and technology to raise productivity and efficiency to maintain their level of competitiveness. At the same time, most of the interviewed SMEs have introduced management and organisation innovations, whereas product and process innovations are less important. The new products and processes in the innovative companies are not radical and not ‘new to the world’. Ideas for new products are mainly acquired from the market: customers come with requests and suggestions, or the owners talk with clients. It is therefore mostly demand-driven innovation.

Innovation systems

In the framework of the ‘Innovation Systems’ research theme, four scientific papers (downloadable from the project website) were developed involving quantitative and qualitative data on India. The first paper addresses the economic impact of trade liberalisation policies on productivity of firms. The research analysed firm-level data of the manufacturing sector in India. The research determines whether the Indian economy benefitted from trade liberalisation not only through the direct effect on firms most exposed to international trade, but also through additional spillovers from the firms directly affected to other firms in the economy. The study confirms the presence of a direct effect of input and output tariffs on firm-level TFP. The research finds no evidence in favour of TFP spillovers between Indian firms. For policy, it is key to quantifying the total gains from trade liberalisation policies. When there are both direct and indirect effects, leaving out the indirect effects may lead to overestimation (if the indirect effects are positive) or underestimation (if the indirect effects are negative) of the total gain from the innovation policy. For example, a common strategy for identifying the total effect of a trade liberalisation policy on productivity is to compare those firms affected by the policy to those firms not affected. The difference is then reported as the total effect. If the latter group is indirectly affected, however, the measured difference is actually the total effect minus the indirect effect, thus only the direct effect. Second, the strength of diffusion matters for the distributive consequences of a policy, the more so if the firms directly benefiting (e.g. the importers) systematically differ from other firms ex-ante. A policy with only a direct effect would then benefit one group, whereas if the spillovers affect the productivity of another group, the benefits from the policy would be distributed more fairly.

The second scientific paper within the ‘Innovation Systems’ theme concerns a study about the adoption of ISO 14001 standards in Indian manufacturing firms. The research hypothesizes that the likelihood of adoption of ISO 14001 standards among Indian manufacturing industries is a function of internal firm characteristics, input and output market pressures, and regulatory pressure. The research finds that exporting firms are more likely to adopt ISO 14001 standards than others. Output market pressures, such as exporting to foreign markets, also positively impact the likelihood of obtaining ISO 14001 certification. The research also finds that while exporting firms are more likely to adopt overall, there are differences based on size with small exporting firms no more likely to adopt ISO 14001 standards than their non-exporting counterparts. Because of their ability to generate employment, policy in India has generally favoured small firms; these firms, however, contribute a large share

of pollution. Small firms are also subject to less regulatory scrutiny because of their sheer numbers as well as the perception that they may not have the resources to undertake pollution control activities. In such a regulatory environment, voluntary initiatives such as ISO 14001 are expected to partly substitute for weak regulations. Thus one implication is that market pressures are unlikely to work as well with small firms as they might with larger firms and one can argue that there is a case for policy interventions. Indian governments (federal and state) already provide subsidies to small scale industries to set up common pollution control facilities in order to achieve economies of scale. Our results show that there may be a case for extending such subsidies to encourage small and medium firms to adopt ISO 14001 certification. Another result with regards to firm size with potential policy implications is the finding that small firms with ability to innovate (proxied by patents) are more likely than other small firms to adopt ISO 14001.

The third scientific paper within the 'Innovation Systems' theme investigated how entrepreneurs of small and medium-sized businesses in India work within a context of institutional voids. The qualitative research (case studies) explored how informal institutional mechanisms take over. Based on analysis of the case studies, five key institutional voids are identified that entrepreneurs must bridge: (i) the absence of explicit and formal innovation policy frameworks and governance directions; (ii) the absence of technical support and interaction with formal science and technology organisations; (iii) the absence of trusted governance institutions, with regard to administrative issues, registration, patents and taxation, amongst others; (iv) the absence of the social and economic safety net provided by regulatory institutions, and (v) the absence of formal credit institutions for innovation financing. Innovation policy makers should acknowledge and address the presence of regulatory institutional voids, and the response of entrepreneurs, who take recourse to a range of normative and cognitive institutions to support their innovation efforts. Entrepreneurs do demonstrate a careful, proactive approach in developing and implementing the firm's innovation imperatives and engage in short-term incremental technology adoption/ adaptation and related management practices. The entrepreneurs apply family and personal reference frameworks and local cultural values, and mirror international quality standards to fill the regulatory institutional void with regard to their innovation ambitions, motivation and learning process. Innovation policy makers in government are often aware that their policies do not reach small and medium business owners and managers on the scale they plan. The acknowledgment of the existence of institutional voids will help them to take a more holistic approach, instead of developing only formal science technology and innovation (STI) policies based on the innovation systems concept, more applicable in advanced countries.

The fourth paper analyses the relationship between gender diversity and innovation output of firms. The research shows that gender diversity at all levels in the organisation has a positive effect on innovation. Furthermore, the research illustrates that a country's level of economic opportunity for women plays an important role in the relationship between gender diversity and innovation. Policy makers must acknowledge the value of gender diversity for innovation and create awareness among managers and employees that innovation emerges and blossoms from gender diversity at the firm level. Government agencies could develop special policies and programmes which encourage and support firms to hire a more gender-balanced workforce, secure more female top managers, and develop a gender diverse ownership structure. This could take the form of awareness raising programmes explaining the particular benefit of gender diversity for a firm's likelihood to innovate. Furthermore, the introduction of tax advantages, subsidies or other incentives targeted at increased gender diversity at all hierarchical levels within a firm could be a driver for increased gender balance. An additional avenue for policy makers is to encourage a social perception of women as being equally valuable members of society, with the same rights and obligations as men.

Finance for productivity growth

The first paper within the 'Finance for Productivity Growth' theme analyses the interplay between informality and access to finance. The research explored financial sector development in the formal and informal manufacturing sector in India. Actually, a large share of private sector activity in LICs takes place in the informal sector, which almost always has negative economic and development consequences. There is among others a large productivity gap between formal and informal firms. The research focussed on the effect of financial development on formal and informal manufacturing firms and explores two dimensions of financial development namely outreach (the ease of access to financial services, including credit) and depth (the overall formal credit volume in the economy). Overall, the empirical findings suggest two positive effects of financial deepening on the incidence of formality in manufacturing: reducing barriers to formality and increasing productivity. The research results show that both depth and outreach are important but in a different way. Financial outreach - measured in the research as branch penetration - helps to reduce formality barriers and thus increases the number of formal firms. Financial depth mainly affects informality through increasing productivity of industries dependent on external finance. There is a lesser effect on reduced informality.

The paper confirms the policy assumption that promoting the informal manufacturing sector to become formal will raise productivity and economic growth. The research suggest that government policies towards financial deepening can play an important role in reducing informality, though with important differences across industries. In terms of promoting raising productivity, a policy implication is to focus on financial depth; increasing the overall formal credit volume in the economy. The working paper demonstrates that financial depth promotes economic growth in LICs via increased productivity of firms. The working paper is also informative for policy makers with regard to their expected impact of their policies. Policy makers should not expect that policies aimed at outreach will increase productivity. The same holds true for the development of financial depth, such policies will have a modest effect on reducing informality of enterprises.

The second scientific paper within the 'Finance for Productivity' theme studies small poor entrepreneurs in the developing world, vulnerable to a range of negative shocks and constraints associated with a lack of development. The research explored the issue of income variability in Vietnam, a country comparable to India, and which possibly impedes the cognitive functioning of low-income individuals. The research was conducted through a field experiment inducing thoughts about finances to a sample of small low-income retailers in their local setting. The results suggest that a lack of financial resources does not necessarily impede cognitive functioning. Cognitive performance in financially stressful situations is not affected by absolute poverty as measured by wealth or income. Instead, what seems to create cognitive stress is the subjective feeling of poverty together with the variability of income. Cognitive performance in financially stressful situations has an inverted U-shaped relationship with income variability: being exposed to very low or very high income variability can be detrimental for cognitive capacity. There seems to be an optimal income variability which maximises the cognitive capacity of the retailers when they face financially stressful situations, which impede their cognitive functioning.

The research has policy implications to safeguarding the cognitive functioning of people on low incomes. Assuring an optimal amount of income variability to assure maximum cognitive functioning: the effectiveness of policy and programmes that focus on the beneficiaries' lack of financial resources, for instance, could be increased if income variability is also given careful consideration. Stability and maintaining the status quo of income variability is also an issue to be considered in new policies and programmes. For instance, new fiscal policies can in fact create additional cognitive stress if they bring lower or higher income variability. This is the

case if government regulations change often or are unclear, which often happens in LICs, and was signalled in the various cases in the EIP-LIC qualitative studies in Vietnam. Entrepreneurs complained a great deal about unclear and constantly changing government policies and regulations, which brought changes in income variability.

The third scientific paper within the “Finance for Productivity Growth’ theme with relevance to India addresses conducts an original field experiment to improving business skills, recognizing the value of locally relevant information as a crucial input when encouraging the adoption of business practices. Instead of teaching set courses, the study design focuses on helping businesses learn profitable practices from their successful peers. Specifically, the research addressed the question whether small-scale businesses can learn and adopt profitable practices of their successful peers. The study finds a significant increase in the adoption of profitable practices in all sub-groups of retailers. Moreover, while the handbook alone does not lead to significant performance gains, it finds that supplementary role models and business counseling improve sales and profitability. Social learning is possible when retailers are able to either observe successful peers implementing the practices or to implement the practices with personalized assistance. Social learning is recognized as an important avenue of business growth, especially concerning the adoption of new technology. This study broadens the spectrum to study social learning of business practices among urban retailers.

The results of the study show that simply providing information on profitable local practices in the form of a handbook is not sufficient for achieving performance gains or promoting the adoption of profitable practices. Instead, the team finds that experiential learning in the form of business role models or personalized counseling is necessary for achieving success. The study shows that it is possible to improve the profitability of small firms by disseminating information on the best practices of successful peers and using low-cost facilitation methods such as role models and personalized counseling to promote adoption.

DFID/World Bank EIP-LIC survey India

The survey aims to contribute to the understanding of the process of innovation and its contribution to productivity, growth and poverty alleviation in the institutional context of a developing country (India). Based on data collected by World Bank and the Innovation Survey carried out by the Tilburg University, the study aims to identify factors that may impact innovation activities (measured as investments in internal and external R&D) and innovation performance (measured as product/service innovation, process innovation, organizational innovation as well as the number of patents filed) of Indian manufacturing SMEs. The study undertakes both a descriptive as well as empirical testing approach to explain the characteristics of the sample of firms on which analysis was to be performance and then the results of multivariate analysis done on the data. The results presented in the report in Annex 2 shed light on the hitherto underexplored area of innovation activities and performance of Indian SMEs as well as provide some guidance on the policy interventions that may be thought of in order to make Indian SMEs more competitive and innovative.

Research and policy dissemination

Based on the research outcomes, EIP-LIC produced series of policy briefs on promoting innovation in manufacturing SMEs in LICs, targeted at a broad audience of policy makers. Innovation policy makers are usually understood to be government officials and staff within various ministries (S&T, industrialization, higher education and economic planning). However, innovation policies and strategies are equally designed and implemented by managers, business owners and branch organizations in the private sector. Likewise, development agencies, donors and NGOs also consider and integrate (inclusive) innovation policies in their programs and projects. All these actors mutually interact and could be enrolled in networks that promote and

enable innovation in manufacturing SMEs in LICs. It is envisaged that all these various stakeholders will make use of the EIP-LIC policy output.

The research output is accessible at the project website www.tilburguniversity.edu/dfid-innovation-and-growth. The output includes the academic reports and papers, the open access databases, a series of policy briefs and videos illustrating some key research findings and policy messages.

1 Introduction

The promotion of innovation in Low Income Countries (LICs) and emerging economies has recently appeared on the agenda of policy-makers and international development agencies. Many agree that innovation is crucial in these countries, because it is fundamental for growth in order to catch up with middle and high income economies (Chaminade et al., 2010). Current research, theory development and policy formulation to promote innovation, however, have mainly focused on innovation in the more advanced economies, whilst investigation of these issues in low income countries to date has been limited.

The 5-year research project '*Enabling Productivity and Innovation in Low Income Countries (EIP-LIC)*,' funded by the British Department for International Development (DFID) and commissioned to Tilburg University and Radboud University, aims to fill research gaps on innovation in LICs from an economic perspective. EIP-LIC aims to deliver robust high quality evidence from Africa and Asia on how to increase innovation and raise productivity in manufacturing SMEs, through a coordinated set of thematic and country case studies providing internationally comparable data. The research has been organized within two thematic areas: 'Innovation System' and 'Finance for Productivity Growth'. The countries of study include Kenya, Tanzania, South Africa, Ghana, Ethiopia, Uganda, Vietnam, Indonesia, India and Bangladesh.

EIP-LIC focuses on manufacturing Small and Medium-sized Enterprises (SMEs) in LICs. Promoting innovation in these enterprises has a particularly positive impact on development (Szirmai et al., 2011): SMEs are usually operating on the boundary of the formal and informal sector and have low levels of productivity and competitiveness. Compared to the agriculture and services sectors, manufacturing in LICs is typically characterised by a limited share of the total GDP. Innovation within SMEs in manufacturing enables these enterprises to raise productivity and grow, resulting in a better-balanced economic structure while generating employment opportunities for poorer groups and contributing to poverty reduction. Moreover, promoting innovation in domestic manufacturing is a way towards import substitution and increases the competitive (export) position of firms on the world market.

The project collected primary data via enterprise surveys in collaboration with the World Bank, conducted randomized control trials (RCTs) and carried out qualitative case studies in all countries of study leading to a series of research papers and articles published in top journals and policy briefs. All written output is available at the project website: www.tilburguniversity.edu/dfid-innovation-and-growth

This 'India Country Report' presents a summary of the key findings of EIP-LIC research of India and the associated policy implications. Chapter 2 sets out the overall project approach of EIP-LIC. In chapter 3, the report introduces the SME manufacturing sector by providing some key finding and context of the qualitative study. Chapter 4 presents summaries of six research papers and policy implications developed within the 'Innovation Systems' theme. Chapter 5 present presents summaries of three research papers and policy implications developed within the 'Finance for Productivity Growth' theme. The policy implications in chapter 3, 4 and 5 are intended for government agencies, donors, NGOs, branch organization or others to could take into consideration in their efforts to promote innovation in manufacturing SMEs in India. Annex 2 present the key survey findings as well as the data addressing the research question articulated by DFID in the original project proposal.

2 Project approach and methodology

In 2012, DFID identified the need for research in this field, and set the terms of reference for project proposals. Tilburg University's successful proposal focused on an overall goal to contribute to innovation and growth and raise productivity in low income countries (LICs), leading to job creation and poverty reduction. The project aims to strengthen evidence-based policy making on innovation and productivity issues in developing countries. At the direct operational and output level, its framework comprises three areas of activity:

1. Research: open-access datasets and written research output (working papers, submitted articles and reports) on productivity and innovation applicable to developing countries.
2. Policy and research uptake materials and dissemination.
3. Capacity development, to train and engage researchers in developing countries in policy relevant innovation research. The project includes a capacity building component including PhD seminars on research methods applied in the DFID project.

The approaches and methodologies involved in 'Research' and 'Policy and Research Uptake' are further described in paragraphs 2.1 and 2.2 respectively. The capacity development component was of lesser importance in the project and is not discussed in this report.

Project organisation

In terms of organisation and implementation, Tilburg University is the lead partner of the project, with Radboud University Nijmegen (RUN) the main Dutch project partner. Within these universities, teams of researchers were formed to prepare and manage the data collection and develop the academic output. In every country of study, the research teams concluded cooperation agreements with academic partners for joint implementation of fieldwork, data analysis, and paper and report writing. This cooperation also incorporated research uptake and policy activities, involving interactions and stakeholder meetings with policy makers within government, donors, NGOs and SME owners/managers. With regard to capacity development, the Dutch project partners organised research methodology seminars for local academic staff and students, in collaboration with their partners in the countries of study.

Partnerships were formed with the University of Nairobi (Kenya), University of Pretoria (South Africa), University of Dar es Salaam (Tanzania), University of Ghana, National Economics University Hanoi (Vietnam), University Indonesia, Ahmedabad University (India), Chittagong Independent University (Bangladesh), and Makerere University (Uganda). A cooperation agreement was concluded with the World Bank for quantitative data collection in the 10 countries of study. For randomised control trials within the 'Finance for Productivity Growth' research theme, a collaborative agreement was concluded with The Abdul Latif Jameel Poverty Action Lab (J-PAL) in Jakarta, Innovation for Poverty Action (IPA) in Accra and the National Board for Small Scale Industries (NBSSI) in Ghana, amongst others.

2.1 Research

The first output area of EIP-LIC focuses on the development of high quality research output, data and academic papers, examining ways to increase innovation in manufacturing SMEs in LICs. In particular, the research teams addressed internal capabilities and external institutional factors, institutions and policies that support or hinder the diffusion and adoption of innovation and finance raising productivity. The research implementation was organised within two thematic areas: 'Innovation Systems' and 'Finance for Productivity Growth'.

The written output of the research is systematically organised in a repository accessible via the ‘Publications and Reports’ menu on the project website. The repository is integrated into the overall Tilburg University repository, established and maintained by its library. In addition, three types of open access datasets are produced: (i) qualitative datasets, (ii) quantitative datasets under the ‘Innovation Systems’ theme, and (iii) randomised control trial (RCT) quantitative datasets under the ‘Finance for Productivity Growth’ theme. These are also accessible via the project website.

Research methodology challenges: combined qualitative – quantitative approach

Overall, the project involved a combined qualitative-quantitative research methodology, including *qualitative* explorations in each country of study into policy and research issues, and *quantitative* data collected through large scale surveys and RCTs. In the quantitative component, the project took an ‘economics’ perspective on innovation, and involved econometric analysis of a set of variables concerning barriers at firm, regional and national levels and their causalities with the innovative behaviour/capability of entrepreneurs and subsequently innovation and productivity. This constitutes a reductionist and deductive approach in defining variables for analysis, in which the impact of individual factors on innovation is assessed by applying quantitative econometric methods. The quantitative analysis served as a basis for identifying relationships between internal capabilities, external institutional factors and finance on the one hand and innovativeness and productivity growth on the other.

Applying quantitative methods in development research brought some limitations and challenges. In EIP-LIC, conceptual issues emerged, in terms of the definition and measurement of innovation and productivity in LICs. These may seem straightforward variables at first glance, but their measurement can be more complicated in the LIC context. Innovation may be manifested differently, not via high profile technological and radical breakthroughs, usually measured by R&D expenditures or patents (OECD, 2005), but by more incremental adoption and adaptation or new combinations of existing technologies (Szirmai et al., 2011). These forms of innovation are equally important for raising the productivity and competitiveness of SMEs in LICs.

Moreover, innovation research and theory development in recent decades have typically involved empirical material from advanced economies, such as the innovation systems literature of Lundvall (1992) and Freeman (1987), where innovation takes place within a relatively stable institutional and Science, Technology and Innovation (STI) policy context, ‘controlled’ and supported by established innovation system actors and innovation policies. In LICs, however, the contemporary institutional realities and formal/informal dual economic contexts are different and may involve other less visible or less commonly known factors and policies around SMEs affecting their innovativeness and how innovation manifests itself.

Therefore, the theory and associated policies of how innovation evolves within an innovation system in the institutional contexts in LICs may be different, which is increasingly acknowledged in recent innovation systems literature (Lundvall, 2009; World Bank, 2010). For instance, entrepreneurs are innovating by Doing, Using and Interacting (DUI) in fast-changing contexts, enabled by informal institutions and informal (social) learning. Applying the research variables on innovation and productivity in LICs from existing literature and theory (deduction) based on advanced economies, therefore, might not take all relevant variables into account. A more precise identification of variables might be obtained by complementing the selection with a broader understanding of contemporary realities and context on the ground in LICs.

Qualitative studies

In an effort to manage these challenges, EIP-LIC included a complementary qualitative research component, involving an exploration and description of contemporary realities of innovation in manufacturing SMEs in LICs

and emerging economies. This sought to inductively identify actual and relevant research and policy issues as input for the EIP-LIC research themes as well as for additional explanatory evidence supporting research outputs. This material could help researchers to validate, compare and complement existing theory in literature and research design and hypothesis development with contemporary bottom-up realities on the ground, as perceived by manufacturing SME owners and managers.

In operational terms, Tilburg University and partners conducted a series of case studies of manufacturing SMEs in each of the 10 countries of study in the project. The holistic case study approach and method involved interviews capturing original insights, views and perceptions of SME owners and managers. A similar report format and comparable data was used for all countries of study in EIP-LIC, enabling cross-country comparison to identify overall trends and patterns in innovation India are presented in chapter 3.

In each of the 10 countries of study, 15-20 semi structured interviews were held with owners and managers of SMEs in manufacturing, textiles, metal processing, food processing etc. The interviews discussed types of innovation, the firm's history, its innovation processes, internal capabilities, and the external business and institutional context. The owners and managers also shared their stories outside this framework and advanced issues that are relevant and interesting for current scientific work. 170 interviews in total were recorded, transcribed and stored in a qualitative research database. The concluding qualitative reports of all 10 African and Asian countries of study are downloadable from the project website. Chapter 3 provides some key insights from the qualitative study in India.

In line with DFID's policy, the original intention was to publish the qualitative database as an open access resource via the project website. However, in contrast to the numerical data, the qualitative data contained some confidential information that owners and managers might not wish to have in the public domain. This ethical consideration means that the interviews and transcripts are not freely available on open access, but may still be used subject to a strict confidentiality agreement, in consultation with Tilburg University.

Innovation systems research

The 'Innovation Systems' theme focused on understanding innovation in the manufacturing sector in LICs, its processes and critical factors hindering or stimulating its diffusion, including innovation policies and governmental institutions. The research involves the quantitative analysis of a set of variables concerning barriers at firm, regional and national levels and their causalities with the innovation capacity of firms. SMEs in manufacturing find it harder to survive than large firms, which are typically more productive and more likely to innovate in the long term, securing employment and economic growth. Regional conditions and infrastructures differentially affect levels of innovation and technological and industrial development in developing countries.

The 'Innovation Systems' team obtained data in close cooperation with The World Bank, particularly focusing on the World Bank Enterprise Survey (ES) and the Innovation Capabilities Survey (ICS). The ES is an ongoing project covering over 155,000 firms in 148 countries, collecting data based on firms' experiences and enterprises' perception of the business environment and investment climate. The whole population of the ES data is the non-agricultural economy, comprising firms from the manufacturing, construction, services, transport, storage, and communication sectors.

The ICS is a follow-up and complementary to the ES, comprising a randomly selected subset of respondents from the ES sample. It focuses on the innovative activities and capabilities of manufacturing firms, and is a collaboration between the World Bank, Tilburg University and Radboud University Nijmegen, funded by DFID through EIP-LIC.

The primary and secondary data enabled the ‘Innovation Systems’ researchers to produce a series of working papers downloadable from the project website. The titles and full details of the papers are listed in Annex ... The data are available on open access for other researchers at the project website. All working papers have been submitted to high quality journals, with some published and some still under review at the time of writing this report. The primary and secondary data also enabled the team to address the original DFID research questions underlying EIP-LIC, which are presented in chapters 4 and 5.

Finance for productivity growth

The ‘Finance for Productivity Growth’ theme focuses on understanding the effects of access to finance in determining the productivity of SMEs and how constraints to investment finance influence growth. The team identified interactions between firm-level characteristics, such as entrepreneurial traits, country-level factors (such as industrial structure, institutional framework etc.) and access to finance.

Contrary to the research approach within the ‘Innovation Systems’ theme, the finance team conducted four extensive RCTs in Vietnam, Ghana, Indonesia and Kenya. The interventions and associated baseline and endline data collection were implemented with local partners including the Abdul Latif Jameel Poverty Action Lab (J-PAL) in Jakarta and Innovation for Poverty Action (IPA) in Accra as well as the National Board for Small Scale Industries (NBSSI) in Ghana. A series of academic papers has been developed from this, listed in Annex 1. The dataset for each country, combining the listing, baseline and endline data, will become available on the project website for future research and follow-up RCTS or endlines.

2.2 Policy and research uptake

In following up on the research of EIP-LIC, the dissemination and uptake of the research evidence is essential to justify the value for money of the project. The underlying principle of the project’s engagement with potential users is to ensure that the research insights in the published output are useful, accessible, actively disseminated and communicated in a way that enables potential users to engage and make use of the research information in their own work (research valorisation). There are four target groups of potential users of the EIP-LIC research outcomes:

- Local policy makers of governmental agencies, international donors and development agencies and NGOs, who may gain new insights into promoting innovation and productivity growth in the manufacturing sector.
- SMEs owners and SME branch organisations, who may learn from the management implications of the research.
- Researchers within the academic development research community, for whom the research outcomes serve as a source of ideas and reference to develop their own research questions and methods.
- The general public worldwide interested in development and poverty alleviation issues. The dissemination will inform the public about DFID’s innovation and growth approach to alleviating poverty.

Policy and research uptake strategies

The project includes several strategies to interact with potential users. At the project start, the partners organised a series of innovation policy stakeholder meetings in Kenya, Tanzania, South Africa, Vietnam, Ghana, Indonesia, India and Uganda. Policy makers from government agencies, donors, NGOs and SME owners and managers discussed the relevance of innovation and identified policy and research issues. These issues were then followed up in the qualitative research component of the project.

A further dissemination mechanism has been the production of a series of EIP-LIC policy briefs in which the findings and implications for policy of the academic papers are discussed. Each policy brief is typically a 2-page presentation of key findings, practical suggestions and implications, accessible via the project website.

The final collection of all research outputs is concluded in a series of country reports, which draw together all the research findings for each country and are an important vehicle to disseminate the policy messages. The last chapter of the report includes and elaborates on the country-specific policy recommendations.

Lastly, three short videos were produced, focusing on key research findings and policy messages, using high quality footage filmed in Accra, Nairobi and Kampala (see project website). The videos present a policy theme illustrated by interviews with several SME owners and managers, tell the entrepreneurs' story, provide an idea of the realities they face on the ground, and show the resilience of the SME owners. They provide policy makers with a sense of the difficulties of the local context, and suggest policy solutions from the DFID research findings

3 Qualitative study in India

3.1 Case study method and fieldwork

The objective of the qualitative study of EIP-LIC is to identify relevant policy and research issues concerning innovation in manufacturing SMEs within contemporary realities in Gujarat, India. The research focused on Gujarat State only because India is simply too diverse, with too many differences between the states to present a coherent overview from the interviews.

The case study research in India involves a series of 16 interviews with managers and/or owners of manufacturing SME in the cities Ahmedabad, Rajkot, Bhavnagar and Morbi in Gujarat. The qualitative data collection through interviews took place from 4 to 14 December 2016. The number of interviews may seem a limited number to justify research validity. However, the approach usually involves in-depth rich and detailed descriptions and a multidimensional analysis of the complexities and linkages of a few cases to gain an understanding of the (socio-economic) mechanisms and processes of the case subject. In the case descriptions, innovation as an economic phenomenon is the case 'subject', whereas the unit of analysis is a manufacturing SME. The case description holistically explores the type and basic features of innovation within the SME, and reviews the impact on productivity and competitiveness over the past 2 to 5 years.

The data for the case descriptions are obtained via 'semi-structured' interviews with SME owners and managers. Of particular interest is what innovation means in the manufacturing SMEs in their context, and the less known favourable and unfavourable institutional conditions and barriers enabling or preventing it.

The selection criteria are defined in such a way that the selected cases represent the EIP-LIC target group: manufacturing SMEs understood as a company with 10-100 employees. Moreover, the criteria assure a certain homogeneity within the selected cases, which will enable comparison of cases while supporting a certain validity of the identified trends or patterns. At the same time, allowing some heterogeneity, by including deviant cases, provides more contrast, and thus enables the research team to better construct and highlight divisions in the innovation process, linkages, system or mechanisms.

An essential element of the selection is the notion that types of SME innovation in LICs are not confined to technological (radical) inventions resulting from particular R&D investments and efforts. Innovation in manufacturing SMEs in LICs more often encompasses incremental adoption and adaptation or new combinations of existing technologies, products, marketing, management or business practices. Moreover, innovation often does not concern one type only. More often, an initial innovation enables and/or triggers other types of innovation within a firm; a new technology allows the introduction of new products, for instance.

From the eight cases in the comprehensive qualitative report of India, accessible via the project website, three cases are presented below to provide some insight on the daily realities of SMEs in manufacturing in India.

3.2 Selected cases

Case 1: Metal – casting (35 employees)

The company manufactures metal rings for bearing cages, which are sold as intermediate products to the machine and automotive industries. The company was established in the 1990s by a metallurgist and his commercial partner, who set up the centrifugal casting foundry. The interview is held with the present owner, who also acts as director.

The company uses a centrifugal casting procedure to produce the cages from copper based alloy. *“The high-end bearing industry uses centrifugal casting only for cages.”*

Raw copper scrap is melted in an induction furnace and then poured into a rotating mould. According to the director, centrifugal casting for producing high quality bearings components is a relatively advanced technology, combining three technical fields of expertise: chemistry, mechanics and metallurgy.



The metallurgist and his commercial partner performed well in terms of product quality and technology, but not as regards financial performance: the company was making serious losses. The key issue was the high production cost and an inefficient centrifugal casting process. However, because of the high product quality, the metallurgist secured a solid market position by becoming a supplier to a large international bearing manufacturer nearby involved in precision engineering. This large buyer was looking for advanced centrifugal casting producers and was willing to provide some credit to the company to temporarily offset the losses. The management of the large company assumed that after a period of time they would recover their financial outlay *“but that day never came.”*

At that time, the present owner was trading engineering tools and supplying to the company. He established a good relationship with the metallurgist and his commercial partner. In 2000, they asked him to join them in the manufacturing business. He was interested *“because I am always ready for new challenges, but at that time I did not know about the big losses in this company.”* A decisive factor was the fact that the company was *“a dedicated vendor”* to the large international bearing manufacturer, which gave him sufficient trust and confidence in their ability to generate future business.

The present owner himself was also in a weak financial position. Even after he found out about the losses, he decided to stay in the business because of the relationship as an important supplier to the large manufacturer. The company had to enlarge production capacity with a new workshop at another location nearby. In 2002 the present owner became the ‘caretaker’ of the new workshop.

The large international bearing manufacturer was impressed by the production volume and quality of the new workshop and contacted the ‘caretaker’ – *“I had been waiting for three years for this moment.”* The representative discussed with the present owner a plan to recover past debts. The large enterprise was able to make the present owner an authorising signatory – *“they gave me this whole factory with some machinery and I started in April 2003.”*

Then, in 2008, the metallurgist and original owner left the company. The present owner took over the remaining debt to the large international bearing manufacturer and paid 1.75 crores (275,000 USD) goodwill to the metallurgist. He signed a new agreement with the large international bearing manufacturer for 50 tonnes minimum of business per month and a repayment arrangement for the debt. After 5 years, in 2012, *“I was clean.”* The company acquired new customers, became profitable and now *“it is a very healthy company.”*



Internal capabilities and innovation

At present, the company has 35 employees in the foundry and 7 office staff. Since the present owner became involved in the company in 2000, the product and centrifugal casting technology have changed little, but he did change the management and administrative processes. He does not have an “*ego problem*” as he puts it: he sits down and talks with the workers while observing what is going on.

Among other things, the present owner spends a lot of time with the workers in the foundry to understand the production process and technical details. Not being a technician by education, “*I am simply a business graduate,*” he asked the workers how to improve the production process. One problem is that the process of melting and re-melting the costly non-ferrous (copper based) material implies burning losses due to evaporation – “*a certain loss is allowed.*” If the production process is well managed, the loss can be kept as low as 6% and then the business becomes profitable. The foundry workers suggested several technical improvements, such as lowering melting temperatures, which resulted in less burning losses in the production process. “*At that time I learned a lot from the workers. Only they know how to do it right.*” The new management style was different from the previous owner, the metallurgist, who used to tell the workers what to do, so “*there was a lot of conflict.*”

Another new practice was the switch from an oil fired furnace to an induction one, an electricity based process for melting copper. His neighbour and friend advised him to buy an induction furnace from him “*because an induction furnace is a must for this industry.*” In 2005, he bought the first induction furnace. They connected it to the continuous centrifugal casting machine, which nobody was doing in India. This was quite a technological invention – “*I told my neighbour and friend that if we succeed, then we should not make another furnace. I don’t want my competitors to have this technology.*”

External business and institutional environment

Initially, the company only supplied to the large international bearing manufacturer, but today the company has ten different clients – “*there is a very big market in India and very few competitors in centrifugal casting.*” The director says that only five companies are involved in centrifugal casting in India, but these other companies operate on a smaller scale and are not serious competitors.

The company does not export, although the products are sold in Germany via the international bearing manufacturer. One German buyer once visited and audited the company – “*they know I am the manufacturer.*” Demand from the international bearing manufacturer has decreased somewhat because it now has its own foundry. The owner is not concerned about competition because the international bearing manufacturer only produces for its own use – “*they don’t want to do anything for others.*”

Regarding the institutional context, the director says that he is content with the policies and regulations of the national and Gujarat state governments – “*if you are doing anything wrong then there is a problem.*” He finds the fourteen government departments that regularly come for audits a bit excessive – “*every month some government inspector comes here checking labour conditions, electricity, safety and pollution.*” In the past, it was quite common to offer Diwali² presents to government officials to maintain a good relationship but “*now our Prime Minister Modi is doing a great deal to counter corruption.*” There are fewer inspections, which makes the owner happy. The government officials never harassed the owner – “*only if you are doing anything wrong with your books will they punish you.*”

² Diwali is the Hindu festival of lights, celebrated every year in autumn in the northern hemisphere.

Fifteen years ago, the infrastructure, road and power supplies were very bad, according to the owner. There was power for only five or six hours per day, which “*made it impossible to run a company.*” In 2001, Modi, as past Chief Minister in Gujarat, addressed these problems seriously and since then the infrastructure has improved daily “*and now things are going smoothly.*”

When he took the decision to take over the company in 2008, “*my liabilities were higher than my assets and I was the only person who knew this. I took a risky decision in taking over the company.*” His family, quite poor, was not aware of the risk – “*if anything went wrong than we would all have been on the street.*” At first, he went by bicycle to work. Since the company began to thrive, he has owned several cars. Today his family is fortunate and still does not believe the success and the wealth they have.



The informal advice of his neighbour and friend has been very important. An owner is a non-technical person – “*anytime I ask him for a technical problem, he comes within 10 minutes and resolves the issue.*” Over time, he learned that one person cannot manage a business – “*you need at least two people, one technical and one commercial.*” The owner has the ambition to reach a much bigger market in five years’ time. He hopes to do it with his neighbour and friend and sees a golden future together – “*in five years we will just sit and monitor the production.*”

Case 2: Pollution – micro-algae water treatment plants (14 employees)

The company produces micro-algae based waste water treatment systems for textile, dye, leather and other polluting chemical industries. The company has an office in Ahmedabad and a laboratory in Chennai – “*we have around 14 people at the moment, but that is bound to increase significantly now.*” There are 6 staff in management and sales and 8 technical staff.

The owner started the company in an informal way 3 and half years ago. It was officially registered a year ago. This year the projects have become successful. The company has large and small clients, with one large client accounting for 70% of the revenue so far. The revenue for this year will be 1.9 crore rupees (300,000 USD).

The interview is held with the owner, who is a qualified biochemical engineer (IIT Kharagpur). He was previously working with a US-owned company manufacturing artificial coal based in Punjab. Biomass from agriculture was collected and processed into artificial coal – “*the waste water to be discharged contained a significant amount of contaminants, which was difficult to treat in the existing treatment systems in the market.*” All of the technology either failed or involved high operational costs, but “*then we met a micro biology professor from Chennai [University of Madras], who provided a solution for us.*”



Internal capabilities and innovation

Conventional processes in waste water treatment typically use bacteria for degradation of organic contaminants. However, in the case of extremely toxic molecules, these bacteria do not survive. The professor found that micro-algae are able to survive while reducing the harmful contaminants. This is the only technology that emits oxygen and absorbs the carbon dioxide, instead of emitting carbons, because this is a green organism involving

photosynthesis. The micro-algae grow and the residue is green biomass, which can be composted for sale to fish farmers and as an agricultural food supplement – *“this is the kind of additional benefit that we can give to the client.”* Sustainability does not come with an extra cost but with extra income.

The professor also discovered that a magnetic field can modify the intake of micro-algae. With changing intensity and frequency of the magnetic fields *“you can control and change the intake behaviour of the microorganism.”* He does not understand exactly how that happens but *“it changes certain receptor pathways in the cell walls.”* With the technology, it is possible to *“programme”* the algae the terms of their uptake. According to the owner, this is the only company in South Asia, *“as far as I know”* that is working in this particular technology.

The professor did not have a business model at that time. The owner *“was very much impressed by the insights he gave us.”* The professor did not have a team to implement the idea on a larger scale. The owner suggested working with the professor to formulate a proper business model around the technology and start a company to commercialise the invention – *“it was an informal collaboration first and then we slowly structured it and this is where we are right now. The professor was very apprehensive at first.”* The owner convinced him about the further engineering and marketing that he would provide. The owner also had an *“angel investor.”*



The professor became an equity holder and the principal scientist in a company. The owner got exclusivity to be able to scale up the product idea in India. The company has 4 key staff involved in engineering, marketing and sales, commissioning of plants and R&D, respectively.

The company secured its first client, a manufacturer of acrylic fibre importing gel dye from Germany which included a significant amount of toxicity. No bacteria was able to clean the waste product and survive and no one in India was able to provide a solution. *“It took us almost 1.5 years to complete that project and it was successful.”*

Now, a year later, the company provides total ‘turn-key’ effluent management systems. The company produces algae in a laboratory housed in the Institute of Magneto Biology in Ahmedabad. The institute conducts interdisciplinary research into magnetic fields. The total systems include some conventional subsystems involving mechanical equipment, which the company outsources – *“there are many manufacturers and traders of such equipment and water tanks.”* Some clients invest in the hardware themselves and the company supplies the *“software,”* the micro-algae.



The company’s technicians go first to a client site to understand the situation and needs – *“then we develop and design end-to-end systems to cater to that.”* The company then conducts a small trial at the client site. The client sees first-hand how the system is going to work in the longer run.

The company is ideally located because nearby in Rajasthan, Gujarat and Maharashtra there is a significant amount of polluting manufacturing activity within the textile, chemical and electro plating industries.

External business and institutional environment

Industrial pollution is a major problem in India and so the market potentially offers many opportunities. The owner is not afraid that employees will leave the company and start businesses themselves because the waste water treatment market in India is huge. The owner sees that awareness within small and medium-sized companies about waste water treatment is very low in India at present – *“people are slowly waking up.”*

The owner shares stories about dye manufacturing companies who secretly discharge heavy polluted water. *“Owners of dye companies position watchmen in the night to check whether any regulatory body is coming and checking. If not they just discharge the extremely toxic effluent.”* Many companies run on *“thin margins”* and cannot afford expensive existing technologies. There are many owners with good intentions looking for credible and cheap waste water treatment alternatives, according to the owner. They are willing to invest in technology if it is commercially viable. For instance, 200 km from Ahmedabad there is an industrial park near Baroda. *“If you take out the ground water at any place, it will be dark brownish, completely dark brownish.”* The company sees an opportunity in those worst contaminated sites – *“we provide technology to them and we provide solutions to them.”*

Recently the company started a collaboration with international partners. Welsh Water in the UK has set up a number of water and sewage treatment plants in Wales. They have invited the company to install a small demonstration project – *“but the accreditation that they require to work there is very stringent.”* The company also has a research cooperation with Swansea University in the UK – *“we are working with them in the field of bio fuel production and an algae based carbon dioxide mitigation system for the Tata Steel plant in the UK.”*

The company does not have a patent because the patent protection structure in India is not very strong. The owner avoids patenting since the application procedure is too bureaucratic and not much advantage is expected at the end of the day. One key issue is that details of his technology will be published in the public domain. He expects that it will only take a year for someone to figure it out and bring systems to the market. If he files a legal case against someone who copies him, it would take 10 years to get any concrete results – *“we do not file and believe in patents. We have got technologies which are our own.”*

The manager does not like to be referred to as a start-up. If he wants, *“the company could easily get featured in newspapers tomorrow”* but he avoids media exposure. *“Manufacturing industries, as our target clients in the country, have a mental block about engaging with people and technologies that are new.”* Potential customers do not want to enter a business contract with start-ups.

Innovation is not popular in manufacturing companies, according to the owner. The sector is still being run by older and traditional people and families who have been in the same position for years now and do not innovate or think ‘outside the box’.

The owner is cautious and somewhat disappointed with the government. With the sustainable technology they have developed – *“you would expect authorities to lower the glass ceiling for us.”* Formal institutions have not helped them so far – *“the pollution control board has been the biggest problem for us.”* They do not want to encourage new technology because *“the environment will benefit but they lose their money gained from corruption.”*

Case 3: Textile and garments – blue jeans (80 employees)

The company produces blue jeans for the domestic market. It has a production factory in the north east of Ahmedabad and an office in the city centre. The 40 year old owner and director started the company 3 years ago with 20 employees (the interview is held with the owner). The production unit currently employs 75 workers –

“all the employees are skilled workers.” Five more employees are working in the office: one accountant and four marketing and sales staff.

There is *“tough competition”* in the industry. There are at least 100 manufacturers in Ahmedabad with similarly sized businesses and many smaller ones. The owner decided to do something different by launching his own brand – *“I am not doing what everybody else is doing.”* The idea of his brand is to adapt existing designs of large international jeans brands to the preferences of the Indian consumers. The main idea is to produce similar products to the big brands for half the price.

Previously, the owner worked in the textile industry, in charge of quality control. Since launching his own business, he has spent a lot of time exploring and learning styling and design – *“I worked hard for the past three years.”* He read many fashion magazines, visited showrooms and checked websites of important brands such as Jack & Jones and Wranglers – *“if it is good in the international market, I ask myself whether the Indian market would accept it.”* He found out that it was equally important to know what style is fashionable in India – *“I had to do research on that on an on-going basis.”* He had to make some changes in fabric quality, wash designs, colours and design and adapt them to suit the Indian market. He is not exactly copying: as he puts it, *“my brand design is basically from the big buyers but I add my own touch.”*

That is how he got the idea to produce jeans – *“I realised that this is my destiny.”* Today the owner keeps following the designs of the global jeans producers – *“everybody has a godfather. Everybody follows somebody.”* The company takes ideas and follows their steps – *“making products which are 50% more cost effective – I don’t have R&D expenses.”* The owner believes that there is no innovation in fashion in India – *“we are making some changes in fashion. We are not actually innovating.”*

The owner purchases fabrics locally as there are many fabric sellers in India. The workshop is organised according to three stages of the production process: cutting, stitching and finishing. For every step in the production process, there is a team in the factory.

The cutting of the fabrics is done manually with a template according to the particular design – *“we don’t have any automated cutting.”* Then the front and back of the jeans are stitched and further assembled with pockets. There is a specialised machine for the pockets but the owner prefers use manual processes too – *“it provides employment to some women and trainees.”* There are special machines for specific parts related to finishing the jeans such as the belt hooks, zipper, brand and size labels and other small details.

The owner plans to buy an automatic laser cutting machine in the future. For the time being, he only invests in the machines required for the necessarily complicated stitching to distinguish his brand – *“I need 16 types of stitches for my brand.”* With regard to future investments, he compares his business to an aeroplane that is taking-off – *“first I need all the resources to fuel the aeroplane to get higher.”*

The owner does not do the colouring (stone washing) and dyeing, which is outsourced to a factory nearby.



When the owner started his business, he outsourced more of the production processes, *“but I was not satisfied with the outsourcing. It is difficult to assure quality while outsourcing.”* The owner sees that in-house production

assures quality control – *“this is my company. This is my brand. So I am going to do whatever is required to improve quality.”*

The owner is proud that he created his business himself, which comes with advantages – *“if you are set free into the jungle then you create your own rules.”* He did not accept any support from his father, but got a private financier in the beginning, which leaves him independent – *“I don’t follow any rules and there is no boss around.”*

The owner does not sell directly to wholesalers or retailers. Sales are handled by agents for large buyers throughout India. Although small retail buyers comprise more than 60% of the total, the large buyers are *“the spinal cord”* of his business. Usually, the owner designs several samples of jeans according to his own design, which he shows to his agents. If the agents like the sample, then the owner produces the jeans in bulk, *“but we do not make goods to order.”*

The owner sees a great advantage in selling via the agents for the 3% margin they claim. The agents bring the buyers to his office where the products are on display.



The agent also brings a payment guarantee – *“selling directly to retailers carries a very big risk factor.”* The owner would like to have his own chain of retail shops, *“but it would be an immature decision. I have to improve my brand and my products. Then I will open shops.”* The owner is planning to export but he is not ready yet in terms of production capacity, quality ranges and working capital – *“I will pick the fruit when it is right.”*

Internal capabilities

The owner holds a BSc degree in chemistry. He decided to go into the textile business because he did not see a future in his field of study. His father used to be in the fabric retail business. The owner picked up knowledge and experience within his family – *“we used to go to my father’s shop after school.”* At present, the owner works 6 days a week. He has a wife, two daughters and a son. His wife manages the household. There are no other family members living with them.

The owner is well informed about the latest fashions. His feeling for fashion comes from experience, which he picked up by going out with *“fashionable friends.”* He developed and maintains a long-term vision for his brand. He considers himself good at prioritising – *“I know what is essential and what is not in growing my brand.”*

Regarding organisation and management, the owner oversees all the production, sales, management and administrative issues. He has trained a floor manager to look after the factory while he is in the office in the city centre. Running a jeans factory brings a lot of daily management and personnel issues. Staff come and go – *“people do quit.”* The problem is to find a replacement and *“train the person according to my quality standards.”* He explains that the new staff have to adopt his brand and quality standards, *“which are different from other producers in the current market.”*

His workers are from Uttar Pradesh, Bihar, Orissa and Rajasthan because there are few skilled workers in Ahmedabad – *“I cannot find skilled workers for the quality I want.”* They arrange their own accommodation and take breaks of a few weeks to go back to their village. The manager is from the Marwari community, but

that does not play a role in how he recruits staff or works with people. It is quality and skills that count. *“If a business owner only deals with people from his own community or caste, then he will not progress.”*

The workers produce on a piece basis – *“all the textile industries in Ahmedabad run on a piece basis these days. There is no fixed salary.”* The owner does not like the fixed salary system *“because people will not work accordingly. If you don’t make anything, you will get nothing.”*



There is no additional holiday for the employees, according to the owner, since in India, there are so many festivals – *“you can celebrate 165 days a year.”*

The skilled workers do not have any formal degrees – *“they are all illiterate.”* Some bring their younger relatives as trainees. The skilled workers learn by joining their parents – *“the children are in the factory with their parents or uncles for training. It is not child labour: they are not being paid.”*

Production is organised in such a way that he can track which piece is made by which worker. This ‘tracking’ is different from other textile producers. If there is damage or any quality concern, he knows who made the mistake *“and he or she will be penalised for that.”*

External business and institutional context

The owner is positive about the business environment in India – *“I have so much demand for my product.”* In his view, the key to success is the assurance of product quality and being an honest businessman.

The owner believes that the formal policies and regulations for SMEs are fair in India and taxes are not too high. He recognises that there are people who complain – *“they don’t want to pay taxes. They want to bring their product to the market and fill their pockets.”* The owner sees that informal and *“black market”* work does not bring benefits in the long run.

When he started his business, he could not take out a bank loan because he did not have a business track record. Since he is doing everything in a proper way, like paying taxes, he is building a CIBIL³ credit score – *“I am an honest businessman, I am paying taxes so I can show my records and my growth.”* The owner engages a chartered accountant who advises him in getting benefits from the government – *“they guide me and I work accordingly.”*

The owner now receives government support in the form of a subsidy for a loan to purchase some machinery. Initially, he applied for a bank loan at a rate of 11% per year, *“which is too high.”* He applied to the state government with the argument that he is a manufacturer bringing money into Gujarat. He now gets a 6% government subsidy, so the bank loan is currently 5% per year. There is a condition that he first has to prove his business growth. Then, after two years, the state will disburse the subsidy.

The owner sees that there is corruption in India, mostly relating to the informal economy – *“if you are doing business and earning in the black market, then you have to pay something to somebody.”* In his view, corruption would be less if the taxation system were simpler and clearer; civil servants would not be able to take advantage of the confusion and get money under the table – *“that is why they are not willing to make the taxation a simpler*

³ TransUnion CIBIL Limited (Formerly: Credit Information Bureau (India) Limited) is India’s first Credit Information Company (CIC), founded in August 2000. TransUnion CIBIL collects and maintains records of an individual’s payments pertaining to loans and credit cards.

process. There is some objection because everybody's pocket is getting filled by the complicated types of taxation processes." The owner would like to see improvements and coordination in tax regulations and paperwork applied across India – *"there are 14 states and 14 different tax procedures and regulations."*

The owner does not work within the informal cash economy. He notes that the result of demonetisation in India was that *"many factories in Ahmedabad that were doing business on the black market shut down."* Demonetisation has also affected him as regards paying salaries. His labourers have bank accounts but they do not want to receive bank cheques, preferring cash. The problem is that Indian banks under the demonetisation regime can only hand out small amounts of cash – *"I have 10 lac rupees in my account but I can't withdraw more than 20,000 rupees per week. I lack cash flow."*

Another issue with bank accounts is that if the owner provides the workers with cheques, the entire amount goes to the bank account and the family back home comes to know about it. The labourer wants to keep something in their pocket for their own use, without showing the family at home – *"in some cases, they can do things which the family does not allow, like drinking liquor and other things we can't discuss."*

There are labour unions in India. The owner has an official licence to establish the factory and maintains a relationship with the labour union. Employees can go to the labour court if there is a problem with the hygienic or sanitary conditions, shelter, ventilation and lighting – *"if the lighting is not enough, it affects their eyes."* The owner installed a single light no higher than eight feet above every machine *"so their eyesight is not damaged."*

3.3 Key findings qualitative research

A first overall observation during the preparation of the fieldwork in India, compared to organising the qualitative interviewing in African countries, was the relatively high number of formally registered SMEs (10-100 employees) in the manufacturing sector in Ahmedabad and around. Moreover, SME owners and managers were open to receiving the research team at their premises for an interview. The interviewed SMEs, in terms of employees, were larger in size than most of those interviewed in the African countries so far. Another large segment was informal household based enterprises, which were not included in this research. This represents the so-called 'missing middle' of SMEs⁴. There are relatively few enterprises of 10-40 employees.

Innovation definition

Most interviewed owners and managers in the Indian companies described in chapter 3, in different ways, introduced new products, processes and technology in order to improve and expand their business operations. Some would clearly qualify as innovation, while others would not, depending on how innovation is defined and assessed. In advanced economies, innovation is typically measured by R&D expenditures and number of patents of new products or processes as proposed amongst others in the Oslo Manual⁵ (OECD, 2005). From a radical technology perspective, many of the 'newness' introduced in the Indian cases would not qualify as innovation. Such an assessment would, in any case, have been impossible because the owners do not systematically record R&D expenditures and have not registered patents.

Taking a broader and economic perspective on innovation, viewing it in terms of incremental adoption and adaptation or of new combinations of existing technologies creating value (Szirmai et al., 2011), it is evident that the new elements introduced in the interviewed companies resulted in improved and expanded business

⁴ This phrase has been used relatively loosely in economic development discussions, meaning a lack of SMEs particularly in the developing world. See: http://www.africa.com/blog/investing_in_africa_defining_themissing_middle/

⁵ <https://www.oecd.org/sti/inno/2367580.pdf>

operations. As described in emerging innovation theories on LICs, much innovation depends “*on an aggregation of small insights and advances through ‘learning by doing’ rather than on major technological inventions*” (Carayannis et al., 2003).

Despite increasing interest in the literature, the exact definition of innovation in LICs remains an issue in theory (Çapoğlu, 2009) and for its application by the researchers in EIP-LIC. The broadest possible definition of innovation, from an economic perspective, referred to in the qualitative research section, is everything new that the company does to raise productivity and/or to stay ahead of its competitors. Or as Fagerberg et al. (2010) put it: “*Innovation is often seen as carried out by highly educated labour in R&D intensive companies with strong ties to leading centers of excellence in the scientific world. Seen from this angle innovation is a typical “first world” activity. There is, however, another way to look at innovation that goes significantly beyond this high-tech picture. In this, broader perspective, innovation – the attempt to try out new or improved products, processes or ways to do things – is an aspect of most if not all economic activities. In this sense, innovation may be as relevant in the developing part of the world as elsewhere.*”

Regarding the dimensions of innovation, Kaplinsky and Morris (2001) identify five types of innovation: (i) process innovation, aiming at improving the efficiency of transforming inputs into outputs; (ii) product innovation, leading to better quality, lower price and/or more differentiated products; (iii) business practice innovation, implying new ways to organise the business and attract new clients; (iv) functional innovations, assuming responsibility for new activities in the value chain, such as design, marketing and logistics; and (v) inter-chain innovations, moving to new and profitable chains. These types of innovation are taken into account in the analysis in this report.

In many innovation definitions and measurement documents, such as the OECD Oslo Manual (OECD, 2005), a distinction between product, process and other types of innovation is made. However, explicitly distinguishing the types of innovation in the manufacturing SME cases interviewed so far in the EIP-LIC countries of the study was not such a clear and simple matter. It is more common to see an integrated combination of several types of innovation, where one type of innovation triggers or enables another, such as the introduction of a new process (technology) that results in the launch of new products requiring the reorganisation of the workshop and staffing. Analysing the Indian cases for newness, process and value creation is one possible way to assess whether the observed new phenomena within the companies qualify as innovation or not.

1. The bearing casting company did not innovate in terms of new products or process technology. Instead, the owner introduced a new human resources management practice by involving staff more and sharing responsibility and ‘ownership’ in improving the production processes. This could be qualified as a management innovation which resulted in increased productivity. Kaplinsky and Morris (2001) classify this type of innovation as business practice innovation.
2. The micro-algae producing company concerns a high-tech product and process innovation that is new to the world. The research discovered and tested that the micro-algae technology is able to clean extremely polluted water and the idea is now commercialised, with initial successes.
3. The textile company producing blue jeans is copying existing jeans models and adapting them to the Indian market. This is an adaption of an existing product in the market, and thus a product innovation. The owner uses existing technology from abroad and has some ideas to upgrade.

Trends and patterns in the cases

From a macro perspective, the Global Competitiveness Report 2015-2016 of the World Economic Forum indicates that India is becoming more industrialised and competitive on the global market. Firms are becoming larger and starting to exploit economies of scale. Input factors are used more efficiently to raise the rate of return

and increase product quality. Productivity increases, because wages rise with advancing development. Against this background, the set of cases explored should be read in the context of an *efficiency-driven* economy, as defined by Porter et al. (2002). The companies interviewed in Gujarat are competing less on factor endowments, unskilled labour and natural resources, as many African countries do. While firms in the latter countries are more involved in the trade (export) and processing of primary materials based on their factor endowments, India processes much of its primary material in the manufacturing sector.

The owners of all the interviewed companies seem much more aware of the importance of introducing new products and technology to raise productivity and efficiency to maintain their level of competitiveness. The interviewed SMEs introduced a mix of product and process innovations as well as management and organisation innovations. The new products and processes in the innovative companies were not radical and not new-to-the-world, with the exception of the micro-algae company, which developed the idea and discovered the technology. The ideas for new products are mainly acquired from the market and from suppliers. The common picture is of customers coming with requests and suggestions and owners talking with clients. Improved or new products requested by customers indicate demand-driven innovation.

Internal capabilities

In all cases, except for the tile producing company, it is the owner who initiates, coordinates and manages the new ideas, including preparations for the innovation, technical details and the product launch. There is also a difference in the expertise and educational background of the successful owners. On the one hand, there are owners who have a particularly technical background, in mechanical or electrical engineering for instance. They have established a company around their technical expertise and stay very close to the production process. Several of these cases show a certain top-down management practice. On the other hand, there are owners with a management or commercial educational background, who introduce management and organisational innovations and delegate responsibility and ownership to technical staff.

Another interesting observation, which differs from the Africa reality, is that most of the interviewed companies are family businesses, a common phenomenon in India. Family members help each other to set up a business, which may be critical to overcoming initial start-up problems. Businesses that belong to a family or a group of family members are usually medium-sized or larger. The confectionery case deliberately deviates from being a family business, because the owner believes that family businesses only remain viable for 2 or 3 generations.

The workforce in the companies comprises unskilled and skilled labourers in the production workshop and well-educated staff in management and marketing. Several owners face the difficulty of a high turn-over rate of unskilled production workers, since there are plenty of employment opportunities in Gujarat for lower educated workers, as reported by several of the managers and owners. All the companies try to retain workers and have some system of rewards and bonuses. The skilled production workers seemed more loyal to the company, and the well-educated staff are the most loyal. The recruitment of workers is, therefore, an ongoing concern for the owners and managers.

The Indian education system does not deliver workers ready to do most of the production, commercial and marketing work. Graduates from colleges and universities do have theoretical knowledge but lack practical skills, so most companies have to provide additional in-house training. Nonetheless, in some cases, the employees provide innovative ideas.

Typically, the firms' technology and machinery has been in use for a long time, but is still able to deliver a certain minimum product quality. Occasionally, new machinery is bought from profits and savings.

The interviewed owners and managers are well-informed about technological possibilities through the internet or informal contacts and have ideas and plans for upgrading and expanding their companies. However, new state-of-the-art machines are too expensive and advanced relative to the expected returns on investment in the short run. The investment cost increases exponentially for advanced technology.

External business environment and formal and informal institutions

All the interviewed SME owners and managers indicate that the business environment is challenging in Gujarat and India as a whole. There are many market opportunities for domestic and export business, but also many competitors. All the business owners see the necessity to be original and innovative. Building and maintaining relationships with the business community is critical. The two cluster cases are discussed, the tile company and the dyestuff company. There is substantial spill-over of technology as a result of cooperation between firms, subcontracting or other forms of collaboration within value chains, business clusters or networks.

Most enterprise owners are positive about the formal institutional context, in particular, national policies to develop economic growth introduced by Prime Minister Narendra Modi. The financial digitalisation, demonetisation and environmental policies are all welcomed. At the operational level, many companies mention some degree of corruption in their interactions with government agencies, mostly to speed up processes for approvals, licences and so forth. Companies are not discouraged in their operational and innovative efforts.

No interviewed company received support from the government. Most owners feel that they have to survive on their own. While most of them think this is reasonable, some support in terms of credit or technical support would have been welcomed.

A bank loan for an investment in new technology is avoided in most cases. The banking system is not an attractive source of finance for SMEs. High interest rates and complex paperwork is a critical issue. Instead, most SME entrepreneurs find investment money from savings and informal loans from family members. Most take a step-by-step approach, involving minimal risk by investing incrementally before or after receiving large orders.

Branch associations are an important source of information and business contacts and contracts for the owners and managers of the interviewed firms. Most of them are members of an association, but interaction with formal technology institutions, as suggested in the innovation systems literature (Lundvall, 1997), does not happen. Many SME owners and managers indicate that they would like to cooperate with universities to undertake research at their premises, to share research insights, for instance.

The informal context for the young female entrepreneur presents some challenges in terms of gender relations. Often, family and friends do not take her entrepreneurship seriously, considering it less valuable and meaningful than studying at university and getting a corporate or government office job. Society expects her to get married in her early twenties.

Policy issues – insights for policy makers to consider

As argued in the introduction to this report, it is desirable to develop innovation within manufacturing SMEs in India to enable them to contribute a larger share to the country's overall GDP. This necessity was acknowledged both in the in-depth interviews with SME owners and managers in Gujarat and in the discussions during the EIP-LIC policy stakeholder meeting, held at Ahmedabad University on 13 December 2016. The state government has for some years formulated and implemented various innovation policies. The Gujarat Industrial Policy 2015 includes support for the Nodal Institution, which supports start-ups and companies with innovative ideas. The Gujarat State Innovation Council aims to promote innovations in the state. In early 2017, the Gujarat government

introduced India's first Student Start-up and Innovation Policy. The objective behind the initiative is to help make a qualitative improvement in the conventional education system and to create a conducive environment to inculcate creative thinking and a problem-solving attitude amongst students.

The reality of the interviewed cases is that SME owners do not enjoy the benefits of any innovation policy. Moreover, several other issues emerged aside from the policies already implemented by the government. Some SME owners and managers are aware of R&D centres and programmes aiming to support technology development for SMEs and develop an innovation-driven economy. However, the companies are seldom involved in the actual technology development, nor are they connected to the formal institutions.

SME owners and managers in Gujarat are well informed about state-of-the-art technology in their line of business, but they cannot afford the machines because of the increasingly high costs. Contrary to many other countries researched in EIP-LIC, where SMEs do not invest because of the uncertain future, the Indian owners seem to have trust and confidence in the current political leaders and their administration. This is witnessed by the fact that companies are not reluctant, once financial means are available, to invest significant amounts of money.

Recruiting well-educated staff is not such a problem in itself, but it is a greater challenge to make them really innovative in their working practices. Higher education is still very theoretical and most SME owners have to test and train the new staff in practical and commercial skills.

Another issue is whether the technology-focused policy approach, directing India further towards an innovation-driven economy, is the most appropriate and most effective way to develop the manufacturing SME sector. This relates to the finding that most technology required by the sector, except for IT and app development, already exists elsewhere in the world. From an economic perspective, the adoption or adaptation of technology and products is also as long as it is commercialised, creating value. Against this background, innovation policy could equally include technology adaption and adaptation as well as business practice, management and organisational innovations.

Some believe that technological innovation is critical for SME development and catch-up in LICs. Technological innovation has, however, been traditionally concentrated in developed countries, given the costs and risks involved in stimulating technological innovation. Foreign sources of technology account for a large part of productivity growth in most countries, also witnessed in the Indian cases. Therefore, the development process in LICs could be supported by tapping existing technical and product knowledge.

Moreover, the stories and experiences of the owners and managers raise the issue of whether an innovation-driven and new-to-the-world innovation approach should be the way forward. Most of the required technology is already available, but elsewhere in the world. All the owners in the cases are well informed about the technological possibilities of their business. Without too much difficulty, they find the technology themselves by drawing on various sources of information such as the internet, informal business contacts and trade fairs. Moreover, the companies themselves refine and adapt the existing technology once acquired. So, although setting up technology development projects and programmes may help SMEs, the availability of technology is not perceived as a barrier to innovation by the owners and managers.

It seems that the notion of growth as 'manna from heaven' as reflected in convergence theory, see the earlier rejected exogenous growth model of Solow and Swan (Fagerberg et al. 2010), might work after all because of the free and widespread access to knowledge and technologies via the internet. The knowledge itself is available to local companies in India. Despite policy recommendations, which are in line with the findings in the cases in chapter 3 of this report, the question remains as to what extent the government will be able to reach SMEs.

Innovation climate

How then can the innovative capacity of SMEs in developing countries be increased? According to the World Bank, an efficient innovation policy by governments will address the overall innovation climate, which goes beyond traditional science and technology policy. At the same time, government action can usefully focus on a few generic functions to help SMEs to grow. It can facilitate the articulation and implementation of innovative initiatives since innovators need basic technical, financial and other support.

The government can reduce obstacles to innovation in competition and in regulatory and legal frameworks. Government-sponsored research and development structures can respond to the needs and demands of surrounding communities. Finally, the education system can help form a receptive and creative population. Regarding actual innovation policy development, there has been a considerable amount of work in developing countries, such as the World Bank (2010) report 'Innovation Policy: A Guide for Developing Countries'.

The lack of relevant education is a problem for the companies interviewed, who feel there are insufficient skilled workers and operators to work with modern machines. SME owners and managers complain that university and college graduates do not have the required technical and craftsman's skills, exposure to modern technologies, or an entrepreneurial and creative attitude.

As mentioned earlier, several ministries and agencies are engaged in efforts to develop and promote innovation policy, usually labelled as Science, Technology and Innovation (STI) policy. Despite considerable effort in developing strategies and plans, actual implementation is challenging, due to the limited availability of public budgets and knowledgeable staff.

Nearly all SME owners and managers suggest that creating a stable and predictable institutional context would be an efficient and effective way to promote innovation in India. All kinds of innovation policies and programmes could be developed, but the results of such policies will be undermined by the weak and unreliable wider formal institutional context.

Another policy idea emerging from the DFID project is that several owners and managers suggest not to focus on governmental policy makers only but on direct advice to SMEs on how to improve their business. One idea is to develop non-governmental business information exchange networks and platforms, establishing contact between entrepreneurs in India and beyond, to facilitate discussion and deals within the various sectors. SME owners suggest that the DFID project could establish a network of all SME owners and managers contacted during the implementation of EIP-LIC and create a website for them to stay in touch with each other.

4 Innovation Systems

The ‘Innovation System’ team produced four scientific papers with special reference to Vietnam. The scientific papers within the ‘Innovation Systems’ in Vietnam were based on data from two main sources: (1) the World Bank Enterprise Survey (ES) conducted between November 2014 and April 2016 and (2) the Innovation Capabilities Survey (ICS) conducted from October 2016 to February 2017. The research findings of each paper are discussed and policy implications are reviewed in the paragraphs below. The associated policy briefs and many others are listed in the project website.

4.1 Total factor productivity spillovers

The first scientific paper within the ‘Innovation Systems’ theme addresses the economic impact of trade liberalisation policies on productivity of firms. A thorough understanding of the economic impact of any policy that affects firm productivity, including trade policy, requires research into the direct effect of that policy, as well as an understanding of the various channels through which the effect of such a policy can diffuse throughout the economy. In this regard, trade policy can have an effect on the productivity of a company whose import tariff is affected, but potentially also have an (indirect) effect on the productivity of other firms with which the company interacts. Therefore, even firms not directly affected by the productivity enhancing policy can experience an increase in productivity, through their interaction with a firm that is directly affected by the policy.

The research analysed firm-level data of the manufacturing sector in India, a country with similarities to Vietnam in terms of economic growth, human capital and growth ambitions of the government. The paper builds on existing research that has identified the positive (direct) effect of trade liberalisation on firm productivity. In particular, the empirical evidence supports the hypothesis that competitive pressures due to lower import tariffs on a firm’s final good, as well as access to better inputs because of lower import tariffs on the firm’s intermediate goods, raises the firm’s productivity. This research goes beyond this direct effect of trade liberalisation and examines whether productivity growth at the firm level has positive (or negative) spillover effects on other firms. Such spillovers take place when one firm’s productivity has an effect on the productivity of another firm. The team used the positive correlation between import tariffs and firm-level productivity as an exogenous source variation in firm-level productivity, in order to estimate the size of TFP spillovers in the Indian manufacturing economy. The original DFID research project working paper is entitled ‘Total Factor Productivity Spill-overs in India’ (2014) by Marijke Bos, Benedikt Goderis and Gonzague Vannoorenberghe.

Research approach and findings

The aim of the research is to determine whether the Indian economy benefitted from trade liberalisation not only through the direct effect on firms most exposed to international trade, but also through additional spillovers from the firms directly affected to other firms in the economy. The authors use a comprehensive dataset of Indian manufacturing firms and employ a spatial econometric technique to estimate the strength of inter-firm TFP spillovers. International trade policy (lower import tariffs) is used because of its exogenous nature, which is needed for consistent estimation of the effect of one firm’s TFP on another’s. Evidently, if spillovers exist, there could also be an effect of the latter firm’s TFP on the former firm’s TFP. The researchers correct for this by using the so-called Instrumental Variables technique, where the import tariff is used as the instrumental variable.

The research team considered several ways in which such spillovers could occur. Spillovers can arise among physically neighbouring firms, as observing new products or best practices is easiest at close quarters. Knowledge can also be transmitted across firms through the movement of labour, or through cheaper or better

quality inputs in a vertical (supplier-buyer) relationship. Consequently, the paper estimates the spillover strength of three different channels: (1) spillovers through observation of neighbouring firms, (2) spillovers through the movement of labour between firms or (3) spillovers through cheaper or better quality of inputs in a vertical relationship. The study uses a weighted average of 'neighbouring' TFP as the spillover term. A positive effect of this spillover term on the original firm's TFP indicates that there are positive spillovers in that spatial dimension. For every channel, the authors define the relevant spatial dimension. Consider the example of a firm dyeing textiles in the province of Kerala. The first channel tests whether this firm's TFP is affected by the average TFP of firms located within a 50 km radius (the authors also use 100 km or the same state as a relevant geographical space). The second channel uses the average TFP of all other firms located in the same state, and tests whether TFP spillovers differ between a state like Kerala, where restrictions to labor mobility are low and a state like Gujarat, where constraints to labor mobility are much more severe. The third channel uses the average TFP of all input supplying firms (for example the dye producers).

In line with previous research, the authors confirm the presence of a direct effect of input and output tariffs on firm-level TFP. The research of the Tilburg University team, however, finds no evidence in favour of TFP spillovers between Indian firms. In contrast to the existing studies, which look at other countries and focus mostly on Foreign Direct Investment (FDI), the Tilburg University team did not find evidence in any of the abovementioned channels in the short run.

Because the empirical model takes an average of TFP of neighbouring firms as the spillover term, the zero result may be driven by the firms that have only a few neighbours. Theoretically, it may be possible that spillovers only occur when there are many other firms' TFP in the average. However, even for the sub sample of firms with many neighbours, the researchers found no spillover effect. '... A decrease in the tariffs on the goods produced by a firm, called the output tariff, raises the competitive pressure from abroad - which can affect TFP either way (e.g. lower scale or higher incentives to innovate) - and may give rise to learning...'. (Bos et al. (2014)

Policy implications

Gaining deeper insights into TFP spillovers is informative for innovation policy with a view to raising productivity, for two reasons. First, it is key to quantifying the total gains from trade liberalisation policies. When there are both direct and indirect effects, leaving out the indirect effects may lead to overestimation (if the indirect effects are positive) or underestimation (if the indirect effects are negative) of the total gain from the innovation policy. For example, a common strategy for identifying the total effect of a trade liberalisation policy on productivity is to compare those firms affected by the policy to those firms not affected. The difference is then reported as the total effect.

If the latter group is indirectly affected, however, the measured difference is actually the total effect minus the indirect effect, thus only the direct effect. Second, the strength of diffusion matters for the distributive consequences of a policy, the more so if the firms directly benefiting (e.g. the importers) systematically differ from other firms ex-ante. A policy with only a direct effect would then benefit one group, whereas if the spillovers affect the productivity of another group, the benefits from the policy would be distributed more fairly.

When innovation and productivity growth within firms spread within an economy, via spillovers, the overall TFP growth speeds up and therefore total economic growth does likewise. Whereas in theory, there may be different channels for TFP to spill over, the research team found no evidence for spillovers during the episode of trade liberalisation in India.

For policy makers, it is therefore essential to be cautious and conservative when estimating the total spillover effect among firms of trade liberalisation as one way to promote innovation and raise productivity. If policies

are evaluated based on a cost-benefit analysis, and this includes some estimation of the positive effects on other firms, the benefit may be overestimated. This would result in the implementation of policies which will not live up to expectations.

The methodology not only provides a better understanding of the consequences of a particular episode of trade liberalisation in India, but acts as an instrument to identify spillovers arising from any kind of policy. Policy makers could apply this instrument to examine different channels through which such spillovers are commonly thought to arise, namely through observation or labour mobility between neighbouring firms or through intermediate input use.

Given the theoretical possibility that spillovers can exist (this research is only the second to examine inter-firm spillovers between domestic firms in a developing country), further research and insights on this topic are essential for policy making. The existing literature on spillovers between domestic firms is limited, but of great importance when examining the total beneficial effect of innovation policies. Expanding this type of research to different countries and different time periods would enable researchers to examine whether this lack of spillovers is specific to the Indian case in the early '90s, or whether this is a more general phenomenon that is supported by robust evidence.

In particular, such further research should also give insight into the ways in which institutional factors may hamper spillovers. The lack of TFP spillovers may thus not only have implications for policy, but may also imply that policy or institutional changes can be devised to facilitate and enhance spillovers between domestic firms. The absence of such spillovers may be the result of a complementary institutional context not sufficiently conducive to spreading innovations. This requires a complementary holistic view in policy analysis.

The results of this paper can be generalised to any policy, not just to trade policy. In particular, a key question regarding spillovers is: 'as a result of a given policy or other event, if the TFP of a single firm is increased, will this have a positive effect on the TFP of other firms in the economy, even when they are not directly affected by the policy?'. Further research into the institutional factors affecting the lack of spillovers in India may inform policy to promote growth through TFP spillovers between firms.

4.2 Adoption of ISO 14001 standards in Indian manufacturing firms

The second scientific paper within the 'Innovation Systems' theme addresses the adoption of ISO 14001 standards in Indian manufacturing firms. Voluntary environmental initiatives by firms are often viewed as important for environmental management in developing countries such as India with weak regulatory institutions and poor enforcement of environmental laws. Past research shows that while such initiatives may not be able to fully substitute for strong regulation, they could be useful complements to reduce environmental degradation in developing countries. In spite of being ranked seventh in terms of number ISO 14001 certified firms, little is known regarding motivations of Indian firms to adopt ISO 14001 standards.

Using theoretical insights from management and policy literature, the research hypothesized that pressures from international markets predominantly drive ISO 14001 adoption among Indian manufacturing firms. The research studies the adoption of the ISO 14001 standards certification among the Indian manufacturing industries. The research team hypothesizes that the likelihood of adoption of ISO 14001 standards among Indian manufacturing industries is a function of internal firm characteristics, input and output market pressures, and regulatory pressure. The original working paper is entitled 'Adoption of ISO 14001 standards in Indian manufacturing firms' by Rama Mohana R Turaga and Vishal Gupta of the Indian Institute of Management Ahmedabad.

The team tests the hypotheses by using the EIP LIC survey of 1000 (large, medium, and small) manufacturing firms across the country. Results show that internal firm characteristics such as large size and firm innovation have a positive association with the likelihood of adopting ISO 14001 standards. The research finds that exporting firms are more likely to adopt ISO 14001 standards than others. Output market pressures, such as exporting to foreign markets, also positively impact the likelihood of obtaining ISO 14001 certification. In particular, exporting to China, which is ranked first in the number of ISO 14001 adoptions, has a statistically significant impact on probability of adoption. \

There is no evidence, however, that predominantly consumer-facing firms, another potential indicator of output market pressure, are more likely to adopt ISO 14001 standards. The research also finds that while exporting firms are more likely to adopt overall, there are differences based on size with small exporting firms no more likely to adopt ISO 14001 standards than their non-exporting counterparts. The research results show that small firms may not have enough incentives to adopt such voluntary measures even when they are exporting to international markets.

State-fixed effects, potentially capture the variation in both formal and informal regulatory pressure across states. Thus, consistent with other research in developing countries, the research team finds that pressure to meet the environmental standards of countries to which firms in developing countries export their products acts as a strong incentive to adopt voluntary environmental initiatives such as ISO 14001 standards. The lack of evidence that consumer-facing firms are no more likely to adopt ISO 14001 standards potentially indicate that firms in India do not yet find the green consumer markets large enough to adopt such initiatives.

Policy implications

In Indian context, there is evidence for example that implementation of ISO 14001 standards may lead to lower pollution. Broadly, the results indicate market pressures may not induce small firms, which contribute significantly to industrial pollution in India, to undertake voluntary initiatives. This suggests need for policy action to facilitate implementation of more formal environmental management systems in small firms through technical assistance and subsidies.

Because of their ability to generate employment, policy in India has generally favoured small firms; these firms, however, contribute a large share of pollution. Small firms are also subject to less regulatory scrutiny because of their sheer numbers as well as the perception that they may not have the resources to undertake pollution control activities. In such a regulatory environment, voluntary initiatives such as ISO 14001 are expected to partly substitute for weak regulations.

Thus one implication is that market pressures are unlikely to work as well with small firms as they might with larger firms and one can argue that there is a case for policy interventions. Indian governments (federal and state) already provide subsidies to small scale industries to set up common pollution control facilities in order to achieve economies of scale. The results show that there may be a case for extending such subsidies to encourage small and medium firms to adopt ISO 14001 certification.

Another result with regards to firm size with potential policy implications is the finding that small firms with ability to innovate (proxied by patents) are more likely than other small firms to adopt ISO 14001. This should of course be interpreted with caution given the really small sample of patented small-scale firms in the sample. Nevertheless, this finding may suggest that in addition to (or instead of) direct subsidies to adopt ISO 14001 standards, government may want to implement policies that improve the innovation capabilities of small firms. In addition, providing technical assistance may also facilitate improve the innovation capabilities of small firms.

The improved innovation capabilities will have additional benefits in terms of more generally improving competitiveness of small firms.

4.3 Institutional voids and innovation drivers

The third scientific paper within the ‘Innovation Systems’ theme addresses the issue of innovation drivers within an operating context of institutional voids. A growing stream of research has highlighted the importance of the institutional context on innovation and entrepreneurship. Formal institutions provide a policy and regulatory framework for economic development, which includes governmental innovation policies such as intellectual property rights and “legally sanctioned” patent laws, amongst others.

However, low income countries (LICs) are often characterised by ‘institutional voids’, the absence of such formal regulatory institutions. Against this background, it is critical to understand how entrepreneurs continue to engage in innovation by working with a range of informal institutions. Several strands of literature focus on understanding these institutions, which are classified as either normative or cognitive. Normative institutions are “morally governed” value systems and preferences, giving a prescriptive, obligatory dimension to social life, while cognitive institutions are recognisable, accepted habits, i.e. “how we do things around here.” Both perform functions that structure and regulate human interaction in the innovation process, providing predictability and stability, and disseminating (technical) information.

The research investigated how entrepreneurs of small and medium-sized businesses in India work within a context of institutional voids. The qualitative research (case studies) explored how informal institutional mechanisms take over the functions of formal regulatory institutions. The original working paper is entitled ‘Emerging Economies, Institutional Voids, and Innovation Drivers: A Study in India’ (2017) by Jaap Voeten, Abrar Ali Saiyed and Dev K. Dutta.

Research approach and findings

The team conducted a series of in-depth qualitative interviews with entrepreneurs in the manufacturing sector in Gujarat State in India in 2016. Based on analysis of the case studies, five key institutional voids are identified that entrepreneurs must bridge: (i) the absence of explicit and formal innovation policy frameworks and governance directions; (ii) the absence of technical support and interaction with formal science and technology organisations; (iii) the absence of trusted governance institutions, with regard to administrative issues, registration, patents and taxation, amongst others; (iv) the absence of the social and economic safety net provided by regulatory institutions, and (v) the absence of formal credit institutions for innovation financing.

Policy implications

Innovation policy makers should acknowledge and address the presence of regulatory institutional voids, and the response of entrepreneurs, who take recourse to a range of normative and cognitive institutions to support their innovation efforts. Entrepreneurs do demonstrate a careful, proactive approach in developing and implementing the firm’s innovation imperatives and engage in short-term incremental technology adoption/adaptation and related management practices. The entrepreneurs apply family and personal reference frameworks and local cultural values, and mirror international quality standards to fill the regulatory institutional void with regard to their innovation ambitions, motivation and learning process.

Informal information sharing about new technologies with trusted business partners, professional and personal network contacts, and the internal labour force replaces the knowledge provision of formal science and technology organisations. Behaving independently while avoiding government interactions and keeping innovations hidden replaces trust in a government that is facilitating and supporting SMEs in terms of legal, tax and administrative issues. Concluding informal settlement arrangements to overcome temporary financial constraints with business partners or personal contacts replaces the social security systems of regulative institutions.

Innovation policy makers in government are often aware that their policies do not reach small and medium business owners and managers on the scale they plan. The acknowledgment of the existence of institutional voids will help them to take a more holistic approach, instead of developing only formal science technology and innovation (STI) policies based on the innovation systems concept, more applicable in advanced countries. One original approach is to complement the informal institutional framework with a formal institutions, instead of overruling them. One example is the formal acknowledgement in inclusion of family ties in the innovation policies. Another more regular avenue is to address institutional weaknesses such as the absence of long term governance directions, interaction with formal science and technology organisations, trusted governance institutions, and social and economic safety nets.

4.4 Gender diversity and innovation

The fourth scientific paper within the ‘Innovation Systems’ theme analyses the relationship between gender diversity in the ownership, management and workforce structure at the firm level and women’s economic opportunity at the country level to improve innovation outputs. In present theory, there is an implicit assumption that higher levels of women’s economic opportunity at a country level enable firms to better render the benefits gender diversity can bring for innovation. The original working paper is entitled ‘Gender Diversity and Innovation: The Role of Women’s Economic Opportunity in Developing Countries’ by Daniela Ritter-Hayashi, Patrick Vermeulen and Joris Knoblen.

Research Findings

The research shows that gender diversity at all levels in the organization has a positive effect on innovation in the firms surveyed in low and lower-middle income countries in South Asia, Africa and the Middle East - despite their below-average performance on a world-wide scale of measuring women’s economic opportunity. Furthermore, the research illustrates that a country’s level of women’s economic opportunity plays an important role in the relationship between gender diversity and innovation.

On the one hand, the results put forward that the positive effect of gender diversity on firms’ innovation likelihood is amplified with increasingly equal opportunities for women. On the other hand, both gender diversity in the ownership structure and in the overall workforce can have a negative effect on a firm’s likelihood to innovate if the firm is operating in a country with very little economic opportunity for women.

It needs to be however pointed out that, extrapolated from this study, gender diversity only has a potential negative effect on innovation in a handful of countries worldwide, ranging at the bottom of the women’s economic opportunity ranking (lowest 5 countries for gender diversity in the workforce and lowest 15 countries for gender diversity in the ownership structure).

Policy Implications

Based on the research results, it is essential to acknowledge the value of gender diversity for innovation and to create awareness among managers and employees that innovation emerges and blossoms from gender diversity at the firm level. Government agencies could develop special policies and programs which encourage and support firms in hiring a more gender-balanced workforce, having more female top managers and supporting firms with a gender diverse ownership structure. This could take the form of awareness raising programs explaining the particular benefit of gender diversity for a firm's likelihood to innovate.

Furthermore, the introduction of tax advantages, subsidies or other incentives targeted at increased gender diversity at all hierarchical levels within a firm could be a driver for increased gender balance. Once awareness is raised at the top ranks of firms, it is pivotal that managers initiate a change of attitude and organizational culture top-down, encouraging women to voice their opinion, urging men to value women's viewpoints and knowledge in the innovation process, and reassuring management on the importance of promoting both men and women based on their performance rather than their gender.

It is crucial to encourage increased levels of women's economic opportunity at a country level as a prerequisite for gender diversity to benefit innovation. Potential avenues are increased access of women to education to decrease the gap in knowledge between men and women. Governments could initiate country-legislation enabling women to better balance family and work demands such as improved childcare as well as maternity and paternity leave. An additional avenue for policy makers is to encourage a social perception of women as being equally valuable members of society like men, with the same rights and obligations.

On a practical level, supporting networking activities through women entrepreneurship associations seems an effective instrument to strengthen women's determination to pursue ambitions. Moreover, establishing programs in which women entrepreneurs lend support to girls on their way of obtaining education can be of advantage. This can take the form of financial support and motivational reinforcement for the girls themselves. Similarly, successful women entrepreneurs can serve as a role model to girls' families, which may be hesitant to invest in their daughters schooling based on traditional gender norms and expectations. Moreover, to change the overall public perception of women entrepreneurs while aiming at a ripple down effect to their immediate surrounding and support system, campaigns celebrating the success of women starting a business can be a further avenue to strengthen their societal position.

5 Finance for Productivity Growth

The ‘Finance for Productivity Growth’ team produced three scientific papers with special reference to Vietnam. The first paper addresses income variability in a field experiment in Vietnam. The second paper analyses informality and access to finance in India, a country comparable to Vietnam as explained below. The third paper discusses access to finance and the demand for skill. The research findings of each paper are discussed and policy implications reviewed in the paragraphs below. The associated policy briefs and many others are listed in the project website.

5.1 Informality and access to finance

The first scientific paper within the “Finance for Productivity Growth’ theme analyses the interplay between informality and access to finance. The research explored financial sector development in the formal and informal manufacturing sector in India, which is comparable with Vietnam in the sense that both countries have an large informal sector and informal ways of finance. The original working paper is entitled ‘Informality and Access to Finance: Evidence from India’ (2014) by Thorsten Beck and Mohammad Hoseini. This policy brief provides the research approach, main outcomes and policy implications of the paper.

Actually, a large share of private sector activity in LICs takes place in the informal sector, which almost always has negative economic and development consequences. There is among others a large productivity gap between formal and informal firms. The productivity is higher in the formal manufacturing sector due to access to better formal services. However, firms have to pay ‘entry costs’ to overcome the barrier to formality. This barrier includes registration costs, indivisibility of investment and formal property claims, where the latter enables entrepreneurs to use assets as collateral and thus gain access to formal finance. Informality can indirectly hamper firm growth through the lack of provision of public services and infrastructure caused by deficits in the government revenue.

Research approach and outcomes

The informal sector suffers from the lack of access to formal sources of external finance too. One of the important differences between formal and informal enterprises, is that around 44 percent of informal enterprises considers access to financing as the main obstacle of doing business, whereas this number is 21 and 14 percent for small and large formal enterprises. It is not clear, however, whether the lack of access to formal finance discourages entrepreneurs from entering the formal economy, or whether informality prevent them from accessing formal finance.

Better access to financial services is assured through financial sector development, also referred to as financial deepening. This constitutes an increased provision of financial services and institutions with a wider choice of services geared to all levels of society. Beck and co-authors earlier found a positive relationship between financial deepening and economic growth in LICs, a relationship that goes more through productivity growth than capital accumulation.

Other previous research work and theory suggest an impact of financial deepening on pulling more firms into the formal sector as well as increasing total production of the formal sector.

The DFID research of Beck and Hoseini focussed on the effect of financial development on formal and informal manufacturing firms and explores two dimensions of financial development namely outreach (the ease of access to financial services, including credit) and depth (the overall formal credit volume in the economy). The research involves firm-level data between 1989-2010 from different regions in India with different levels of depth and outreach allowing a cross-regional comparison with regard to incidence of informality.

Overall, the empirical findings suggest two positive effects of financial deepening on the incidence of formality in manufacturing: reducing barriers to formality and increasing productivity. The research results show that both depth and outreach are important but in a different way.

Financial outreach - measured in the research as branch penetration - helps to reduce formality barriers and thus increases the number of formal firms. Theory already suggested that one effect of access to finance enables firms to overcome the costs of formality. This is especially the case in industries with a higher demand for external finance. Given the importance of geographic proximity in lending relationships especially of smaller firms, small firms stand to benefit more from financial outreach than large firms. There is no significant effect on productivity for branch penetration.

Financial depth mainly affects informality through increasing productivity of industries dependent on external finance. There is a lesser effect on reduced informality. Thus in conclusion, financial deepening increases the productivity of formal sector and reduces informality.

Summary research outcomes

	Outreach	Depth
Reduced informality	++	+
Productivity	0	++

Policy implications

The working paper of Beck and Hoseini confirms the policy assumption that promoting the informal manufacturing sector to become formal will raise productivity and economic growth. A formal sector, and entrepreneurs choosing to become formal, implies more commitment to the firm’s survival and consequently a more stable economic sector. Formality also means tax revenue with government can use for developing public services and institutional stability. A formal economy brings benefits for its workforce too. Formal companies usually have an organised system of employment with written rules and has a standardised relationship between the employer and the employee is maintained through a formal contracts.

The research suggest that government policies towards financial deepening can play an important role in reducing informality, though with important differences across industries. A key insights of this paper is that broadening access through outreach plays will have a more important effect on reducing informality than financial depth. In particular, access to bank account makes the operation of firms at least partly observable and reduces the information asymmetry between firm and formal agency. This particularly the case for smaller firms that face high entry barrier to the formal sector. Decentralisation policies of the banking sectors, establishing easy accessible small branches in the more remote areas, is one way forward. Policy of government, but also the policies and strategies within state or private banks, may focus on the ease of access to financial services, including credit.

In terms of promoting raising productivity, a policy implication is to focus on financial depth; increasing the overall formal credit volume in the economy. The working paper demonstrates that financial depth promotes economic growth in LICs via increased productivity of firms.

The working paper is also informative for policy makers with regard to their expected impact of their policies. Policy makers should not expect that policies aimed at outreach will increase productivity. The same holds true for the development of financial depth, such policies will have a modest effect on reducing informality of enterprises.

In addition, the outcomes of the working paper can be further discussed in the context of the different stages of economic development. In factor-driven economies, where informal labour intensive enterprises compete in terms of factor endowments. These informal enterprises process raw materials and have low productivity, while the urgency for efficiency is not so evident. Then outreach oriented policies seems to be the logical way to promote formality. In the next stage of economic development, efficiency-driven economy, more enterprises are formal while the incomes the skilled labour force have risen. In this stage, price competition by production efficiency and products services quality is critical, so raising productivity becomes important. Policy making within an efficiency-driven economy aiming at raising productivity, developing financial depth is a more effective option than outreach.

5.2 Income variability – a field experiment

The second scientific paper within the ‘Finance for Productivity Growth’ theme with relevance to India analyses income variability in Vietnam. Small poor entrepreneurs in the developing world are vulnerable to a range of negative shocks and constraints associated with a lack of development. They spend most of their lives coping with frequent income disruptions, balancing expenses, and making difficult trade-off decisions. This is not without implications; some studies suggest that entrepreneurs' preoccupations with pressing budgetary concerns and income variability could leave them with a reduced mental capacity to guide their decision making in business management.

A team of researchers from Tilburg University explored the issue of income variability in Vietnam and which possibly impedes the cognitive functioning of low-income individuals. The research was conducted through a field experiment inducing thoughts about finances to a sample of small low-income retailers in their local setting. The intervention consisted of asking retailers to think about scenarios describing a financial situation they might encounter in their daily lives.

The experiment was carried out in May 2015, in Tam Bac Market, one of the biggest markets in Hai Phong, in northern Vietnam. The original working paper is entitled ‘The Right Amount of Income Variability: Evidence from Small Retailers in Vietnam’ (2016) by Patricio Dalton, Nguyen Nhung and Julius Rüschenpöhler.

Research approach and findings

The results, confirmed in earlier literature, suggest that a lack of financial resources does not necessarily impede cognitive functioning. Cognitive performance in financially stressful situations is not affected by absolute poverty as measured by wealth or income.

Instead, what seems to create cognitive stress is the subjective feeling of poverty together with the variability of income. Cognitive performance in financially stressful situations has an inverted U-shaped relationship with income variability: being exposed to very low or very high income variability can be detrimental for cognitive capacity. There seems to be an optimal income variability which maximises the cognitive capacity of the retailers when they face financially stressful situations, which impede their cognitive functioning.

This points to the existence of an optimal degree of income variability. Retailers who are used to facing some intermediate degree of fluctuation in their revenues reach the highest cognitive performance when they are confronted with financially stressful situations. The effect of income variability on the cognitive function of low-income retailers remains valid even for the poorest retailers.

Policy implications

The research has policy implications to safeguarding the cognitive functioning of people on low incomes. The underlying idea is to avoid their cognitive functioning being unintentionally harmed as a result of financial, fiscal or income generating policies and programmes.

Assuring an optimal amount of income variability to assure maximum cognitive functioning: the effectiveness of policy and programmes that focus on the beneficiaries' lack of financial resources, for instance, could be increased if income variability is also given careful consideration.

In concrete terms, it is preferable for policies and programmes to include an assessment of the optimal (context-specific) income variability. This depends, amongst other factors, on the macro-economic environment and beneficiaries' educational background. Finding, monitoring and assuring the right amount of income variability may substantially increase the effectiveness of a given policy or programme.

Alternatively, in measuring the impact of finance policies and programmes, an indirect indicator of success can be an increase in cognitive capacity in combination with income variability. This equally relates to entrepreneurial activity. Risk taking is central and related to cognitive capacity in terms of understanding and interpreting the economic context. Thus maximum cognitive capacity, risk taking and innovation are all linked to optimal income variability.

Stability and maintaining the status quo of income variability is also an issue to be considered in new policies and programmes. For instance, new fiscal policies can in fact create additional cognitive stress if they bring lower or higher income variability. This is the case if government regulations change often or are unclear, which often happens in LICs, and was signalled in the various cases in the EIP-LIC qualitative studies in Vietnam. Entrepreneurs complained a great deal about unclear and constantly changing government policies and regulations, which brought changes in income variability – “time and again the government regulation is a headache.”

5.3 Learning from peers – a field experiment

The third scientific paper within the “Finance for Productivity Growth” theme with relevance to India addresses the barriers to growth for MSEs and policies to alleviate them is therefore an important research and policy goal. Numerous business training programs have been developed and implemented across the globe to foster entrepreneurship through better business skills. Yet, the results from these training programs have not yielded consistently positive impacts. Most research studies conclude with small and statistically insignificant effects of managerial training on sales and profits, and in particular on the adoption of business practices.

The study takes an original approach to improving business skills, recognizing the value of locally relevant information as a crucial input when encouraging the adoption of business practices. Instead of teaching set courses, the study design focuses on helping businesses learn profitable practices from their successful peers. These peers are very similar to the ultimate beneficiaries in terms of business type, size, entrepreneurial characteristics, and geographic location. Specifically, the research addressed the question whether small-scale businesses can learn and adopt profitable practices of their successful peers. The study identified such practices through a detailed business survey in urban Indonesia and disseminate the information to a randomly selected sample of small retailers through a professionally developed handbook. Additional support through business role models, and another through individualized business counseling.

The original working paper is entitled 'Learning Business Practices from Peers: Experimental Evidence from Small-scale Retailers in an Emerging Market', by Patricio Dalton, Julius Rüschenpöhler, Burak Uras and Bilal Zia.

Research approach and findings

In the first stage of research, the research team identified business practices that best predict profitability among a cross-section of small-scale retailers in urban Jakarta, Indonesia. The quantitative and qualitative insights were combined for the development of a professionally developed handbook on best business practices.

Second stage is the randomized controlled trial (RCT) involving the hand as the main ingredient. As part of this RCT, 1040 retailers out of the baseline sample were provided a free copy of the handbook while the remaining 261 served as a control group. A first sub-set of handbook recipients was exposed to business role models from the Jakarta retail sector, who in a video describe their own trajectory of business growth after having implemented a subset of the best practices that are highlighted in the handbook. A second sub-set of handbook recipients was provided individualized business assistance by trained counselors. These counselors provided one-on-one implementation guidance and troubleshooting for the business practices highlighted in the handbook, hence facilitating learning through own experience. Finally, in order to test for complementarities the team offered a third sub-set of handbook recipients both role models and counseling treatments. Overall, this study design allows to test different channels of disseminating relevant business information.

Instead of offering a formal business course, the research disseminated the top practices in a handbook with the help of role models and personalized counseling. This makes the study unique in several dimensions. It is low-cost, for both policy makers and beneficiaries. It is relevant, as the business practices are the practices that work for this local population of small retailers in Jakarta. It is idiosyncratic to the local context - for instance in terms of habits and norms - and it can be replicated and scaled up without much logistical effort or substantial monetary cost.

Regarding the best practices at baseline. The team observes that while there is large variation in both business performance measures and business practices across the sample, there are certain types of business practices that strongly predict business profitability. For example, implementing record-keeping practices is associated with additional monthly profits of between 26% and 45%. Likewise, developing a fixated schedule for the purchase of the firm's main products, never running out of stock of these main products, and stocking up daily rather than weekly, are associated with higher monthly profits in the range of 25% to 37%. Moreover, the handbook synthesizes relevant practices of successful peers and provides guidance on how to adopt them.

The team hypothesizes that these two facilitation methods work through different channels and affect different types of business practices. The role models treatment relies on observing and learning from the successful experience of others. The team specifically tests whether role models can facilitate the adoption of successful business practices among urban business owners. It is hypothesized that the practices best influenced by role models are those that can easily be observed and adopted, specifically practices related to marketing and sales. In comparison, a counseling treatment relies on learning by doing and facilitation through individual expert attention. The research team further hypothesized that the practices best influenced by counseling are those that require significant learning by doing and which are harder to adopt through simple observation, such as book-keeping and accounting.

The study finds a significant increase in the adoption of profitable practices in all sub-groups of retailers. Moreover, while the handbook alone does not lead to significant performance gains, it finds that supplementary role models and business counseling improve sales and profitability. Social learning is possible when retailers are able to either observe successful peers implementing the practices or to implement the practices with personalized assistance. Social learning is recognized as an important avenue of business growth, especially concerning the adoption of new technology. This study broadens the spectrum to study social learning of business practices among urban retailers.

Policy implications

The results of the study show that simply providing information on profitable local practices in the form of a handbook is not sufficient for achieving performance gains or promoting the adoption of profitable practices. Instead, the team finds that experiential learning in the form of business role models or personalized counseling is necessary for achieving success. The team also finds evidence consistent with a business-skills-based poverty trap, as the interventions are only successful for businesses who already were in the high end of the business practices distribution.

In terms of cost-benefit analysis, all interventions implemented in this study can be scaled up and replicated relatively inexpensively. The Handbook intervention cost approximately USD 100, the Role Model intervention cost and additional USD 25 and the Counselling cost an additional USD 25. Many of the costs are fixed and sunk, particularly the cost of developing the handbook. For any scale-up, the costs would therefore be considerably lower. The benefits that are identified after six months are up to USD 330 per month in profits, along with a high adoption rate of profitable practices. Hence, by all measures, business learning through the channels that are tested in this study is feasible for scale-up and wider use.

The study shows that it is possible to improve the profitability of small firms by disseminating information on the best practices of successful peers and using low-cost facilitation methods such as role models and personalized counseling to promote adoption. While the results show improvements in sales, the study does not detect changes in business expenses or the number of customers, which suggests that the improvement in performance outcomes is driven by the adoption of profitable business practices and the resulting efficiency gains. Indeed, the study finds that treated firms adopt up to eighteen new profitable business practices out of a total of thirty two practices in the study.

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Annexes

Annex 1: Series of EIP-LIC working papers

Innovation systems

1.	Bos, M. J. D., B. V. G. Goderis and G. C. L. Vannoorenberghe. 2014. Inter-industry Total Factor Productivity Spillovers in India. DFID Working Paper. Tilburg: Tilburg University.
2.	Barasa, L., P. Kimuyu, P.A.M. Vermeulen, J. Knoben and B. Kinyanjui. 2014. Institutions, Resources and Innovation in Developing Countries: A Firm Level Approach. DFID Working Paper. Nijmegen: Radboud University *)
3.	Osoro, O., G. Kahyarara, J. Knoben and P.A.M. Vermeulen. 2015. Effect of Knowledge Sources on Firm Level Innovation in Tanzania. DFID Working Paper (**)
4.	Osoro, O., S. Kirama, J. Knoben and P.A.M. Vermeulen. 2015. Factors Affecting Engagement and Commercialization of Innovation Activities of Firms in Tanzania. DFID Working Paper
5.	Barasa, L. P. Kimuyu, B. Kinyanjui, P. Vermeulen and J. Knoben. 2015 R&D, Foreign Technology and Technical Efficiency in Developing Countries. DFID Working Paper
6.	Vannoorenberghe, G. 2015, Exports and innovation in emerging economies, Firm-level evidence from South Africa. DFID Working Paper. Universite Catholique de Louvain and Tilburg University
7.	Daniela Ritter-Hayashi, Patrick Vermeulen, Joris Knoben Gender Diversity and Innovation: The Role of Women's Economic Opportunity in Developing Countries DFID Working Paper. Nijmegen: Radboud University
8.	Barasa, L., B Kinyanjui, J. Knoben, P. Kimuyu and P. Vermeulen. 2016. Export and Innovation in Sub-Saharan Africa. DFID Working Paper. Nijmegen: Radboud University
9.	Bos, M. and G. Vannoorenberghe. 2017 Imported input varieties and product innovation: Evidence from five developing countries
10.	Ritter-Hayashi, D., P. Vermeulen and J. Knoben. 2017. Success belongs to the Flexible Firm: How Labor Flexibility Can Retain Firm Innovativeness in Times of Downsizing. Working paper Radboud University
11.	Thuy M.T. Phung, P. Vermeulen, J. Knoben and Dat Tho Tran. 2017. Made in Vietnam: The Effects of Internal, Collaborative, and Regional Knowledge Sources of Product Innovation in Vietnamese Firms Working paper Radboud University
12.	Voeten, J, A. A, Saiyed and Dev K. Dutta. 2017. Emerging Economies, Institutional Voids, and Innovation Drivers: A Study in India. DFID working paper

*) Paper accepted in 'Research Policy': <http://www.sciencedirect.com/science/article/pii/S0048733316301986>

**) paper is accepted in 'Innovation and Development': <http://dx.doi.org/10.1080/2157930X.2016.1195086>

‘Finance for Productivity Growth’

1. Beck, T. H. L., H. Pamuk, R.B. Uras. 2014 Entrepreneurial Saving Practices and Business Investment: Theory and Evidence from Tanzanian MSEs. Tilburg: Tilburg University. Paper accepted in journal “Review of Development Economics”
2. Beck, T. H. L. and M. Hoseini. 2014. Informality and Access to Finance: Evidence from India. Tilburg: Tilburg University.
3. Beck, T. H. L., H. Pamuk, R.B. Uras and R. Ramrattan. 2015. Mobile Money, Trade Credit and Economic Development: Theory and Evidence (new title: “Payment Instruments, Finance and Development” R&R for Journal of Development Economics”). Tilburg: Tilburg University.
4. Dalton, P., Nguyen Nhung and J. Ruschenpohler. 2016. The Right Amount of Income Variability: Evidence from Small Retailers in Vietnam. Tilburg University.
5. Beck, T. H. L., M. Homanen and B. Uras, B. 2016. Finance and Demand for Skill: Evidence from Uganda. Tilburg University
6. Dalton, P., H. Pamuk, D. van Soest, R. Ramrattan and B. Uras. Technology Adoption by Small and Medium Businesses: Experimental Evidence from Mobile Money in Kenya.
7. Dalton, P., J. Rueschenpuller and B. Zia. Aspirations of Small Firms: Evidence from Jakarta
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10. Dalton, P., J. Rueschenpuller, B. Uras and B. Zia. Learning business practices from peers: Evidence from an RCT in Jakarta. (*)
11. Naveed Ahmed. Relationship Lending and Terms of Credit: Evidence from Firm Level Data in Bangladesh
12. Dalton, P., J. Rueschenpuller, B. Uras and B. Zia. Framing Effects and Small Businesses Performance: Experimental Evidence from Urban Indonesia (^)
13. Dalton, P., Ty Turley. Developing Goals for Development. Experimental Evidence from Small Cassava Producers in Ghana.

All papers are accessible at the EIP-LIC project website: <https://www.tilburguniversity.edu/dfid-innovation-and-growth/>

Annex 2: DFID/World Bank EIP-LIC survey India addressing the DFID research questions

**FACTORS IMPACTING THE INNOVATION ACTIVITY
AND INNOVATION PERFORMANCE OF
MANUFACTURING SMES IN INDIA**

INDIA COUNTRY REPORT

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FACTORS IMPACTING THE INNOVATION ACTIVITY AND INNOVATION PERFORMANCE OF MANUFACTURING SMES IN INDIA: COUNTRY REPORT

INTRODUCTION

In a world characterized by heightened competition, volatile economic and market conditions, rapidly changing technologies and fast changing consumer preferences, innovation has become of utmost importance for firm's survival and sustained competitive advantage (Indarti & Postma, 2013; Madrid-Guijarro, Garcia, & Van Auken, 2009; Rhee, Park, & Lee, 2010). Innovation is said to be one of the key differentiating factors between business organizations and other organizations (Rosenbusch, Brinckmann, & Bausch, 2011). At the organizational level, innovation is defined as the successful introduction and implementation of new and creative ideas and knowledge within an organization. The Oslo Manual defines innovation as (OECD 2005, p. 46): "Innovation is the implementation of any new or significantly improved product (goods or services), operational processes (methods of production and service delivery), any new marketing methods (packaging, sales and distribution methods), or new organizational or managerial methods or processes in business practices, workplace organization or external relations". Innovative firms are essential for advancing living standards and wealth creation in societies and are a prerequisite for today's dynamic and competitive economies (Gronum, Verreyne, & Kastle, 2012; Madrid-Guijarro et al., 2009). As innovation is considered important for organization's growth and survival, it is becoming increasingly important to examine factors, processes and boundary conditions that contribute to the innovation of a firm (Ndubisi & Agarwal, 2014).

Innovation is particularly vital to small firms with limited resources (van de Vrande, de Jong, Vanhaverbeke, & de Rochemont, 2009). Small firms that do not embrace innovation within their core business strategy run the risk of becoming uncompetitive because of obsolete products and processes (Madrid-Guijarro et al., 2009). Small- and Medium-size Enterprises (SMEs) contribute in a big way to the development and growth of many countries through their ability to innovate new products and processes (Prajogo & McDermott, 2014; Zeng, Xie, & Tam, 2010). SMEs primarily have resource limitations, a fire-fighting mentality, informal strategies, and flexible structures and as a consequence, they tend to have a failure rate higher than that of large organizations (Terziovski, 2010). Innovation is likely to have positive impact on the performance of small and medium enterprises (SMEs). Despite a growing number of studies have started to examine the factors that impact innovation in SMEs, research that encompasses all the relevant constructs in an integrated manner remains rather limited (Prajogo & McDermott, 2014; Rhee et al., 2009). While it is broadly accepted that innovation contributes to positive outcomes and some research has been carried out on antecedents of firm innovativeness, the collective relationship between innovativeness and its key drivers remains underexplored (Hult, Hurley, & Knight, 2004; Lee, Park, Yoon, & Park, 2010).

Indian SME sector is a vibrant and dynamic sector of the Indian economy. It not only plays crucial role in providing employment opportunities at relatively lower capital cost than larger industries but also helps in industrialization of rural areas. SMEs are complementary to large industries as ancillary units and this sector contributes enormously to the socio-economic development of the country. The Sector today consists of about 36 million units and provides employment to over 80 million persons (SME Chamber of India, n.d.). SMEs also play a significant role in the development of the nation by enhancing domestic production, export earnings, reducing investment requirements, improving operational flexibility, enhancing location-wise mobility, reducing and substituting imports, enhancing capacities to develop indigenous technologies, enhancing defense production, and improving competitiveness in domestic and export markets, thereby, generating newer entrepreneurs by providing training and knowledge. This sector contributes about 8% to the annual GDP besides contributing 45%

to the total manufacturing output and 40% to the exports from the country (SME Chamber of India, n.d.).

Despite their high potential and capabilities to grow, Indian SMEs are facing a number of problems such as the sub-optimal scale of operation, rapid technological obsolescence, inefficiencies in the supply chain, increasing competitions at both domestic and global front, shortages in the working capital, inability to get trade receivables from large and multinational companies in time, lack of sufficient skilled manpower, changes in manufacturing strategies and turbulent and uncertain market scenario (SME Chamber of India, n.d.). To survive with such issues and compete with large and global enterprises, SMEs need to adopt innovative approaches in their operations. The manufacturing industry is the main driving force of economic growth and social development in developing countries (Zheng et al., 2010). While SMEs in the manufacturing sector make a significant contribution to economic growth, yet most of the research into innovation management in the manufacturing sector has focused on large organizations (Terziovski, 2010). In spite of India's impressive manufacturing output growth since the economic reforms in 1991, the share of manufacturing as a percentage of GDP has been relatively stagnant (Nagraj, 2017). Thus, in order to help them improve their competitiveness, it is essential that researchers explore the external cooperation network of manufacturing SMEs. Given the critical role of innovation in rapidly growing economies around the world and the increasing interest in doing business in Asia, understanding the factors that contribute to the innovation of firms in an emerging Asian economy such as India is worthy of investigation (Sok & O'Casey, 2011).

The present work aims to contribute to the understanding of the process of innovation and its contribution to productivity, growth and poverty alleviation in the institutional context of a developing country (India). The study of innovation, including the obstacles to its successful implementation, while relatively well researched in the industrialized countries is rather neglected in less-developed countries (Hadjimanolis, 1999; Minh & Hjortsø, 2015). The envisaged impact of the present study is to strengthen evidence based policy making on innovation and productivity issues in developing countries. Policy makers in developing countries often look upto the research done on SMEs in developed economies (Radas & Božić, 2009). However, an important question is to what extent the policy makers can rely on these findings. In the present study, we provide some light on this question by investigating factors that significantly impact innovation in SMEs in India, a rapidly developing economy.

METHODOLOGY

Sample and Data Collection

The data for the present study was collected using the Innovation Capability Survey conducted in the year 2016. Innovation surveys are among the surveys that have been used by economists, statisticians and other analysts to understand the reasons why firms innovate, the obstacles in the process of innovating, the sources of information for innovation, the cooperation in innovation and the importance of intellectual property rights (Mairesse & Mohnen, 2010). Innovation surveys were conceived to inform such policy by measuring and benchmarking innovation performance across countries. The 2016 India Manufacturing Innovation Capability Survey (the 2016 India ICS) was conducted in collaboration between the Tilburg University and the Enterprise Analysis Unit (DECEA) of the Development Economics Group of the World Bank. This is part of a wider project undertaken by the Tilburg University to study the innovative capability of manufacturing firms in ten countries selected from three regions - Ghana, Tanzania, Uganda, Kenya, South Africa, and Ethiopia from Africa, Bangladesh, and India from South Asia and, Vietnam and Indonesia from East Asia and Pacific⁶. The

⁶ Please see <http://www.tilburguniversity.edu/dfid-innovation-and-growth/> for more details.

project, which is funded by the British Department for International Development (DFID), is carried out in ten developing countries by Radboud University and Tilburg University in cooperation with local partners.

The 2016 India ICS aims at studying the innovative activities and innovative capabilities of manufacturing firms in India, by collecting firm-level data using a suitably designed questionnaire and following the DECEA’s global methodology of survey design. This survey is a follow-up to and complements the 2014 India Innovation Follow-up Survey undertaken by the World Bank Group. The data can be linked to the 2014 India Innovation Follow-up Survey (and the 2014 India Enterprise Survey (ES)) using the “IDSTD” variable, enabling a richer analysis of the links between innovative capabilities, innovation and the performances of manufacturing firms in the country.

The sampling strategy follows the standard ES global methodology of stratified random sampling¹. However, sample is drawn from manufacturing firms covered in the 2014 India Innovation Follow-up Survey (itself a sub-set of manufacturing firms covered in the 2014 India Enterprise Survey [ES])⁷. Therefore, sample is stratified based on firm size and location, unlike the standard ES sampling methodology which includes sector as one of the three stratifying variables. It is important to note that geographic wise this follow up survey covers 17 of the 23 states covered in the 2014 India ES.

The universe consisted of a total of 2076 manufacturing firms, out of which 1000 firms were randomly selected and interviewed. Firms are selected from all the regions covered in the 2014 India Innovation Follow-up Survey, and distributed across small (5 to 19 employees), medium (20 to 99 employees) and large (100+ employees) firms. Table 1 below provides distribution of the realized sample by region and firm size. Overall, the survey response rate is fairly good, with over 62% of the contacted interviews turned into completed interviews. Table 2 below provides a brief summary of the characteristics of the sample firms.

Table 1: Realized Sample for the 2016 India ICS

State	Size			Total
	Small	Medium	Large	
Bihar	20	19	2	41
Chhattisgarh	12	23	17	53
Delhi	19	38	10	67
Goa	4	11	9	24
Gujarat	36	30	3	69
Haryana	7	27	35	69
Jharkhand	8	25	12	45
Karnataka	9	31	28	68
Madhya Pradesh	13	34	20	67
Maharashtra	20	38	7	65
Orissa	10	19	20	49

⁷ Please see the World Bank’s Enterprise Survey website (<http://www.enterprisesurveys.org/data/survey-datasets>) for detailed information on the 2014 India Innovation Follow-up survey and the 2014 India ES. In particular, the implementation reports of the respective surveys contain useful information on the design and implementation of the surveys. Access to the raw data and the implementation reports requires having a log-in account.

Punjab	16	31	18	65
Rajasthan	8	46	21	75
Tamil Nadu	14	46	7	67
Uttar Pradesh	18	33	15	67
Uttaranchal	7	20	18	45
West Bengal	23	16	25	64
Total	246	487	267	1000

Table 2. Characteristics of Sample Firms (Sample Size = 1000)

Firm Characteristic	Description
Size	<ul style="list-style-type: none"> • Small (25%), Medium (47%), and Large (28%) • No. of full-time employees: Mean - 122, Median - 40, Maximum - 3700
Location	17 states represented; distribution across states is generally proportionate to the size of the state
Industry sector	19 manufacturing sectors represented; 10 sectors account for 85% of sample firms
Age	Mean age of 23 years, median of 20 years, newest firm is 3 year old, and the oldest firm was established in 1863
Ownership	<ul style="list-style-type: none"> • 28% of the sample firms are part of a larger firm • 98.7% of the firms are owned by domestic individuals, companies, or organizations; only 2 firms have some government stake and only 2 firms are 100% foreign-owned • About 15% of the firms in the sample have some level of female ownership; about 45% of these firms have 50% or more of female ownership.
Export Orientation	<ul style="list-style-type: none"> • 28% of sample have some levels of exports in 2012, exporting to more than 45 different countries; over a quarter (27%) of those firms export to the United States with UK and Germany (8% each) being the other major destinations • The mean value of exports in 2012 was ₹150 million (Standard Deviation = ₹500 million)
Annual Sales	<ul style="list-style-type: none"> • Mean annual sales (all sample firms) = ₹504 million, S.D. = ₹2.46 billion; • Mean annual sales: ₹1.55 billion (large), ₹125 million (medium), and ₹27 million (small)

The following are some of the highlights.

- The sampling firms more or less distributed proportionate to the size of the states; Rajasthan, a relatively small state, is an exception with a slightly higher share at 7.5%.
- Ten sectors out of the 19 industry sectors represented in the sample account for more than 85% of the sample firms.
- In terms of size, a quarter of the sample firms are small, almost half of them are medium, and a little over a quarter are large.
- The average age of sample firms is approximately 23 years; the newest firm is 3 years old and the oldest firm was established in 1863.
- Almost all the firms are domestically owned with around 15% of the firms owned by females.
- A little over a quarter of the sample firms export their products to other countries; the United States, the UK, and Germany being the main destinations.

In the next section, we provide the description of the analyses performed on the study variables as well as the results obtained. All the variables used in this report and their measurement are reported in Appendix A1.

ANALYSIS AND RESULTS

Innovation Activities, Performance, Capabilities, and Barriers: The Impact of Size and Industry Sector

In this section, we analyze how the firm size, and in some instances the industry sector, influence innovation activities, performance, capabilities, and barriers. Given that one of the main objectives of this report is to understand innovation from the perspective of SMEs, a comparative analysis of large and small and medium industries will provide insights relevant for policy.

Innovation Activities

Our surveys have two main measures of innovative activities that the firms undertake: Internal research and development (R&D) expenditures and external R&D expenditures. The questions ask whether the firms engage in these activities as well as the levels of expenditures on each of them⁸. The results (Table 3) show significant differences across large (94%), medium (86%), and small (75%) industries in terms of the percentage of firms that conduct internal R&D ($\chi^2 = 35.8$, $p < 0.001$). In general, much fewer firms (14% of sample firms) conduct external R&D, and even here, there are significant differences based on size with 22% large firms saying they conduct external R&D and only 7% of small firms saying so ($\chi^2 = 25.5$, $p < 0.001$).

Interestingly, although a greater proportion of large firms than small firms stated that they conduct internal R&D, there is no statistically significant differences in internal R&D expenditures across the three size groups ($F(2, 978) = 1.22$, $p = 0.29$). This perhaps indicates that conditional on deciding to spend on internal R&D, the resource commitments that the smaller firms make are similar to those made by larger firms. The story is somewhat similar in the case of external R&D expenditures as well. The results of analysis of variance shows that the differences across size categories is not statistically significant (at 5%) for external R&D expenditures ($F(2, 984) = 2.17$, $p = 0.11$).

Innovation Performance

⁸ The questionnaire defines internal R&D as “creative work undertaken to increase knowledge for developing innovative products and processes” and external R&D as “creative work undertaken by other enterprises, public or private research organizations, which was paid for by this establishment.”

We measure four types of innovation performance⁹. Overall, close to 60% of the sample firms stated that they introduced a new product or service in the last three years. This, however, differs based on size. As Table 4 shows, while 72% of the large firms reported introducing a product innovation, only 41% of small firms and 60% of medium firms introduced new products ($\chi^2= 53$, $p < 0.001$). The product/service innovation also varies by sector. In some sectors such as transport, electronics, fabrications, and machinery, more than 60% of the sample firms report introducing new product/service while in the case of paper industry the percentage of firms reporting product/service innovation is as low as 34%. In most other sectors with a reasonably large sample size, around half of the sample firms reported introducing product innovation.

The pattern is somewhat similar in the case of process innovation as well. A little over 60% of all the sample firms reported introducing process innovation with statistically significant differences across size categories ($\chi^2 = 33.4$, $p < 0.001$). As in the case of product innovation, a much larger percentage of large firms (72%) report introducing process innovation relative to small firms (48%).

Table 3. Innovative Activities and Size

Size	Internal R&D (Yes)	Mean Internal R&D Spending (₹) ^a	External R&D (Yes)	Mean External R&D Spending (₹) ^b
Large	93.6% (n=282)	2,056,997 (1.56e+07)	22% (n=280)	171,578 (1,364,456)
Medium	86% (n=471)	1,257,923 (1.65e+07)	12.6% (n=469)	82,963 (659,340)
Small	75.3% (n=247)	126,669 (388,224)	7.3% (n=247)	17,247 (121,149)
Overall	85.5% (n=1000)	1,205,165 (1.4e+07)	13.96% (n=996)	91,117 (852848)
	$\chi^2 (2) = 35.7$, $p < 0.001$	$F(2, 978) = 1.22$, $p = 0.29$	$\chi^2 (2) = 25.5$, $p < 0.001$	$F(2, 984) = 2.17$, $p = 0.11$

a,b Numbers in parentheses represent standard deviation

Table 4. Innovation Performance

⁹ (i) whether introduced a new product or service in the last three years (yes/no), (ii) whether introduced a new method of production in the last three years (yes/no), (iii) whether introduced a new organizational innovation or management practice in the last three years (yes/no), and (iv) the number of patents filed in the last three years (0, 1, 2, >=3).

Table 4a. Innovation Performance and Size

Size	Product/Service innovation (Yes)	Process innovation (Yes)	Organizational innovation (Yes)	Patents			
				0	1	2	>=3
Large	72.0% (n=282)	72.0% (n=282)	60.3% (n=282)	79.4% (n=277)	9.0% (n=277)	9.7% (n=277)	1.8% (n=277)
Medium	60.7% (n=471)	63.3% (n=471)	56.0% (n=471)	91.3% (n=469)	5.8% (n=469)	2.6% (n=469)	0.4% (n=469)
Small	41.1% (n=246)	47.8% (n=247)	45.3% (n=247)	97.1% (n=245)	2.0% (n=245)	0.8% (n=245)	0.0% (n=245)
Overall	59.1% (n=999)	61.9% (n=1000)	54.6% (n=1000)	88.6% (n=1,000)	5.75% (n=1000)	4.14% (n=1000)	0.71% (n=1000)
	Pearson χ^2 (2) = 53.00 p < 0.001	Pearson χ^2 (2) = 33.44 p < 0.001	Pearson χ^2 (2) = 12.61 p < 0.001	Pearson χ^2 (6) = 53.35 p < 0.001			

Sector-wise, close to three-quarters of firms in transport and electronics report introducing process innovation. In food and paper industries, however, less than half of the sample firms reported introducing process innovation in the last three years.

The percentage of sample firms that report introducing organizational innovation is slightly lower at close to 55%, again with differences across size categories ($\chi^2= 12$, $p < .001$). Sixty percent of large firms relative to 45% of small firms report introducing a new organizational process or management practice in the last three years. With respect to sectoral differences, among the sectors with sufficiently large sample size, around 60% of the firms in each of the four sectors - transport , electronics, machinery, and fabrication - report introducing organizational innovation in the last three years. In food (32%), chemicals (44%), and basic metals (42%), relatively fewer firms report introducing organizational innovation.

Finally, we analyze the performance from the perspective of number of patents filed by our sample firms. As Table 4 shows, close to 90% of the sample firms did not file any patent in the previous three years. Among those who filed patents, only 7 firms in our sample filed more than two patents. The number of patents varies across both size ($\chi^2 = 53.3$, $p < 0.001$) and industry sector ($\chi^2 = 106$, $p < 0.001$). While almost 20% of the large firms filed at least one patent, only 3% of the small firms and 9% of medium sized firms filed at least one patent. Sector-wise, 25% of the chemical firms in our sample filed at least one patent. Among other sectors with a significant representation in our sample, 15% of firms in food industry, around 10% of textile, plastic, and machinery firms filed at least one patent. No more than one firm in any sector in our sample filed more than two patents in the past three years.

Overall, clearly the medium and small firms lag behind the large firms in terms of innovation performance (across all four types of measures of performance). Differences across firm size in the perception of barriers to innovation (which we present later in this report) will perhaps provide us with better understanding for why small firms lag large firms in innovation performance. From the perspective of industry sectors, an interesting finding is the case of chemical industry. Although this

sector is not among those sectors in which large proportions of sample firms report product (53%), process (52%), or organizational innovation (44%), a quarter of the firms in this sector filed at least one patent over the previous three years. This indicates that either chemical firms are more willing to patent the innovations they introduce or they are more likely to introduce innovations that are patentable.

Table 4b. Innovation Performance and Sector

Sector	Product innovation	Process innovation	Organizational innovation	Patents				n
	(Yes)	(Yes)	(Yes)	0	1	2	>=3	
Food	50.0% (n=68)	42.6% (n=68)	32.3% (n=68)	86.8%	7.3%	4.4%	1.5%	68
Tobacco	33.3% (n=9)	77.8% (n=9)	66.7% (n=9)	100.0%	0.0%	0.0%	0.0%	8
Textiles	61.8% (n=76)	60.5% (n=76)	51.3% (n=76)	89.5%	6.6%	2.6%	1.3%	76
Garments	53.3% (n=45)	71.1% (n=45)	68.9% (n=45)	91.1%	4.4%	2.2%	2.2%	45
Leather	68.7% (n=16)	62.5% (n=16)	37.5% (n=16)	75.0%	6.2%	12.5%	6.2%	16
Wood	57.1% (n=7)	28.6% (n=7)	57.1% (n=7)	85.7%	14.3%	0.0%	0.0%	7
Paper	34.6% (n=26)	42.3% (n=26)	50.0% (n=26)	96.1%	3.9%	0.0%	0.0%	26
Publishing	64.7% (n=17)	70.6% (n=17)	70.6% (n=17)	82.3%	5.9%	11.8%	0.0%	17
Chemicals	53.4% (n=88)	52.3% (n=88)	44.3% (n=88)	75.0%	12.5%	11.4%	1.1%	88
Plastics	56.2% (n=96)	67.0% (n=97)	54.6% (n=97)	90.7%	3.1%	6.2%	0.0%	97
Non metal	51.3% (n=37)	56.8% (n=37)	43.2% (n=37)	97.3%	2.7%	0.0%	0.0%	37
Basic metal	57.0% (n=86)	59.3% (n=86)	41.9% (n=86)	91.9%	8.1%	0.0%	0.0%	86
Fabricate	63.5% (n=104)	61.5% (n=104)	59.6% (n=104)	91.2%	4.9%	3.9%	0.0%	102
Machinery	60.5% (n=109)	55.0% (n=109)	60.5% (n=109)	90.7%	6.5%	2.9%	0.0%	108
Electronics	67.0% (n=97)	76.3% (n=97)	62.9% (n=97)	87.4%	5.3%	6.3%	1.0%	95
Precision	33.3% (n=3)	66.7% (n=3)	66.7% (n=3)	66.7%	0.0%	0.0%	33.3%	3
Transport	68.7% (n=99)	74.7% (n=99)	67.7% (n=99)	95.8%	2.1%	2.1%	0.0%	96
Furniture	73.3% (n=15)	80.0% (n=15)	66.7% (n=15)	100.0%	0.0%	0.0%	0.0%	15
Recycling	100.0% (n=1)	100.0% (n=1)	100.0% (n=1)	100.0%	0.0%	0.0%	0.0%	1
	Pearson χ^2 (18) = 25.50, p < 0.001	Pearson χ^2 (18) = 46.95 p < 0.001	Pearson χ^2 (18) = 47.35 p < 0.001	Pearson χ^2 (54) = 106.71 p < 0.001				

Sources of Information for Innovation

The survey we analyze in this report asked questions on sources of ideas for innovation activities. Our results (Table 5) show that the most common source from where firms seek ideas for their innovation is the customers. Almost all firms (96%) report sourcing ideas from customers, followed by internet (72%), business associations (61%), and suppliers (63%). Rather surprisingly, 67% of the sample firms report sourcing ideas from competitors for their innovation activities. Relatively, much smaller proportion of firms source ideas from universities/research institutes (18%) and consultancy firms (19%).

Table 5. Sources of Ideas for Innovation and Size

Size	Parent firms as source of idea for innovation Done b/w 2010/12? (Yes)	Used information or ideas from Competitor for innovation (Yes)	Used information or ideas from suppliers for innovation (Yes)	Used information or ideas from products or services available (Yes)	Used information or ideas from Universities and research (Yes)	Used information or ideas from consultancy firms (Yes)	Used information or ideas from Business association (Yes)	Used information or ideas from Professional journals (Yes)	Used information or ideas from the internet (Yes)	Used information or ideas from customer feedback (Yes)
Large	49.3% (n=274)	63.3% (n=278)	58.6% (n=278)	64.7% (n=278)	30.9% (n=278)	28.4% (n=278)	71.2% (n=278)	64.7% (n=278)	72.3% (n=278)	98.6% (n=278)
Medium	29.0% (n=435)	68.2% (n=462)	64.3% (n=462)	57.4% (n=462)	13.6% (n=462)	16.9% (n=462)	62.8% (n=462)	54.5% (n=462)	78.3% (n=462)	95.7% (n=462)
Small	20.5% (n=205)	69.8% (n=242)	67.8% (n=242)	45.9% (n=242)	9.9% (n=242)	11.6% (n=242)	47.1% (n=242)	39.3% (n=242)	61.6% (n=242)	95.0% (n=242)
Pearson χ^2 (2)	50.40, p < .001	2.87, p < .001	4.87, p < .001	18.97, p < .001	48.90, p < .001	26.20, p < .001	32.51, p < .001	34.08, p < .001	22.45, p < .001	5.62, p < .001

The relationship between size and the sources of ideas for innovation shows some interesting results. Almost every firm depends on customers for innovation ideas but small firms are as likely (at 5% significance level) as large firms to rely on customers ($\chi^2 = 5.6$, $p = 0.06$). Similarly, although two-thirds of sample firms reported sourcing ideas from competitors, there is no statistically significant difference across size categories ($\chi^2 = 2.8$, $p = 0.238$). The only other source of ideas for which there is no statistically significant difference (at 5% level) across size categories is suppliers ($\chi^2 = 4.87$, $p = 0.09$). In this case, larger proportion of small firms than large firms (68% vs. 59%) report sourcing ideas.

The large vs. small (and medium) difference is clearly visible in the case of all other sources of ideas for innovation. Two sources that should perhaps be highlighted are business associations and universities/research institutions. Less than half of the small firms (47%) reported sourcing ideas from business associations relative to 71% of large firms (Chi-square = 32.5, $p < 0.001$). It is possible that large firms have much greater influence in business associations such as Confederation of Indian Industry (CII) and Federation of Indian Chambers of Commerce and Industry (FICCI), thus benefiting disproportionately from collective innovation efforts. In the case of universities, although only 18% of firms overall source their ideas, the difference between large and small and medium firms is rather stark (31% large vs. 14% medium vs. 10% small, $\chi^2 = 48.9$, $p < 0.001$). This suggests that (i) the industry-academia R&D relationship in India is poor and (ii) smaller firms have relatively little access to universities and research institutions, which are largely publicly funded in India.

Motivation for Engaging in Innovation

The survey asked about the extent to which four sources motivated the sample firms' decision to innovate. Overall, our results suggests that a large proportion of our sample firms are motivated by buyer firms (85%) and final good consumers (86%) whereas around two-thirds of firms are motivated by competitors (67%) and suppliers (63%). Except for the case of competitors, there are no statistically significant difference across large, medium, and small (Table 6); competitors are more likely to motivate small firms than large firms (70% vs. 60% of sample firms, $\chi^2 = 10.8$, $p = 0.005$).

Table 6. Sources of Motivation for Innovation and Size

Size	In 2010-12, were competitors important In motivating the establishment's decision	In 2010-12, were suppliers important In motivating the establishment's decision	In 2010-12, were buyer firms important In motivating the establishment's decision	In 2010-12, were final good consumers important In motivating the establishment's decision
	(Yes)	(Yes)	(Yes)	(Yes)
Large	59.7% (n=278)	59.7% (n=278)	83.8% (n=278)	88.1% (n=278)
Medium	70.6% (n=462)	63.0% (n=462)	85.1% (n=462)	83.3% (n=462)
Small	70.7% (n=242)	66.5% (n=242)	84.3% (n=242)	87.6% (n=242)
χ^2 (2)	10.77, $p < .001$	2.58, $p < .001$	0.22, $p < .001$	4.17, $p < .001$

Barriers to Innovation

The survey asked respondents questions on the perception of sample firms on the factors that hinder innovation. These barriers include both financial as well as non-financial. The results (Table 7) once again show that size matters. In particular, with respect to financial barriers, it is clear that the difference between large and small and medium industries is quite sharp. A much larger proportion of small and medium firms thought that internal funds, external credit as well as high cost of innovation are either very important or moderately important. For example, while only 17% of the small industries and 30% of medium industries thought that internal funds were not at all important as a barrier to innovation, more than half (52%) of large industries thought so. These figures are similar for external credit and cost of innovation (Table 7).

This trend continues for non-financial barriers. The differences across firm size categories are statistically significant for several barriers although the difference between large and small and medium enterprises is not as sharp as in the case of financial barriers. A majority of firms in our sample think that is not at all important for innovation (i) that market is dominated by established entrepreneurs (64%), (ii) that there is uncertain demand for innovative goods (66%), and (iii) that there is no need for new innovation because of prior innovations (62%). On all these three questions, there is no statistically significant difference across size categories. This means that although, as much as the larger firms, smaller firms perceive the need for new innovation and are not worried about the lack of demand for innovative goods, they are less innovative than larger firms, likely because of a variety of financial and non-financial barriers. This suggests a need for careful policy interventions to improve the ability of smaller firms to innovate.

Firm Innovative Capabilities, Trust, and Interaction

Firm capabilities to innovate such as the ability to identify and select knowledge, acquire knowledge, recombine knowledge, and commercialize products are measured to understand their role in innovation performance. In addition, the survey also asked two additional questions: (i) the extent to which the sample firms trust their partners and (ii) the firm's relations with customers and institutional actors. All these variables are measured on a 7-point Likert scale (0-completely disagree to 6-completely agree).

Using factor analysis (Appendix A2), we separated the ability to identify and select knowledge into two parts: (i) using external sources such as universities and an active network of scientific and research community (two items) and (ii) through internal processes (three items, see Appendix A1 for all the relevant questions). We summed over all the items under each capability to measure the relevant variables.

In general (see Table 8), firms in our sample perceive their capability to identify and select knowledge from universities and scientific community to be relatively low (overall mean score = 3.9 out of a maximum score of 12). For most other capabilities, the mean scores are relatively high indicating a perception of relatively strong capabilities to innovate. It is clear, however, that this perception of capabilities varies significantly across size categories with small and medium industries perceiving lower capabilities than larger firms for all types of capabilities (Table 8).

Table 7. Barriers to Innovation and Size

Size	Factors Hampering Innovation (Not at all important)									
	Lack of funds within the enterprise	Lack of finance from sources outside	High cost of innovation	Lack of qualified personnel	Lack of information on technology	Lack of information on market	Difficulty in finding cooperating partner	Market dominated by established enterprise	Uncertain demand for innovation goods	No need due to prior innovation
Large	52.4% (n=248)	61.4% (n=233)	59.1% (n=247)	60.7% (n=247)	59.9% (n=247)	69.3% (n=248)	68.3% (n=246)	64.3% (n=249)	66.1% (n=248)	62.2% (n=249)
Medium	29.7% (n=431)	30.2% (n=410)	31.6% (n=430)	45.1% (n=430)	40.4% (n=428)	50.9% (n=428)	52.9% (n=429)	56.1% (n=431)	62.5% (n=429)	58.6% (n=428)
Small	16.9% (n=219)	20.9% (n=206)	20.8% (n=216)	36.7% (n=215)	28.8% (n=215)	50.2% (n=215)	48.6% (n=214)	52.4% (n=212)	58.4% (n=214)	56.9% (n=216)
Pearson $\chi^2(4)$	73.05, p < .001	94.15, p < .001	86.24, p < .001	28.52, p < .001	49.17, p < .001	29.42, p < .001	23.66, p < .001	8.71, p < .001	3.09, p < .001	2.59, p < .001

Table 8. Firm-Level Capabilities and Size

Size	Cap_know_ext (Mean)	Cap_know_int (Mean)	Cap_acq (Mean)	Cap_recomb (Mean)	Cap_comn (Mean)	Cap_trust (Mean)	Cap_relate (Mean)
Large	4.97 (SD=3.47, n=247)	13.28 (SD=2.76, n=271)	14.32 (SD=2.08, n=281)	18.66 (SD=2.79, n=282)	18.82 (SD=2.85, n=274)	19.49 (SD=2.92, n=228)	18.53 (SD=2.92, n=276)
Medium	3.62 (SD=3.31, n=401)	12.29 (SD=3.42, n=448)	14.14 (SD=2.27, n=467)	18.37 (SD=3.05, n=470)	18.09 (SD=3.69, n=463)	19.04 (SD=3.19, n=361)	18.36 (SD=3.00, n=467)
Small	3.15 (SD=3.04, n=217)	10.41 (SD=4.03, n=237)	13.68 (SD=2.36, n=241)	16.85 (SD=3.61, n=243)	16.77 (SD=3.64, n=241)	18.40 (SD=3.83, n=183)	17.61 (SD=3.15, n=242)
F	F(2,862)=19.95, p<0.01	F(2,953)=45.86, p<0.01	F(2,986)=5.56, p<0.01	F(2,992)=25.67, p<0.01	F(2,975)=22.96, p<0.01	F(2, 769) = 5.54, p<0.01	F(2,982) = 6.78, p<0.01

On the issue of trusting their partners for innovation, our sample firms express relatively high trust (mean = 19, s.d. = 3.3 out of a maximum possible score of 24). In terms of trust as well, there are differences across firms with larger firms, on an average, expressing greater trust in their innovation partners (Anova test: $F(2, 769) = 5.54, p=0.004$). Same holds for interaction with institutional actors (Anova test: $F(2,982) = 6.78, p=0.001$).

In the next sections, we conduct multivariate analyses to understand how firm characteristics, location characteristics, innovation collaboration with other partners, capabilities, and barriers affect innovation activities and innovation performance.

Modeling Innovation Activities: Multivariate Regression Results

In this section, we conduct regression analyses of innovation activities in manufacturing sector in India. Similar to the previous section, we differentiate between innovation activities (measured in our survey in terms of internal and external R&D expenditures) and innovation performance (product-, process-, and organizational innovation and patents filed). We model both innovation activities and innovation performance as a function of firm attributes, regional characteristics, source of ideas for innovation, barriers to innovation, and firm capabilities to innovate.

Appendix A1 explains how we measured various variables used in our analysis in this section. In all our analyses, we control for sector and state fixed effects.

Innovative Activities and Firm/Location Characteristics

We consider internal R&D expenditures and external R&D expenditures (both variables are logged in our regression models) as innovation activities of firms that translate into innovation performance. As Table 9 (Model 1) shows, with regards to internal R&D expenditures, both large and medium scale industries spend higher amounts than small industries; more specifically, after controlling for other firm and regional characteristics, large firms spend 3.1% higher than small firms and medium firms spend 1.6% higher than small firms. As expected, firms that export more spend more on internal R&D while being part of an industrial cluster is weakly correlated with internal R&D expenditure (statistically significant at 10%). Age and being part of larger firm has no statistically significant impact on internal R&D spending. The gender variables – female ownership and the top manager being a female – has no impact. The ordinary least square regression model explains 14% of the variation in internal R&D expenditures.

With regards to external R&D expenditures as well (Table 10, Model 1), size matters; while the difference in expenditures is statistically significant between large and small firms ($p = 0.02$), the difference between medium and small is less significant ($p = 0.07$). On an average large firms and medium firms respectively spend 0.89% and 0.57% more than small firms. Among other variables, firms that have higher exports spend larger amounts on external R&D as do firms that are part of a larger firm. While female ownership has a weak negative relationship, age and being part of an industrial cluster has no statistically significant impact on spending on external R&D.

Innovation Activities and Source of Ideas for Innovation

Firms operate within a network of partners (e.g., suppliers, customers, etc..) from whom they could source ideas for innovation. Here we examine, after controlling for firm and regional characteristics, if the source of ideas has an influence on R&D expenditures. The source of ideas are classified into three types: markets, immediate network, and knowledge partners (see Appendix A1 for detailed explanation on the

measurement of these variables and Appendix A2 for the factor analysis of source of ideas variables). The results show (Tables 9, Model 2 and Table 10, Model 2) that firms that source ideas from immediate networks such as business associations, suppliers, and customers spend more on internal R&D than others. Firm size and being an exporting firm continue to be statistically significant in the case of internal R&D expenditures. With regards to external R&D, firms that source ideas from knowledge partners such as research institutions, parent firms, and external consultants spend higher than others. In this case, size has no impact after controlling for sources of ideas for innovation but exporting positively influences the expenditures on external R&D. None of the gender variables is statistically significant.

Innovation Activities and Barriers to Innovation

In a developing country such as India, firms, especially the small and medium enterprises face several problems that create barriers to innovate. Our survey asked the sample firms their perception of the extent to which they face various kinds of barriers. Using factor analysis (see Appendix A2), we have reduced the types of barriers to two types: financial and nonfinancial. We analyzed the influence of these barriers to innovation on firms' internal and external R&D expenditures, controlling for firm and regional characteristics. The results are shown in Table 9 (Model 3) and Table 10 (Model 3). Non-financial barriers (e.g., lack of information, uncertain demand for innovative products, etc.) have a negative influence on the internal R&D expenditures but not on external R&D expenditures. Financial barriers (e.g., internal funding, external finances, etc.) affect neither the internal nor the external R&D expenditures. In the case of internal R&D, size continues to be a significant factor, even after controlling for barriers to innovation, whereas firms with higher share of exports continue to spend more on external R&D. Neither of the gender variables – female ownership and female being a top manager – had any significant impact on R&D expenditures.

Innovation Activities and Firm Capabilities to Innovate

We also examined if certain capabilities known to affect innovation in firms has any impact on innovation activities, which in our case, are internal R&D and external R&D expenditures. The questionnaire has questions on assessing several self-reported capabilities: identify and select knowledge for innovation, acquire knowledge, recombine knowledge, and commercialize products. In addition, we also asked the sample firms about the extent to which the firm has trust in its partners and maintains good relations with its customers and institutional actors. We analyze the extent to which these capabilities affect the firms' propensity to spend more or less on internal and external R&D.

The results (see Table 9, Model 4 and Table 10, Model 4) show that capability to identify and select knowledge from external sources as well as the ability of the firms to acquire knowledge positively influences their internal R&D. Again, size continues to matter with large and medium industries spending more than small industries, even after controlling for capabilities. In the case of external R&D, only the firm's capabilities to recombine knowledge have any influence on the expenditures. In this model for explaining external R&D expenditures, share of exports, being part of a larger firm, and being part of an industrial cluster have positive impact on expenditures. Consistent with other models, size has no influence on external R&D while female ownership has a negative relationship.

Table 9. Innovation Activity (Internal R&D Expenditure) as a Function of Firm Characteristics

Variables ^a	Ln (IntRD) ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	10.3***	9.59***	13.3***	6.27***
<i>Firm Characteristics</i>				
Size = large	3.09***	3.03***	2.84***	2.85***
Size = medium	1.62***	1.48***	1.7***	1.37**
Age	0.01	0.01	0.01	0.00
Export_perc	0.01**	0.01*	0.01	0.01
Larger_firm	-0.14	-0.24	-0.27	-0.02
Ind_cluster	0.68*	0.48	0.7	0.16
Female_mgr	-0.40	-0.36	-0.59	-0.46
Female_owner	-0.28	-0.22	-0.5	-0.32
<i>Industry Sector Effects Included^d</i>	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		-0.13		
idea_knowledge_partners		0.09		
idea_imm_network		0.16**		
<i>Barriers to Innovation</i>				
barrier_fin			-0.18*	
barrier_nonfin			-0.12**	
<i>Firm-level Capabilities</i>				
cap_know_int				0.14
cap_know_ext				0.15**
cap_acq				0.32**
cap_recomb				0.02
cap_comm				0.00
cap_trust				0.02
cap_relate				-0.20*
Adj. R ²	0.14	0.13	0.14	0.12
F	4.77***	4.05***	4.08***	2.64***
N	974	891	816	608

^a For details about the variables, please refer to Table X above.

^b Self-reported annual internal R&D expenditure in ₹

^c Unstandardized Regression Coefficient

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.

*** p < .01; ** p < .05; * p < .10

Table 10. Innovation Activity (External R&D Expenditure) as a Function of Firm Characteristics

Variables ^a	Ln (ExtRD) ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	0.74	0.03	1.05	-0.44
<i>Firm Characteristics</i>				
Size = large	0.86**	0.63	0.47	-0.12
Size = medium	0.55*	0.34	0.56	-0.08
Age	0.00	0.00	0.00	0.00
Export_perc	0.015***	0.01**	0.02***	0.02***
Larger_firm	0.83**	0.44	0.85**	0.99**
Ind_cluster	0.28	0.15	0.008	0.95**
Female_mgr	-0.83*	-0.71	-0.77	-1.11*
Female_owner	-0.15	-0.04	-0.11	0.15
<i>Industry Sector Effects Included^d</i>	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		0.11		
idea_knowledge_partners		0.44***		
idea_network		-0.00		
<i>Barriers to Innovation</i>				
barrier_fin			-0.07	
barrier_nonfin			-0.05	
<i>Firm-level Capabilities</i>				
cap_know_int				-0.05
cap_know_ext				0.08
cap_acq				-0.02
cap_recomb				0.20**
cap_comm				-0.01
cap_trust				-0.03
cap_relate				-0.04
Adj. R ²	0.14	0.16	0.14	0.16
F	4.85***	4.77***	4.13***	3.33***
N	980	896	813	612

^a For details about the variables, please refer to Table X above.

^b Self-reported annual external R&D expenditure in ₹

^c Unstandardized Regression Coefficient

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.

*** p < .01; ** p < .05; * p < .10

Modeling Innovation Performance: Multivariate Regression Results

As described above, we measure innovation performance of manufacturing firms using four indicators: (i) introduction of a new product/service, (ii) introduction of a new process, (iii) introduction of a new organizational structure or management practice, and (iv) filing of at least one patent in the preceding three years. In this section, we examine the impact of various factors on the innovation performance.

Innovation Performance and Firm/Regional Characteristics

We first investigate which of the firm and regional characteristics influence each of the four indicators of innovation performance. Given that all our indicators are binary variables, we employ logistic regressions for all our analyses. In addition, in all our analyses, we include innovation activities (internal and external R&D expenditures) as explanatory variables.

The results are presented as Model 1 in Tables 11, 12, 13, and 14. Large industries perform better on all indicators, relative to small industries. This is consistent with all our other findings so far. Among other factors, higher export share and being part of an industrial cluster have weak correlation with process innovation but not with product or organizational innovation. Interestingly, being part of an industrial cluster has a negative impact on the probability of introducing a process innovation although the relationship is statistically weak. Female ownership has a negative impact on process innovation and organizational innovation (at 10% significance) whereas having a top female manager makes it more likely that firms file patents.

Expenditures on R&D (both internal and external) have strong influence only on the probability of filing a patent (Table 14, Model 1). For every 1% increase in internal R&D expenditure, the odds of filing a patent increase by 14% and the odds increase by around 8% for every 1% increase in external R&D expenditures. Being part of a larger firm also has a positive influence on the probability of filing a patent. Even after controlling for R&D expenditures, large firms are more likely to file a patent than small firms (although this coefficient is statistically significant at only 10%).

Innovation Performance and Source of Ideas for Innovation

If we extend our previous analysis to include the three sources of ideas for innovation - markets, firm's immediate network partners, and firm's knowledge partners - we find that size continues to matter with large industries performing better than small industries on all four indicators (Model 2 of Tables 11, 12, 13, and 14). Internal and external R&D expenditures continue to have strong influence on the probability of filing a patent. Female ownership continues to have a negative impact on process innovation and having a top female manager makes it more likely that firms file patents.

Source of ideas for innovation has no impact on product or process innovation; however, sourcing ideas from the immediate network partners positively influences the organizational innovation (although at 10% significance) and negatively influences the probability of filing a patent. One interpretation of this result could be that ideas sourced from immediate networks (e.g., suppliers, customers, business associations) translate into only relatively easily implementable innovations - a change in organizational or management practice - but not necessarily into innovations that are worthy of patenting. On the other hand, the coefficient on ideas from knowledge partners (research institutions, consultants, and parent firms) has a positive sign in the case of patents, although only approaching statistical significance ($p = 0.13$) at 10%. Overall, there is a weak evidence that different sources of ideas for innovation may result in different kinds of innovation.

Table 11. Innovation Outcome as a Function of Innovation Activities and Firm Characteristics

Variables ^a	Product/Service Innovation ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	0.94	1.00	1.49	0.41
<i>Firm Characteristics</i>				
Size = large	2.63***	2.55***	2.38***	2.50***
Size = medium	1.89***	1.88***	2.08***	1.59*
Age	1.01	1.01	1.01	1.01
Export_perc	1.00	1.00	1.00	1.00
Larger_firm	1.19	1.28	1.37	0.97
Ind_cluster	0.92	1.06	1.01	1.51
Female_mgr	0.81	0.71	0.86	0.67
Female_owner	0.85	0.86	0.89	0.89
<i>Innovation Activities</i>				
Ln (IntRD)	1.01	1.01	1.00	1.01
Ln (ExtRD)	1.00	1.00	0.98	0.97
<i>Industry Sector Effects Included^d</i>				
	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>				
	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		0.96		
idea_knowledge_partners		0.93		
idea_network		1.05		
<i>Barriers to Innovation</i>				
barrier_fin			1.01	
barrier_nonfin			0.94**	
<i>Firm-level Capabilities</i>				
cap_know_int				1.01
cap_know_ext				0.99
cap_acq				1.03
cap_recomb				1.06
cap_comm				0.97
cap_trust				1.01
cap_relate				1.00
Pseudo R ²	0.18	0.14	0.18	0.15
LR χ^2	242.56***	163.76***	198.91***	111.68***
N	963	874	806	583

^a For details about the variables, please refer to Table X above.

^b Whether introduced any new or significantly improved product or service during the last three years? (Yes = 1, No = 0)

^c Odds Ratio of the Logistic Regression. Number ≥ 1 signify positive coefficient and ≤ 1 signify negative coefficient.

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.

*** p < .01; ** p < .05; * p < .10

Table 12. Innovation Outcome (Process Innovation) as a Function of Innovation Activities and Firm Characteristics

Variables ^a	Process Innovation ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	1.62	2.36	2.67	0.71
<i>Firm Characteristics</i>				
Size = large	1.91**	1.81**	1.66*	1.95*
Size = medium	1.33	1.27	1.16	1.23
Age	1.00	1.00	1.00	1.00
Export_perc	1.01	1.01**	1.01	1.01
Larger_firm	1.06	1.00	1.26	1.08
Ind_cluster	0.63*	0.64*	0.73	0.56*
Female_mgr	1.21	1.15	1.15	1.24
Female_owner	0.61**	0.61**	0.58**	0.62
<i>Innovation Activities</i>				
Ln (IntRD)	1.01	1.00	1.01	1.01
Ln (ExtRD)	0.99	0.99	0.99	1.02
<i>Industry Sector Effects Included^d</i>				
	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>				
	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		0.99		
idea_knowledge_partners		0.99		
idea_network		0.97		
<i>Barriers to Innovation</i>				
barrier_fin			1.13**	
barrier_nonfin			0.93**	
<i>Firm-level Capabilities</i>				
cap_know_int				1.01
cap_know_ext				0.99
cap_acq				1.04
cap_recomb				0.97
cap_comm				0.92
cap_trust				1.10*
cap_relate				1.05
Pseudo R ²	0.28	0.22	0.28	0.26
LR χ^2	365.42***	252.93***	301.63***	197.92***
N	964	881	807	590

^a For details about the variables, please refer to Table X above.

^b Whether introduced any new or significantly improved methods of manufacturing products or offering services? (Yes = 1, No = 0)

^c Odds Ratio of the Logistic Regression. Number ≥ 1 signify positive coefficient and ≤ 1 signify negative coefficient.

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.

*** p < .01; ** p < .05; * p < .10

Table 13. Innovation Outcome (Organizational Innovation) as a Function of Innovation Activities and Firm Characteristics

Variables ^a	Organizational Innovation ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	1.82	1.29	3.17	1.38
<i>Firm Characteristics</i>				
Size = large	1.92**	1.95**	1.29	1.49
Size = medium	0.97	0.98	0.86	0.65
Age	1.00	1.01	1.00	1.01
Export_perc	1.00	1.00	1.01	1.00
Larger_firm	0.86	0.85	1.26	0.79
Ind_cluster	0.97	1.03	1.21	0.67
Female_mgr	1.3	1.32	1.2	1.72
Female_owner	0.66*	0.67	0.69	0.54*
<i>Innovation Activities</i>				
Ln (IntRD)	1.01	1.00	1.01	1.02
Ln (ExtRD)	0.99	1.00	0.99	1.00
<i>Industry Sector Effects Included^d</i>				
	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>				
	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		0.91		
idea_knowledge_partners		0.93		
idea_network		1.08*		
<i>Barriers to Innovation</i>				
barrier_fin			0.98	
barrier_nonfin			0.94*	
<i>Firm-level Capabilities</i>				
cap_know_int				1.11**
cap_know_ext				0.96
cap_acq				0.98
cap_recomb				1.01
cap_comm				0.94
cap_trust				0.94
cap_relate				1.12*
Pseudo R²	0.32	0.32	0.32	0.28
LR χ^2	425.99***	388.72***	353.82***	208.91***
N	964	881	807	553

^a For details about the variables, please refer to Table X above.

^b Whether introduced introduced any new or significantly improved organizational structures or management practices? (Yes = 1, No = 0)

^c Odds Ratio of the Logistic Regression. Number ≥ 1 signify positive coefficient and ≤ 1 signify negative coefficient.

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.*** p < .01; ** p < .05; * p < .10

Table 14. Innovation Outcome (Patents Filed) as a Function of Innovation Activities and Firm Characteristics

Variables ^a	Patents ^b			
	Model 1 ^c	Model 2	Model 3	Model 4
Constant	0.001	0.001	0.0001	0.0001
<i>Firm Characteristics</i>				
Size = large	2.44*	2.92**	3.57*	2.28
Size = medium	1.62	1.90	1.62	2.31
Age	0.99	0.99	0.99	0.99
Export_perc	1.01	1.01	1.01	0.99
Larger_firm	2.22***	1.82*	2.76***	2.66**
Ind_cluster	0.58	0.61	0.28**	0.39*
Female_mgr	2.76**	2.16*	11.9***	2.14
Female_owner	0.73	0.75	0.45*	1.00
<i>Innovation Activities</i>				
Ln (IntRD)	1.15***	1.15***	1.28***	1.09*
Ln (ExtRD)	1.09***	1.08***	1.10***	1.11**
<i>Industry Sector Effects Included^d</i>				
	Yes	Yes	Yes	Yes
<i>Region (States) Effects Included^e</i>				
	Yes	Yes	Yes	Yes
<i>Sources of Ideas</i>				
idea_markets		0.90		
idea_knowledge_partners		1.15		
idea_network		0.87**		
<i>Barriers to Innovation</i>				
barrier_fin			1.11	
barrier_nonfin			1.05	
<i>Firm-level Capabilities</i>				
cap_know_int				1.07
cap_know_ext				1.24***
cap_acq				1.24*
cap_recomb				1.02
cap_comm				1.02
cap_trust				0.94
cap_relate				0.92
Pseudo R²	0.33	0.33	0.45	0.36
LR χ^2	219.55***	206.86***	218.58***	135.32***
N	860	771	696	468

^a For details about the variables, please refer to Table X above.

^b Whether the establishment applied for at least one patent between fiscal year 2010/2011 and fiscal year 2012/2013? (Yes = 1, No = 0)

^c Odds Ratio of the Logistic Regression. Number ≥ 1 signify positive coefficient and ≤ 1 signify negative coefficient.

^d Industry sector effects were modelled but have not been presented for the sake of clarity and readability of the results

^e Region effects were modelled but have not been presented for the sake of clarity and readability of the results.

*** $p < .01$; ** $p < .05$; * $p < .10$

Innovation Performance and Barriers to Innovation

We examined whether the perceived barriers to innovation affect the innovation performance after controlling for firm and regional characteristics. As the results (Model 3 of Tables 11, 12, 13, and 14) show, non-financial barriers to innovation negatively affect innovation performance, except for the probability of filing a patent. In other words, firm that perceive nonfinancial issues to be important barriers in innovation are less likely to introduce product, process, or organizational innovation but this perception has no impact on the probability of filing a patent. Internal and external R&D expenditures, being large, and being part of a larger firm have a positive influence on the probability of filing a patent. In these models, gender variables have no influence on product or organizational innovation. However, female ownership has a weak negative influence and having a female as top manager has a strong positive influence on the probability of filing patents.

A couple of results that are slightly surprising are, first, the perception that financial issues are important barriers to innovation has a positive influence on the probability of introducing a process innovation. This is a surprising finding. Additionally, being part of an industrial cluster has a negative correlation with the probability of filing a patent. In fact, this negative correlation persists in all our models of patenting with varying levels of statistical significance.

Innovation Performance and Capabilities to Innovate

Finally, we analyze the role of firm innovation capabilities on indicators of innovation performance, controlling for firm and regional characteristics. None of the examined capabilities affects the probability of introducing product innovation (see Model 4 of Table 11); being a large industry continues to be a strong determinant of the probability of introducing product innovation. Firms with higher trust in their partners and large firms are more likely to introduce process innovation (Model 4 of Table 12), whereas ability to maintain good relationships with customers and institutional actors raises the probability of introducing organizational innovation (Model 4 of Table 13). In these models the gender variables have no influence on innovation performance except for a weak negative relationship between female ownership and the probability of introducing organizational innovation.

The probability of filing a patent is positively influenced by the firms' ability to identify and select knowledge through external sources such as researchers and scientific community (see Model 4 of Table 14). The ability to acquire knowledge has a weak correlation with the probability of filing a patent. In this model, external R&D expenditures significantly and positively affect the probability of filing a patent but size has no impact, after controlling for expenditures.

DISCUSSION

Importance of Size

Size persists, in all the models, as an important determinant of innovation among manufacturing firms in India. Our analysis clearly shows size differences in firm innovative activities, innovation performance, capabilities, and their perceptions on barriers to innovation. Indarti and Postma (2013) argued that firm's size and age are positively related to product innovation. Older and larger firms are likely to have bigger networks that may positively impact the possibility to exchange knowledge and to innovate. Innovation processes of larger firms are likely to be more structured and professionalized (van de Vrande

et al., 2009). Larger SMEs are likely to develop and apply formal structures, recruit specialized workers, and introduce managerial layers, rules and procedures (Rahayu & Day, 2015). Also, once a critical size is reached, they may be better able to formalize their innovation practices and to develop structures for licensing IP, venturing activities and external participations (van de Vrande et al., 2009). Our results supported these arguments. We found that the large- and medium-sized firms are more likely to invest in conducting internal R&D, engage in product/service innovations, process innovations, organizational innovations and also invest in patenting their innovations. Small and medium firms seem to lack the financial resources to invest in innovation although their perception on the need for innovation is no different from that of large firms. This is reflected in the innovation activities and innovation performance.

Investments in Innovation Activities (Internal R&D, External R&D)

Apart from size, we found that firms that are part of industrial clusters, have better immediate networks (with suppliers, customers, business associations, internet, journals or trade publications) and have better capabilities of exploring knowledge through extensive external contacts (universities, research community) invest more in conducting internal (within firm) R&D. Our study also found that firms that export their products to foreign countries, are part of larger firms, and belong to industrial clusters as well as source their ideas from knowledge partners (external research agencies and consulting firms) invest more in external R&D. Barriers to innovation were not significant for external R&D.

Researchers (e.g., Gunawan, Jacob, & Duysters, 2016; Indarti & Postma, 2013; Piana, Vecchi, & Vivacqua, 2015; Sternberg & Arndt, 2001) have highlighted that interactions within regional clusters provide an effective platform for firms to learn and innovate. Being part of a geographically concentrated cluster provides firms easy access to new ideas due to the localized nature of knowledge spillovers. SMEs engage in various modes of collaboration and SME networking and alliances have attracted considerable research attention (Lee et al., 2010). Cooperation with customers, suppliers will promote innovations for SMEs when compared with competitors and rivals (Fischer & Varga, 2002). Vertical linkages (with suppliers, and customers) are considered to be relatively stable innovation-linkages and a stronger source for ideas for innovations for the firm (Zheng et al., 2010). Fischer and Varga (2002) noted that customer networks represented the most frequent form of inter-firm cooperation. Information provided by customers and suppliers can be used frequently by firms in order to develop products that are high on novelty. Cooperation with suppliers may also enable firms to reduce the risks and lead times of product development, while enhancing flexibility, product quality and market adaptability. Our study provides strong support for these observations. Collaboration with suppliers may also have the goal to overcome size constraints while collaboration with both suppliers and customers may be performed for the purpose of co- design (Radas & Božić, 2009; Sawang & Matthews, 2010). Business associations often interact with large number of firms in a particular geographical district and are, therefore, exposed to a wide variety of solutions to organizational challenges. Such associations may impact innovation by providing specific knowledge as a consequence of their position as intermediaries and as a result can explore and transfer new, exclusive information, knowledge, and opportunities (Molina-morales & Martínez-Fernández, 2010). Also, such bodies provide firms with a specific capacity to compare and evaluate different solutions to problems since they are members of broader scale associations, participate in congresses, or carry out joint projects with external partners, and so on.

Research-focused collaborations with universities, consultancy firms and parent firm are likely to provide innovating firm with new scientific and technological knowledge, in particular in studies of high-tech industries (Tödting, Lehner & Kaufmann, 2009). Studies have shown that SMEs tend to use almost twice as much of their R&D expenditures towards R&D collaboration than large firms (Narula, 2004). Small and medium-sized enterprises (SMEs) rely heavily on external knowledge for innovation as they may find external R&D to be less risky than formal in-house R&D (Moilanen et al., 2014). Also, SMEs are likely to be less bureaucratic and have more flexible management practices and thus may be better positioned to take advantage of external knowledge than other large firms (Ortega-Argiles et al. 2009). Existence of an in-house R&D department is likely to enhance the capability of introducing innovations and patenting, thereby, enhancing the internal knowledge base of companies. Also, cooperation with universities and research institutes allows firms to diversify their knowledge base and provides them access to complementary scientific knowledge relevant for developing novel products (Tödting et al., 2009).

Our study also found that non-financial barriers were negatively related to internal R&D investment. Lack of qualified employees and information about technology and markets has been recognized in literature as a significant barrier to innovation in developing economies (Purcarea, Benavides Espinosa, & Apetrei, 2013). Kaufmann and Tödting (2001) observed that manpower is the second most frequent innovation bottleneck in the SME sector, either because adequately qualified personnel are missing or there is a lack of time available for innovation activities. Small business managers often lack the types of education and training that have been linked with a successful innovation strategy and are often constrained in their ability to attract, train, and retrain managers who are qualified to effectively incorporate innovation into business strategy. Also, their lack of information about technology, markets, and government policy initiatives may be another major obstacle to innovation (Madrid-Guijarro et al., 2009).

Innovation Performance

While size continues to be important, with large industries being more likely to introduce product innovation, non-financial barriers turn out to be prominent in hindering innovation. The probability of introducing product, process, and organizational innovation was negatively related to non-financial barriers, suggesting that, on average, firms that experience non-financial barriers have difficulty in producing innovations, even after controlling for size. In the one case where financial barrier emerged as significantly related, it was positively related to process innovation. While this result is counterintuitive, one possible interpretation is that firms that face significant financial barriers are perhaps more motivated to innovate to reduce costs and thus more likely to introduce process innovation. Our results with regards to non-financial barriers are consistent with the finding in the literature that non-financial barriers such as inadequately trained and qualified human resources are often a challenge for the firm and may limit its innovation performance (Madrid-Guijarro et al., 2009). Lack of qualified manpower gives firm little time as well as opportunity to identify, select and absorb the innovation happening outside its boundaries (Kaufmann & Tödting, 2001) and are unlikely to incorporate innovations into their long-term business plans.

Whether the firm belonged to industrial cluster was negatively related to process innovation in most of the models. This result is contradictory to the idea that being part of a cluster improves the ability of firms to develop stronger immediate networks, which are positively related to innovation. Researchers (e.g., Nieto and Santamaria, 2007; Indrati & Postma, 2013) argue that interaction between a firm and entities in its immediate network significantly impacts the accumulation and sharing of knowledge that can then be used in the innovation of the firm's products. This surprising result might be related to the generally poor performance of special industrial zones that the Indian government has created. Studies in particular find

that enterprises in these special zones do not promote cluster of industries in related industrial sectors (Shah et al., 2008). This might hinder development of networks that help in innovation.

Investment in both internal as well external R&D was positively related to firms' patenting activity. Firm's capability to identify, select and acquire knowledge from external partners (research collaborations with universities, colleges) was also positively related to patenting activity. Whether the firm belonged to (was a part of) larger firm was also positively related to the probability of filing a patent. Basic research performed by the firm creates a link of familiarity between the firm and external researchers and enables the development of a common vocabulary that facilitates communication. This common knowledge base assists firm's researchers in identifying and exploiting external (university-based) science and also allows for more effective knowledge transfer (Fabrizio, 2009). Moreover, if an SME uses external R&D, it also has to develop a sufficiently mature internal R&D capability in order to absorb the knowledge obtained from external knowledge partners (Moilanen et al., 2014). While SMEs collaborate in order to extend their technological know-how, they also have limited scope to engage in external collaborations as they have limited technological insights to offer in exchange to the partner (Spithoven et al., 2013). Thus, firm's investment in internal R&D along with external R&D and complementing it with development of capabilities to identify, select and acquire knowledge from external sources becomes crucial for promoting innovative performance. In general, the factors that correlate with the probability of filing a patent suggest a need for a combination of internal and external efforts, perhaps because of the greater costs involved in finding patents relative to introducing product, process, or organizational innovation.

CONCLUSION

The study aims to contribute to the understanding of the process of innovation and its contribution to productivity, growth and poverty alleviation in the institutional context of a developing country (India). Based on data collected by World Bank and the Innovation Survey carried out by the Tilburg University, the study aims to identify factors that may impact innovation activities (measured as investments in internal and external R&D) and innovation performance (measured as product/service innovation, process innovation, organizational innovation as well as the number of patents filed) of Indian manufacturing SMEs. The study undertakes both a descriptive as well as empirical testing approach to explain the characteristics of the sample of firms on which analysis was to be performance and then the results of multivariate analysis done on the data. We sincerely hope that the results presented in the report will shed light on the hitherto underexplored area of innovation activities and performance of Indian SMEs as well as provide some guidance on the policy interventions that may be thought of in order to make Indian SMEs more competitive and innovative.

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APPENDIX A1. DESCRIPTION AND MEASUREMENT OF STUDY VARIABLES

Construct	Variable	Measurement
Innovation Activities	<i>IntRD</i>	Self-reported annual internal R&D expenditure in ₹
	<i>ExtRD</i>	Self-reported annual external R&D expenditure in ₹
Innovation Performance	<i>product</i>	Whether introduced any new or significantly improved product or service during the last three years? (Yes = 1, No = 0)
	<i>process</i>	Whether introduced any new or significantly improved methods of manufacturing products or offering services? (Yes = 1, No = 0)
	<i>organization</i>	Whether introduced any new or significantly improved organizational structures or management practices? (Yes = 1, No = 0)
	<i>patents_yes</i>	Whether the establishment applied for at least one patent between fiscal year 2010/2011 and fiscal year 2012/2013? (Yes = 1, No = 0)
Size	<i>large, medium, small</i>	Categorization based on number of employees: Large ≥ 100 employees Medium ≥ 20 and ≤ 99 Small ≥ 5 and ≤ 19 <i>large</i> = 1 if Large else 0 <i>medium</i> = 1 if Medium else 0 <i>small</i> is the reference category in all the analyses
Exporting Firm	<i>export_perc</i>	The sum of percentage of sales directly exported and percent indirectly exported (i.e., sold domestically to third party that exports products)
Part of a Larger Firm	<i>larger_firm</i>	Whether the firm is part of a larger firm? (Yes = 1, No = 0)
Part of an Industrial Cluster	<i>ind_cluster</i>	Whether the establishment is part of an export processing zone or an industrial park? (Yes = 1, No = 0)
Age	<i>Age</i>	Years since the establishment of the enterprise
Female Top Manager	<i>Female_mgr</i>	Is the top manager female? (Yes = 1, No = 0)
Female Owner	<i>Female_owner</i>	Amongst the owners of the firm, are there any females? (Yes = 1, No=0)
Sourcing Ideas for Innovation from Market	<i>idea_market</i>	Sum of scores on two binary variables Has this establishment used ideas or information (yes = 1, no = 0) from (i) competitors and (ii) products or services available in the market?
Sourcing Ideas for Innovation through	<i>idea_know_partner</i>	Sum of scores on three binary variables

knowledge partners		Has this establishment used ideas or information (yes = 1, no = 0) from (i) universities and research institutes (ii) parent firms, and (iii) consultants?
Sourcing Ideas for Innovation from Firm's Immediate Network	<i>idea_imm_network</i>	Sum of scores on five binary variables Has this establishment used ideas or information (yes = 1, no = 0) from (i) suppliers, (ii) business associations, (iii) professional journals or trade publications, (iv) internet, and (v) customers?
Financial Barriers	<i>barrier_fin</i>	Sum of scores on three items (response scale for each item varies from 0 - Not important to 2 - Very important) How important are the following factors, if any, in hampering the establishment's innovative activities and capacity to improve? (i) Lack of funds within the enterprise, (ii) Lack of finance from outside sources, and (iii) High cost of innovation
Nonfinancial Barriers	<i>barrier_nonfin</i>	Sum of scores on seven items (response scale for each item varies from 0 - Not important to 2 - Very important) How important are the following factors, if any, in hampering the establishment's innovative activities and capacity to improve? (i) Lack of qualified personnel, (ii) Lack of information on technology, (iii) Lack of information on markets, (iv) Difficulty finding cooperative partners, (v) Market dominated by established enterprises, (vi) Uncertain demand for innovative goods or services, and (vii) No need due to prior innovations
Capabilities to Select and Identify Knowledge	<i>cap_know_ext</i>	Sum of scores on two items (response scale 0 - completely disagree to 7 - completely agree) To what extent do you agree or disagree with the following statements? (i) This establishment has extensive contact with researchers at universities (ii) This establishment has an active network of contacts with the scientific and research community
	<i>cap_know_int</i>	Sum of scores on three items (response scale 0 - completely disagree to 6 - completely agree) To what extent do you agree or disagree with the following statements? (i) This establishment regularly reads specialized journals and magazines to keep abreast of market and technical trends (ii) This establishment regularly conducts a technological audit (iii) This establishment monitors the needs of its clients and customers
Capabilities to Acquire Knowledge	<i>cap_acq</i>	Sum of scores on three items (response scale 0 - completely disagree to 6 - completely agree) To what extent do you agree or disagree with the following statements? (i) This establishment is successful at acquiring the knowledge required to understand customer needs (ii) This establishment is successful at acquiring the knowledge required to identify market opportunities (iii) This establishment is successful at acquiring the knowledge required to comply with the expectations of trading partners

Capabilities to Recombine Knowledge	<i>cap_recomb</i>	<p>Sum of scores on four items (response scale 0 - completely disagree to 6 - completely agree)</p> <p>To what extent do you agree or disagree with the following statements?</p> <p>(i) This establishment's employees have the skills to fuse or link newly acquired knowledge with existing knowledge.</p> <p>(ii) This establishment improves its knowledge management systems to better use or exchange information, knowledge and skills within the establishment.</p> <p>(iii) This establishment has a department or coordinator that diffuses and disseminates knowledge within the establishment.</p> <p>(iv) In this establishment, different departments can work together easily.</p>
Capabilities to Commercialize Innovation	<i>cap_comm</i>	<p>Sum of scores on four items (response scale 0 - completely disagree to 6 - completely agree)</p> <p>To what extent do you agree or disagree with the following statements?</p> <p>(i) This establishment has a well-organized marketing department.</p> <p>(ii) This establishment can easily commercialize products and services that are completely new to the establishment.</p> <p>(iii) This establishment can easily increase the sales of new products in existing markets.</p> <p>(iv) This establishment can easily increase the sales of new products in new markets</p>
Trust in Partners	<i>cap_trust</i>	<p>Sum of scores on four items (response scale 0 - completely disagree to 6 - completely agree)</p> <p>To what extent do you agree or disagree with the following statements?</p> <p>(i) This establishment and its partners have a high level of mutual trust.</p> <p>(ii) This establishment's partners are always frank and truthful in their dealings with the establishment.</p> <p>(iii) This establishment's partners stand by their words.</p> <p>(iv) This establishment has the tendency to trust other organizations.</p>
Relations with Customers and Institutional Actors	<i>cap_relate</i>	<p>Sum of scores on four items (response scale 0 - completely disagree to 6 - completely agree)</p> <p>To what extent do you agree or disagree with the following statements?</p> <p>(i) This establishment has very well established relations with buyers.</p> <p>(ii) This establishment has very well established relations with suppliers.</p> <p>(iii) This establishment has very well established relations with competitors.</p> <p>(iv) This establishment has very well established relations with institutional actors</p>

APPENDIX A2. FACTOR ANALYSES RESULTS

Table A2.1 Factor Analysis of Sources of Ideas for Innovation (N=914)

Item	Factor Loadings*		
	<i>idea_imm _network</i>	<i>idea_know _partners</i>	<i>idea_market</i>
Used ideas or information from parent firm	0.16	0.50	-0.35
Used ideas or information from competitors	0.36	-0.40	0.44
Used ideas or information from suppliers	0.58	-0.22	0.22
Used ideas or information from market	0.10	0.17	0.82
Used ideas or information from research organizations	0.02	0.74	0.25
Used ideas or information from consultants	0.37	0.55	0.09
Used ideas or information from business associations	0.70	0.11	0.12
Used ideas or information from professional journals	0.74	0.17	-0.01
Used ideas or information from internet	0.73	-0.03	-0.04
Used ideas or information from customers	0.30	-0.29	-0.16
Eigen Values	2.41	1.43	1.05
Percent Variance	24.1	14.3	10.5

*Rotated factor loadings (Oblimin Rotation)

Table A2.2 Factor Analysis of Barriers to Innovation (N=831)

Item	Factor Loadings*	
	<i>barrier_nonfin</i>	<i>barrier_fin</i>
Lack of funds within the enterprise	0.32	0.84
Lack of finance from outside sources	0.25	0.81
High cost of innovation	0.25	0.78
Lack of qualified personnel	0.60	0.53
Lack of information on technology	0.56	0.52
Lack of information on markets	0.73	0.26
Difficulty finding cooperative partners	0.68	0.32
Market dominated by established enterprises	0.81	0.17
Uncertain demand for innovative goods or services	0.80	0.07
No need due to prior innovations	0.80	0.10
Eigen Values	5.32	1.25
Percent Variance	53.27	12.54

*Rotated factor loadings (Oblimin Rotation)

Table A2.3 Factor Analysis of Capabilities: Identifying and Selecting Knowledge (N=857)

Item	Factor Loadings*	
	<i>cap_know_ext</i>	<i>cap_know_int</i>
Extensive contact with researchers at universities	0.96	0.05
Active network of contacts with the scientific and research community	0.96	0.06
Regularly reads specialized journals and magazines to keep abreast of market and technical trends	0.23	0.77
Regularly conducts a technological audit	0.16	0.80
Monitors the needs of its clients and customers	-0.14	0.82
Eigen Values	2.22	1.62
Percent Variance	44.3	32.4

*Rotated factor loadings (Oblimin Rotation)

Table A2.4 Factor Analysis of Capabilities: Acquiring Knowledge (N=989)

Item	Factor Loadings*
	<i>cap_acq</i>
Acquiring the knowledge required to understand customer needs	0.83
Acquiring the knowledge required to identify market opportunities	0.80
acquiring the knowledge required to comply with the expectations of trading partners	0.80
Eigen Values	1.97
Percent Variance	65.9

*Rotated factor loadings (Oblimin Rotation)

Table A2.5 Factor Analysis of Capabilities: Recombining Knowledge (N=995)

Item	Factor Loadings*
	<i>cap_recomb</i>
Employees have the skills to fuse or link newly acquired knowledge with existing knowledge	0.81
Improves its knowledge management systems to better use or exchange information, knowledge and skills	0.81
Has a department or coordinator that diffuses and disseminates knowledge	0.81
In this establishment, different departments can work together easily	0.84
Eigen Values	2.7
Percent Variance	67.2

*Rotated factor loadings (Oblimin Rotation)

Table A2.6 Factor Analysis of Capabilities: Commercializing Knowledge (N=978)

Item	Factor Loadings*
	<i>cap_comm</i>
Has a well-organized marketing department	0.81
Can easily commercialize products and services that are completely new to the establishment	0.81
Can easily increase the sales of new products in existing markets	0.81
Can easily increase the sales of new products in new markets	0.84
Eigen Values	2.7
Percent Variance	67.2

*Rotated factor loadings (Oblimin Rotation)

Table A2.7 Factor Analysis of Trust in Partners (N=978)

Item	Factor Loadings*
	<i>cap_trust</i>
This establishment and its partners have a high level of mutual trust	0.87
This establishment's partners are always frank and truthful in their dealings with the establishment	0.86
This establishment's partners stand by their words	0.84
This establishment has the tendency to trust other organizations	0.75
Eigen Values	2.76
Percent Variance	69.1

*Rotated factor loadings (Oblimin Rotation)

Table A2.8 Factor Analysis of Relationship with Partners and Institutional Actors (N=985)

Item	Factor Loadings*
	<i>cap_relate</i>
Very well established relations with buyers	0.76
Very well established relations with suppliers	0.79
Very well established relations with competitors	0.72
Very well established relations with institutional actors	0.73
Eigen Values	2.22
Percent Variance	55.7

*Rotated factor loadings (Oblimin Rotation)