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

Country Report Kenya

September 2017

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

Acknowledgments

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 Kenya. The research output on Kenya was amongst others the result of a fruitful cooperation with the University of Nairobi, in particular with Prof. Jane Mariara, Prof. Peter Kimuyu, Dr. Bethuel Kinyanjui and Dr. Laura Basara (former PhD candidate in the project).

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 Kenya 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.

Prof. Lex Meijdam (Dean Tilburg University)

[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 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 'Kenya Country Report' presents an overview of the scientific output and policy implications relating to Kenya. The scientific output comprises a qualitative research report, six papers within the 'Innovation Systems' theme, and three papers within the 'Finance and Productivity Growth' theme. In Annex 1 a comprehensive list of all research working papers written in the framework of EIP-LIC is presented. The key DFID/World Bank survey findings for Kenya are presented in Annex 2 and the research addressing the original DFID questions is presented in Annex 3.

Qualitative research

The qualitative report is based on data collected through open semi-structured interviews with owners and managers of SMEs in Nairobi and the surrounding area. 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 Kenya, as perceived by manufacturing SME owners and managers. Specifically, the case descriptions illustrate the different ways in which companies in Kenya introduce new products, processes, technology, or machinery.

Although the innovation in the Kenyan cases is not 'new to the world' high tech innovation, but mostly incremental technology adoption, it is still critical for the firms' survival and growth. The interviewed owners and managers innovate step-by-step to see what works and what does not. They mention that the skills and knowledge gained through formal education do not match the company's requirements. No formal support from innovation systems institutions was received in their efforts to innovate. In fact, most owners indicated that formal government institutions, represented by government officials, make their business environment even more challenging.

Innovation systems

The scientific papers within the 'Innovation Systems' theme were based on data collected among 549 firms in Kenya. Three waves of data were used: from the 2013 World Bank Enterprise Survey, the 2013 Innovation Follow-up Survey module, and the 2015 Innovation Capabilities Survey. The first scientific paper analyses the relationship between firms' human capital endowments and firm-level practices to improve innovative output. The research finds that employee schooling is a relatively unimportant factor for innovation within SMEs. However, it demonstrates a strong relationship between formal company training and the probability of producing innovative output. Furthermore, the research finds that a firm that gives slack time to its employees has a higher probability of producing innovative output. An implication is that government agencies could develop special policies and programmes that encourage and support SMEs in providing formal company training. Policies and programmes could assist in the development of formats and curricula for such in-company training programmes. Lastly, a government might inform the business community of how slack time could contribute to innovative ideas and output from employees, encouraging them to establish a culture which includes slack time as routine and a way to promote innovation.

The second scientific paper within the 'Innovation Systems' theme reviews regional institutional quality through data from Kenya, Tanzania and Uganda. The study finds that firms situated in an environment with a low degree of institutional quality have a lower likelihood of conducting and benefitting from R&D. A lack of legislative transparency creates uncertainty, discouraging firms from investing in R&D. The implication for policy is to focus on strengthening institutions by fighting corruption, enforcing the rule of law and fostering regulatory quality. This is not only important at the national level, but is also beneficial at the regional level. Policy makers could make 'best practices' out of the regional implementation and enforcement of their national institutional policies and facilitate the spread of these best practices across the rest of their country.

The third scientific paper finds that R&D within firms decreases technical efficiency. This is surprising because it has been previously suggested that inefficiency in manufacturing firms in Africa arises from a lack of organised R&D and low levels of investment in internal R&D. The low rates of human capital found in Africa, necessary to make the adoption of advanced foreign technology worthwhile, may indicate a lack of capacity for sophisticated R&D activities. The implication for government support is a policy focus on the operational environment, being the underlying factor behind the apparent mismatch between internal R&D and efficiency. The challenges here include limited access to credit and inputs, low levels of human capital, poor infrastructure and poor governance.

The fourth scientific paper assesses the importance of external knowledge sources to firm-level innovation. The research finds that regional variations in knowledge availability influence the success of openness. In regions with high knowledge availability, the relationship between openness and innovation is similar to that found in

Western countries, which adds to the external validity of this relationship. The study shows that firms located in regions where knowledge availability is lower are more innovative when they are not using search breadth and only low levels of search depth, indicating that in some environments, closed innovation is preferable. These results contrast with most previous research on open innovation, which highlighted the benefits and the positive relationship with innovative performance. Interestingly, the research results indicate that openness can even be a harmful strategy, which should be acknowledged by policy makers. In regions where knowledge availability is lower, being open has more costs than benefits. In policy making, the context should be considered explicitly when establishing a relationship between openness and innovation. For governments, the concept of openness is not automatically replicable from one context to another, and collaboration with new partners could result in lower innovative performance.

The fifth scientific paper investigated the bi-directional relationship between innovation and exporting in four countries in Sub-Saharan Africa. The research finds that the relation between innovation and subsequent exporting is positive and significant. The other way around, there is a positive but non-significant relation between exporting and subsequent innovation. The research further indicates that market creation mediates the innovation-exporting relationship because the innovation process entails the introduction of new products and services to the marketplace. Moreover, customer feedback mediates the relation between exporting and innovation to a large extent. Innovation policies aimed at fostering product innovation by providing incentives may be crucial for exporting. Customer feedback mediates the exporting-innovation relation to a very large extent. Therefore, policies focusing on information and communications technology infrastructure investment are vital in enabling faster response to market needs. Additionally, export promotion policies encompassing instruments such as export subsidies are likely to play a key role in stimulating innovation.

The sixth 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 three scientific papers within the 'Finance for Productivity Growth' theme were based on the SME survey 'FinAccess Business 2013', a field experiment in Nairobi and a relevant research study in Uganda. The first paper focuses on access to trade credit, since an increasing body of literature stresses the significant role this plays in economic development in LICs. Unlike credit from official financial institutions, trade credit does not rely on formal collateral but on trust and reputation. The research explored whether the use of electronic money within their business helps entrepreneurs to access such trade credit. The research team found a positive relation between the use of mobile money 'M-Pesa', as a payment method when purchasing inputs from suppliers, and access to trade credit among SMEs. A theoretical implication of the research is that the use of mobile money

lowers the probability of theft and alleviates trade credit constraints, thereby stimulating entrepreneurial performance.

Policy implications point toward overcoming SMEs' limited use of mobile money for their financial transactions, compared to households in Kenya. Government policy makers, donors, NGOs' policies and programmes could explicitly focus on promoting its use within SMEs. The research suggests that significant policy impact could be achieved if mobile money technology is promoted in combination with trade credit. The research also provides input for the current policy debate on financial inclusion in LICs. While for a long time there has been a focus on credit services for micro- and small entrepreneurs, in recent years the policy debate has broadened to other financial services and mechanisms. The research shows the importance of trade credit, providing efficient payment services as a means to help firms expand their network and production.

The second scientific paper within the 'Finance for Productivity Growth' theme, based on the field experiment, investigates the determinants of - and the barriers to - the adoption of a profitable financial technology by SMEs. Specifically, the study involves a field experiment focusing on the adoption of mobile-money as a payment technology by restaurants and pharmacies in Nairobi. The field experiment studied the factors that foster adoption of mobile money technologies by SMEs, and the barriers to its adoption. The research team offered a randomly selected sample of restaurants and pharmacies the opportunity to sign up for mobile-money technology which allows efficient mobile-money based transactions between a business and a customer. The study found that over 60% of restaurant owners/managers signed up for the new technology, whereas adoption rates were about 20% among pharmacies.

The research suggests that policies and programmes to promote new technology adoption could be best designed by addressing (situational) barriers, particularly bureaucratic barriers and lack of information. A government programme providing free mobile technology, a relatively low-cost intervention, would bring substantial commercial benefits for SMEs. Moreover, such an intervention would repay itself in terms of increased taxation revenues. Providing free technology might also result in a 'tipping point' being reached, when non-adopting SMEs switch to the mobile technology because it has become common practice. This would also moderate the effect of the status quo bias. Along with providing free technology, an additional policy recommendation is to reduce bureaucracy, particularly the application procedures for mobile banking accounts. These could be offered through a one-stop shop with flexible guarantee requirements, for instance as a package with a trial period. The problem of lack of information can be addressed effectively once the application bureaucracy is eased, through information campaigns to reach out and assist SME owners to apply for mobile banking accounts.

The third scientific paper within the 'Finance for Productivity Growth' theme investigates interactions between access to finance and employment creation for educated workers. The research shows that the extent to which micro and small businesses expand skilled employment, as their sales and profits increase, depends significantly on access to external funding. Firms with positive performance and a bank loan will hire more trained and experienced employees. Thus, growing and profitable small businesses create more jobs for trained and experienced workers - which is interpreted as demand for skill - if they have access to external finance. The analysis does not reveal a significant relationship in the case of hiring casual employees or family and friends in the informal context, suggesting that financing constraints are more likely to bind in the context of employment contracts associated with experienced and trained employees with high human capital intensity.

Regarding policy, the research findings underline the importance of well-developed financial systems for policies focusing on job creation. Firms with greater financial flexibility are more likely to hire skilled labour once their performance improves. For policy makers focusing on the challenge of creating formal and permanent jobs in a developing society, devising a complementary financial sector policy is equally important. The policy

should go beyond helping firms directly to strengthening efficient financial systems and credit programmes as well. Better access to external funding can thus be an accelerator of human capital investment demand and growth. Policy makers must also acknowledge that firms which are financially constrained save a greater proportion of their additional profits (or pay other expenses associated with financial constraints) and therefore cannot invest further in greater levels of employment. If access to finance is difficult, one could question the optimal effectiveness of employment creation policies. For government, interest rates by state banks would be a first point of attention in policy efforts to create formal employment of higher skilled labour. Against this background, policy monitoring systems for employment creation could include the degree of access to finance. Looking at it from the other side, formal credit policies and programmes could include formal job creation, since the two are linked.

Highlights of DFID/World Bank EIP-LIC survey Kenya

The Kenya Country Report highlights some important descriptive statistics capturing variables such as turnover, number of fulltime employees, labour productivity, and gender diversity of firms in Central, Nyanza, Mombasa, Nairobi, and Nakuru provinces in Kenya.

Export status and origin of material inputs and supplies is contrasted with that of economies in various regions with the aim of providing a background to the study context. Essentially, it is observed that the firms in our sample report larger proportions of indirect exports. This suggests that firms may consciously produce with the intention of supplying products to third party exporters or may do so in a bid to circumvent bureaucratic red tape associated with a weak trade and customs regulatory environment. Additionally, sampled firms generally rely on domestic inputs. Some possible explanations include availability of alternative local suppliers and purchasing from local importers. Nevertheless, we also note that countries in SSA are highly dependent on inputs of foreign origin relative to countries in other regions. These contrasting results indicate that on the overall, SSA imports large quantities of raw materials and technologies from foreign suppliers.

Regarding innovation activities, this report also highlights the topic of innovation where reported measures of innovation, innovation activities, sources of information for innovation, and barriers to innovation are discussed extensively. The difference between the percentage of firms reporting innovation in Kenya and the EU-28 firms is accentuated. We explain that it is highly probable that self-reported measures of innovation may focus on less incremental forms of innovation, which is likely to be the case for Kenya. Regarding innovation activities, it is observed that R&D activities are regarded as less important innovation activities relative to new equipment and formal training. This indicates that firms are more likely to invest in physical assets and human capital as opposed to internal R&D.

With respect to sources of information for innovation and barriers to innovation, we also note that customer feedback is the most important source of information for innovation. This observation suggests that a high premium is placed on customers as a source of ideas for innovation. This section also reveals that high costs of innovation, lack of internal funds, and lack of external finance are perceived as the most critical barriers to innovation in Kenya. This may suggest the existence of credit constraints.

Dynamic capabilities, trust, and relationship with external actors including institutions are described in the context of the firm's operational environment. A striking observation arises from the two measures of trust where we observe that on average that firms in Kenya trust their business partners much more than they trust government institutions. This suggests that business dealings with the government pose major impediments to a majority of firms in their operations. Thus, firms are likely to be operating in an environment with weak

institutions (see Barasa et al., 2017). Furthermore, we also observe a somewhat high degree of embeddedness of firms indicating that firms have higher likelihood of benefiting from information and opportunities within their sphere of economic activity.

Gender diversity is observed to be context specific to a large extent. Regions characterized by matriarchal societies such as Central are likely to have more women as owners and top managers. The level of urbanization may also play an important role in fostering female workforce participation. The role of gender diversity is of importance in fostering innovation performance. Female ownership is positively associated with innovation performance. This indicates that the role of women in driving the innovation process should not be overlooked especially in the manufacturing industry which is likely to be male-dominated at all hierarchical levels.

With regard to linkages with external actors, one major observation is that well-functioning institutions benefit commercialization of innovative output. We also find that relative to in-house and collaborative innovation activities, firms that acquire foreign technology increase their innovative output. Furthermore, cooperating with other firms and consultants significantly affects innovation performance lending credence to the positive influence of horizontal spillovers. Notwithstanding, firms cite market dominance by established firms and lack of cooperating partners as major impediments to the innovation process. This indicates that innovating firms are likely to be operating in markets with limited freedom of entry for new products and services. Moreover, lack of cooperating partners as an impediment to the innovation process implies that linkages between firms, universities, and research institutes are likely to be weak but very important because we find that linkages with domestic and foreign firms, and private consulting companies/individuals are positively associated with internal R&D. Furthermore, linkages with domestic and foreign forms are also positively impact external R&D. Nevertheless, linkages with academic and research institutions seem not to matter for innovation in the context of Kenya. The role of government is also shown to be important for fostering innovation in the manufacturing industry. Specifically, financial support from government agencies and departments is critical for engendering innovation.

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 'Kenya Country Report' presents a summary of the key findings of EIP-LIC research of Kenya 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 abd 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 Kenya. Annex 2 and 3 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 and productivity policy and research issues in manufacturing SMEs in LICs. The qualitative research findings for Kenya 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 Kenya.

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. 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 Kenya

3.1 Case study method

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 Kenya. Applying a case study approach is particularly useful in this respect, since this method is an approach for inductively exploring and identifying concepts, noticeable similarities, trends and patterns of socio-economic phenomena (Yin, 2003).

The case study research in Kenya involves a series of 20 interviews with managers and/or owners of manufacturing SME in Nairobi and around. The qualitative data collection through interviews took place from 19 – 29 May 2015. 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 Kenya, accessible via the project website, we present three cases below to provide some insight on the daily realities of SMEs in manufacturing.

3.2 Selected cases

Case 1: Automobile spare parts - Engine gaskets (25 employees)

The first case concerns a company in Nairobi that manufactures engine gaskets for the Kenyan market, and also imports original gaskets from various well-known car brands. It is an Indian family owned business, established by the current owner's father in 1994. The company is a main supplier of a large assortment of gaskets and employs 25 workers, mostly technical staff in the manufacturing of gaskets. The company is located in the

industrial area where all mechanics shop, and workshops are located within a 2-3 kilometre radius. All the spare parts shops are on one road.

The manufacturing process basically consists of the development of a die (mould) for punching the gaskets. There are about 20 to 30 types of gaskets per car. The workers product the dies manually with jigsaw machines, which requires fine craftsmanship. The die is completed by inserting in metal cutting strips. Once the die is ready, the workers punch the gaskets from various materials with a press machine. The material is imported from India, China and from the UK. The company has not registered a product patent or brand trade mark.

The company holds a large stock of produced and imported gaskets - "we have thousands of different gaskets" - but this seems not to pose a risk. In Kenya, cars are driven for many years and are repaired over and over again. Stock management and administration is handled by a combination of books, computer records and the personal experience of the production manager of the workshop, who has worked for 40 years in the company.

Innovation and internal capabilities

The owner is aware that the equipment and machines are becoming outdated. The jigsaw machines do not provide the accuracy required these days, and some customers have complained. He is planning to buy new machinery. He has a network of clients who have suggested directions and ideas for innovation and ideas -"in Kenya the business community is very open and there are many informal contacts". He made various business trips, to trade fairs in India and China amongst others, and saw new technology products for manufacturing dies and gaskets.

He has identified a computerised laser machine, produced in Germany and China, which is able to produce accurate dies for gaskets very rapidly. The owner realised that if he wants to stay in the market, he will need this machine, and is now arranging to make a purchase. He is in a dilemma because the product is expensive - the price ranges between 100,000 and 150,000 Euros - but it will enable him to attract more customers and expand the business. Regarding risk taking, the owner developed a remarkable view on calculating and analysing returns and risk in detail - "the biggest mistake is to calculate everything; my biggest mistake was to do an MBA, now I am scared". He refers to people in Kenya who do not have an understanding of detailed calculations - "they just put things to work, if it doesn't work they then forget it."

The company has a production manager, sales and production staff. Within the company, it is the owner who comes up with the initiatives and ideas for innovation. The production manager and the production staff only (but often) suggest improvements in the manufacturing process of the dies. It might happen that a client makes a mistake in the design of a cardboard box, for instance, which the worker sees and corrects. Besides this, the production staff are simply given instructions for production and are not involved in exploring new advanced technology or technological innovation.

Staff turnover is low. The workers are dedicated and loyal to the company, and most have been employees for 10 to 15 years. The owner values the skills and motivation of the workforce, many of whom are specialised craftsmen. The owner also recognises that they are fast learners. A new worker, usually a young person, is trained

on-the-job by the production manager. Older workers also take the initiative to help newcomers learn how to operate the machines: learning by doing.

The workforce have very little experience with computer and digital production technology and machines, which the owner identifies as a gap in education in Kenya. Another problem is that other companies sometimes "hijack" good workers from his company, as soon as they find out that the workers are well-trained, skilled and experienced. This discourages the owner from providing formal training for the workers.

Nor does the owner give workers slack time to develop innovation activities. He is aware that some employers encourage creativity in their employees, who come up with ideas that might improve the company, but he has never tried it. He is aware that there is a good deal of creativity among his staff, but he has never been able to tap it - "if you train people, if they are more exposed to other ideas, that could help".

External business and institutional environment

With regard to investing in the new machines, the key problem is finance. Getting financial backing for an innovation idea is a "big headache", according to the owner. The owner is now considering his options. The interest rate of Kenyan banks is 16%. The owner argues that he has to make sure that the laser die machine assures a profit margin of over 16% to cover the interest.

The owner has heard that the Kenyan government aims to promote innovation, but his company has never participated in a programme nor benefited from a policy. In fact, his experience with governmental institutions is not positive – "at least two government officials are coming every week. They check permissions, regulations etc. and impose all kind of 'taxes' and bribery". He mentions that government officials harass the company all the time. At the company's location in Nairobi, they are located right on the front line - "you have the customers walking in and you have the Government officials walking in".

Regarding other technical support, an NGO, the Don Bosco Missionary, has a full training facility, good light machine operators and also does some engineering work. They provide the company with machine parts.

There are only three manufacturers of gaskets in Kenya, so there is little competition. All companies are similar in size. There is little competition from other importers. The owner sees it as essential to establish a good relationship with customers and provide good service. Pricing is also important, but the owner's experience indicates that clients are willing to pay a slightly higher price for a good service.

As an Indian, the owner has strong ties in the Indian community in Nairobi. Enterprise owners and managers in this community often help each other. He will regularly call a friend if he has a question concerning a certain technology or supplier. In his experience, when starting a business, family and friends are critical in supporting the start-up. In the Indian community especially, relatives support each other, by providing new businesses with orders.

Case 1: Personal hygiene products – Tissue paper products (42 employees)

The company, launched in 2006 by a female Kenyan entrepreneur, produces tissue paper. Located in the industrial district of Nairobi, the company employs 42 workers, of which 30 are women and 12 are men. The company has advanced machines that cut pulp paper into tissue paper and subsequently package the products. The input – pulp paper on a big roll – is purchased from a supplier in Kenya. This supplier imports the raw material from Uganda and the virgin paper from Egypt. There is a paper pulp recycling plant in Kenya, but it is too expensive.

The products are sold to small and medium supermarkets in Nairobi, but not yet to major supermarkets. Initially, the owner and her staff delivered the products themselves, but she now has contracts with distributors that deliver the products to supermarket chains. The owners recently expanded the range of products to include hand washing soap, shampoo, nappies, paper napkins and kitchen towels.

After repeated burglaries, the company moved from their original site on the outskirts of Nairobi to their current location in the South-eastern industrial district. They enjoy the protection of the security service of a bigger company nearby. The rent is higher than their original location, but it is more secure.

Innovation and internal capabilities

Before staring her company, the owner was a distributor for a large foreign soda company in Kenya some 5 years ago. She did not enjoy the work as a sales representative; she was "dreaming" of owning a company and a brand by herself. Reflecting on fast moving consumer goods with constant demand, she came up with the idea of tissue paper. She saw a good opportunity and good prospects because more and more people in Kenya are adopting better hygiene habits. There are few local producers of tissue paper in Kenya. She started to collect information and went to supermarkets, bought several ranges of tissue paper products to explore and learn the details. Nobody believed in the idea and her plans – "not even my own family".

She borrowed a small amount from a women's credit group to start up the business. She registered a brand name. Then, instead of producing tissues by herself, she bought some existing tissue products. She re-packaged, re-branded and sold these in order to test the market for her own brand name. After the first prompt sales, she became convinced of the opportunity. She approached the Kenya Women Finance Trust, a specialised bank for women-owned companies, for a larger amount enabling her to produce by herself. The signature of her spouse was a prerequisite (in Kenya the man usually owns collateral). She agreed with an Indian business woman to lease a machine for a few shillings per day. She started to produce good quality tissue paper, a premium product. Initially, revenues were still very small. She and her only employee had to do all the work - "I was the sales person, I was the tea girl, I was the sales representative, I was the manager, I was the accountant, I was everything".

With the first commercial evidence, she successfully approached the bank for another loan to establish a production plant herself. She learned that she could buy such a machine in India. In 2011 she went to India to investigate and buy a machine. The Indian manufacturer taught her how to make tissue paper, serviettes, and facial tissue papers. Once in operation in Kenya in 2013, she employed 21 people and introduced a lower-quality tissue paper product for a larger market.

Again she looked for ways to improve her business, as the Indian machine was semi-automatic. The employees had to do the gluing, cutting and packaging manually. She found that more advanced machines were available in China. She and her husband, who by this time had left his regular job and joined her business, toured through China. The bank was supportive and enabled her to buy 4 machines, with ten times the capacity of the older machine from India. The new machines are able to produce a range of products: paper napkins/serviettes, facial tissues, kitchen towels and disposable handkerchiefs. With the new multi-purpose machines, they are able to produce new products. She is currently expanding the range of products into cleaning and hygiene products, including hand washing soap, shampoo, conditioners and industrial detergents.

She had to struggle a lot for many years, but she is enjoying great inner satisfaction – "the company is mine'. Besides running a good business, she wants to create employment opportunities, in particular for women. She considers that a social obligation. In her view, creating employment for women has a particularly positive societal impact because women feed their families and can be more independent. The company pays for their employees' health insurance.

Running the business involves a top-down management approach. She is the director, does the marketing and sales. The director develop ideas for new technology and new products. She listens very carefully to the needs of the clients. The buyers provide ideas for innovations, by doing new patterns or printing patterns. Sometimes the employees also have ideas for improving production. Her husband takes care of the technical operations. The finances are run by their son, who recently graduated from university. All staff have been loyal so far - no one has left since the start the company. In the morning they have devotional meetings. Staff members are invited to come forward with a comment, worries and concerns.

The employees are trained on the job. When the machine from China came, it was included in the agreement with the Chinese supplier that an engineer would teach the operations manager and staff for 10 days. This included the operation of the machine, replacement of spare parts and repairs. In fact shortly after the installation of the machines, there was a technical problem and some parts had to be replaced. Fortunately local people are available who can do such repair work.

External business and institutional environment

The director is not aware of government innovation programmes or polices. She benefitted from networking events organised by the government, such as COMESA exhibitions, drawing manufacturers and suppliers from other countries, which are a good opportunity to identify new products, interact with manufacturers and talk about branding and registering one's own brand.

She mentions that government laws and regulations are easy to follow. There is one concern, that the law in Kenya requires a company to join the labour union once it has more than a hundred employees. She is reluctant to join the labour union, which will force her to employ workers under their terms not under her own - "It is a good thing if I was employed but it's not a good thing for the employer". She considers the unions to be stronger than the employer who is creating the employment.

An essential element in her entrepreneurial experience was her participation in a short training course on women entrepreneurship organised in 2011 by USAID (an American bilateral donor). The course provided good insights into business planning, organisation and management, accounting, public relations and marketing. The course also underlined the necessity to collaborate and network with other organisations. She joined the Kenya Association of Manufacturers (KAM) and the Kenya Association of Investors. She already had contact with the Kenya Bureau of Standards during the process of registering her brand. She participates in regular KAM seminars.

Her early days as a female entrepreneur were not easy. Within her family and in business circles, she felt that she was initially not taken seriously. Other businessmen would say that "she is after another man". She encountered the idea that a woman should not be in business. Securing credit and the formal proprietorship of the company with her husband was also a complicated procedure to sort out. Kenyan law on business ownership by married women is complex and biased towards men.

However, entrepreneurship in Kenya is now somewhat easier for women than before. Kenyan men still think women are not up to it – "in tendering they still think that a woman entrepreneur cannot do it" – and they must run both the company and family affairs. Women owners have to be very careful in shift timings, in that men can work overnight, while women cannot. There are other obligations in social life such as church commitments – "When you are doing well, they expect you to be their leader and inspire other women."

After the USAID entrepreneurship training, the participants formed a group called 'Magnet Mothers'. This informal group support female entrepreneurs in doing business better and learning business skills together. Successful entrepreneurs give assistance to other members in business skills. For the owner of this firm, the satisfaction of running her own business motivated her to help others. She sees and shares the value of networking – "together you can go very far. The group will bring ideas to you because as you share with them they also share with you."

Case 3: Textile and clothing – Kikoy beach towels (70 employees)

The company producing Kikoy products was established in 2010 by a young Kenyan entrepreneur in Mombasa. After coincidently meeting European customers looking for Kikoy products, he suggested – without having a production facility - that he could deliver much better quality than the available products. Having secured an agreement, he quickly established a business in Mombasa that included four sewing machines employing 10 people. The newly established entrepreneur quickly found out that with high quality materials and accurate stitching, his business could be a success.

Shortly thereafter, the owner got word about a newly constructed 'Export Processing Zone (EPZ)' in Nairobi. The idea of a government-funded EPZ is to set up an attractive investment environment for export-oriented businesses. The EPZ provides tax incentives (no corporate tax for 10 years, export and VAT tax holidays amongst others) and provides infrastructure and facilitation in export procedures, logistics and acquisitions. In 2012, the company moved to the EPZ near Mombasa Road in Nairobi.

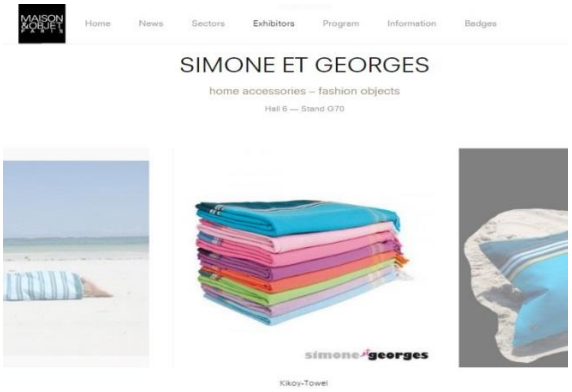
At the EPZ in Nairobi, the company grew rapidly and specialized in producing their main product: Kikoy beach towels. The Kikoy beach towel is 2 sided: one side toweling and the other the Kikoy. At present, the company has 26 sewing machines employing 46 people. The company exports to Europe (Denmark, Germany, Italy, Spain, France, The Netherlands and the UK) and to Japan.

They wish to export to the USA - a big market - but do not do so yet. The problem with the American market is that the input textiles are locally produced and the quality does not meet American standards. The company adds the brand names of their customers, such as Simone & Georges, who advertise the product on their website as "a colorful sarong lined with a very thin towel. This best seller is a funky fashion solution for the beach and also for home use".

Innovation and internal capabilities

The product is subject to a seasonal production cycle, following the sales season in the European shops. April to September is low season for Kikoy. This year, the company sold 80,000 pieces, but next year the order will reduce to 40, because there are still products in stock. So the market is saturated at present.

The changing demand for Kikoy beach towels forced the company to think about new products. The owner sees the necessity to introduce new products. Last year the company started to produce leather bags with Kikoy fabrics on the inside. A Spanish customer asked the company whether they could manufacture bags as well. They sent some samples and suggested using Kikoy fabric on the inside. The company developed some test bags accordingly and sent them back to the customer in Spain, who then placed a larger order.



The staff are also developing some products using ideas from the owner. The company has a small space for design and product development, where they are currently working on an idea to produce hotel textile items such as bed sheets, pillow covers or towels with a Kikoy lining at the end. The company is currently testing this and buying input from a local supplier. The owner believes that this could be a good product because the hotel business is relatively constant - customers never stop going to hotels.

Another recent opportunity arose when a friend of the owner placed an order to stitch 50,000 gowns. This friend owns a production factory in Indonesia where they manufacture gowns to be sold in Egypt. This friend visited the Kikoy company, and the owner explained about the low production of beach towels in the low season (April – September). The owner asked his friend whether he could undertake some of the gown production, in order to retain his skilled workers. Instead of doing the production in Indonesia, the friend asked to do the production in Kenya and export it to Egypt, which is an easy and convenient procedure at the EPZ.

Innovation is essential for the continuation of the company. The owner wishes at all costs to avoid laying off skilled and experienced workers, because getting these people back is a problem. Hiring new staff and teaching them to stitch takes 2 to 3 months. The owner does not want to lose staff because they have unique skills – "it's not everyone who can do this".

Ideas for new products and securing new orders come from the production manager and the owner.

The owner does many business trips to Europe. He employs a designer who develops ideas for new products from pictures in magazines or websites. It is essential that the new products sell well, because the development is costly – "if you don't get someone with that innovative spirit, the business cannot work".

External business and institutional environment

There are no specific innovation regulations or policies at the EPZ. The owner sees many advantages in being at the government-supported EPZ, which provides an environment with a good supply of both employees and customers. To do business in the EPZ, a firm must be exporting outside the country.

The EPZ management organize customer visits, taking company products to display elsewhere, and sometimes bringing customers back. Other people come to visit the factories. Outside the EPZ, it was difficult to convince potential clients to come, but when they come to the EPZ office, they see the company profile, and sometimes come in. The company has secured 2-3 customers in this way. At the EPZ, the manager finds the taxes and government regulations transparent and easy to complete, much easier than outside EPZ. The EPZ provides clear information about government regulations.

Outside the EPZ in the past, a company had to pay various taxes (VAT amongst others). If products are exported, the company can reclaim the taxes because the product is not sold on the local market. However, while in Mombasa, the company found that this reclaim procedure was very lengthy. Indeed, reclaimed taxes from 2010 to date have still not been refunded, which makes business complicated.

The owner feels that the EPZ is a good location, much more efficient, in particular as regards export procedures and paperwork. Before the company entered the EPZ, they had to take their products to the airport, and complete the documentation and procedures by themselves. It usually took a week before the products could actually be shipped. Now, thanks to the efficient customs office at the EPZ, if the product is finished by 3 pm, then by 6 pm it is at the airport with the procedures completed and ready to go.

Regarding support for innovation, customers in Europe demand quality standards and regulations with which the company has to comply, which stimulates the company to produce high quality products. The clients first ask the firm to deliver a sample. The customer in Europe will check the quality, stitching and packaging and then give the go-ahead for the company to start producing in bulk.

The process of marketing and finding customers has changed fundamentally. The owner now only infrequently goes out and visits customers. These days, most of the customers search and find textile producing companies via their websites, and it is through its website that the company gets most of its customers. Only last year, the owner met a customer in person for the first time, having supplied them with products for three seasons (a year) - "That is how business goes these days".

The owner identifies the secret to their success as pursuit of quality, hard work and doing many things by themselves -"we are trying to squeeze ourselves to develop it; to make it happen". The owners and managers are passionate about their job.

3.3 Research and policy issues

Innovation definition

The qualitative research shows that the owners and managers in all the interviewed companies, in different ways, introduce new products, new processes, new technology, or machinery in order to improve and expand their business operations. In advanced economies' innovation terms, in which R&D expenditures and number of patents are typically measured (OECD, 2005), these cases would not be assessed 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.

However, taking a broader perspective on innovation, viewing it as a more incremental adoption and adaptation or new combinations of existing technologies (Szirmai et al., 2011), it is evident that the new elements introduced in the interviewed companies resulted in better and more efficient business operations, creating value. 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 a problem (Çapoğlu, 2009). How should researchers distinguish innovation in LICs from other activities? The broadest possible definition of innovation would be everything new that the company does to survive and be ahead of its competitors. Innovation could be considered as a 'means' towards the ultimate objective of raising productivity and increasing competitiveness. A cross analysis of definitions in innovation theory from recent decades shows that innovation is repeatedly typified by three key elements: newness, process and value creation (Voeten et al., 2011).

Addressing the first element, Kotabe and Swan (1995) argue that innovation can be investigated in terms of both newness to the company and newness to the market or world. Although the new products and new processes in the interviewed Kenyan companies were not radical and 'new to the world', they were new for the companies, as units of analysis. Interestingly, most company owners and managers did not perceive their incremental adoption, adaptation and new combinations of existing technologies to be innovation. They associated innovation with a radical technological invention or breakthrough. In many innovation definition and measurement documents, such as the OECD Oslo Manual (OECD, 2005), an explicit distinction between product, process and other forms of innovation is made. Kaplinsky and Morris (2001) identified 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 organize 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.However, the Kenyan cases show a combination of new technology, new processes, new products and new clients within the companies. One could not unambiguously distinguish one type of innovation within the interviewed companies.

Regarding the second element, the innovation *process*, all owners and managers themselves initiated, managed and owned the innovation process within the unit of analysis, their company. They developed the idea, sometimes inspired by others, started to run small experiments and trials and eventually implemented the new product or production technique on a commercial scale. As is often the case in incremental innovation, this is not a planned and formalized process involving a pre-defined innovation strategy and an R&D department. In fact, all the innovations observed in the cases are the product of experiential learning and a process of doing, using and interacting (DUI), as earlier described by Lundvall et al (2009).

The third element, *value creation* of innovation, is evidenced either through lower input costs or higher sales revenues (Porter, 1985). Higher profit through new premium products of better quality, or appealing to a certain fashion increases competitiveness. Several of the interviewed companies clearly pursue a higher sales revenue strategy via high quality, while others invest in machinery that is faster and brings lower input costs, which raises labor and capital productivity.

Table 1: Summary innovation manifestations observed in 8 cases

Case #	***Novelty***	***Value creation***
1 Automobile parts	Process (technology) – laser die machine	Faster production raising productivity and quality (competitiveness)
2 Tissue paper	Process (technology) – machines from China Product – tissue paper, hand washing soap	New markets, competitive products
3 Kikoy	Business practice – export in EPZ Product – gowns, hand bags	High quality and competitive edge in exporting, survival

Internal capabilities

Many of the innovating entrepreneurs are in pursuit of high quality products – this contrasts with the general idea in Kenya that local products are of poor quality. The owners of the interviewed companies are well aware that quality counts, and creates an opportunity for an alternative to cheap (counterfeit) imports.

The EIP-LIC research agenda includes an assessment of firm-level barriers, which refer to the internal capabilities of the companies. A common feature in all cases in this respect is the resilience of owners and managers, who all have a clear vision, determination and persistence in setting up their business as well as a 'drive' to continually improve their business operations.

The SMEs typically have a workshop or production hall where the employees work with machines and are sometimes organized in production lines. The SMEs have an organogram of separate production, marketing and finance departments. The marketing department is typically large in most companies and includes the marketers, sales persons and the delivery staff.

The owners generate and launch new ideas. Although ideas from the workers and production managers are generally appreciated, they only suggest improvements on the production level. Except for creative design activities, the owners indicate that most of their employees have little knowledge or exposure to new technologies, products and other outside information. The management of the innovation process does not follow a planned and 'projectified' strategy involving a research department, a cost-benefit analysis of R&D expenditures and a financial forecast. The owners and managers of the interviewed cases simply work step-by-step and see what works and what does not.

The owners mention that the skills and knowledge gained through formal education do not match the company's requirements. Moreover, it is difficult to find skilled craftsmen to do the manual manufacturing work in Kenya today. Despite these shortcomings, no interviewed company provides additional formal training for the workers, opting instead for on-the-job training. Some owners are reluctant to provide formal training because they are afraid that workers will move to other jobs. However, workers are loyal and have worked for a long time in most of the companies. Most owners and managers do not give employees free time to develop their own ideas, except for design activities. The workers do what they are told to get the job done. Some owners acknowledge the potential innovation capacity within the workforce, but this is not applied in practice. This outcome suggests a research focus on the development of capabilities and the possible positive impact on innovative performance (further elaborated below in the section on implications for EIP-LIC research questions).

Several owners explicitly mentioned that they did not establish the company for profit reasons only. The sense of fulfillment and achievement ('passion") gained from setting up the business is valued, regardless of how difficult it is to make ends meet. Owners take environmental and social considerations into account, and go 'beyond compliance' in terms of employment creation for the community stakeholders, and women in particular, and contribute to poverty alleviation. In the literature, most examples of responsible entrepreneurship and

Corporate Social Responsibility (CSR) concern advanced and large business operations (Hart, 2007). The cases show that these considerations also apply for several managers of manufacturing SMEs in Kenya.

Formal institutions

In innovation systems theory, innovation is not considered as a firm-level effort only. The support of a network of formal institutions, or innovation system (Freeman, 1987; Lundvall, 1992) is critical, complementing government Science, Technology and Innovation (STI) policies (Kuhlmann et al., 2010). Innovation system institutions include R&D and technology development centers, innovation and research funds, the financial and banking sector, universities and education institutes, patent registration bureaus and certification offices, to name a few. Governments in most LICs today, including Kenya, see the importance of promoting innovation via setting up and strengthening innovation system institutions and are developing STI policies accordingly.

However, the contemporary reality of the interviewed companies is different; there was no support of formal innovation systems institutions in their efforts to innovate. All the owners mention that they are not aware of innovation policies, nor did they benefit from or participate in innovation support programs. The innovation systems theory involving formal and (semi-)governmental support institutions, such as technology development centers and universities, did not apply for the interviewed companies.

In fact, most owners referred to the fact that the formal government institutions, represented by the government officials, make their business environment even more challenging. There are unclear business and tax regulations. While usually entrepreneurs in any country complain about government taxes, the situation in Kenya is even more stressful and unpredictable as a result of bribery and corruption. As a result, most companies are careful to avoid external exposure, which would attract government officials. This is not in line with common marketing practices of advertisements and other PR signs that attract clients. Owners consider this a trade-off dilemma. While entrepreneurs need a formal institutional context that assures stability and predictability, the Kenyan reality seems to be the other way around, implying extra uncertainty and risk. This is a notable outcome of the case descriptions, adding to the insights gained by the project surveys.

The banking sector, as another formal innovations systems institution, is not providing credit to most of the interviewed companies. The owners mention yearly high interest rates of banks ranging from 16 to 25% per year, which is difficult to cover, given the low profit margins of their operations. The owners face challenges in obtaining finance at a viable rate, for instance through banks or government funded foreign loans. Some companies are in contact with formal institutions such as the Kenya Industrial Property Institute (KIPI), responsible for examining and granting patents in Kenya. The Kenya Bureau of Standards checks food quality. These institutions are considered useful for their business sectors. In two cases, NGOs provided training and support: vocational training and women's entrepreneurship training. These initiatives were very much appreciated by the participating owners.

Business system

Instead of the narrow theoretical and STI view that the innovation system is an exclusive concern of (semi-) government institutions and policy, recent theoretical ideas about innovation systems and policies in LICs show that actors can also be understood as business system and value chain actors (World Bank, 2009). The cases confirm several ways through which the business system stimulates innovation.

Competition is one example of mutual interaction that stimulates innovation. A competitive environment forces businesses to stay 'sharp' and look for innovative ways to do better than their competitors. As confirmed by the owners of most cases, a key challenge for the Kenyan context is competing with imports and cheaper counterfeit products from China and India. The low quality of imported products is considered by several companies as a

motivation to innovate, focusing on affordable durable consumer goods. Developing firm capabilities is critical in a competitive environment, since internal capabilities significantly contribute to the innovative performance of companies in dynamic institutional and business contexts (Teece, 2007).

Regarding the demand side, most interviewed companies are client-oriented and see the need for innovation to respond to changing demands. The clients often come with requirements and suggestions, to which most owners are attentive. The marketing teams come with product improvement suggestions, as well as export client and partners. In these cases, the buyers and clients are the driving force for innovation, corresponding to the theory distinguishing buyer-driven from producer-driven value chains (Gereffi, 1994).

Many ideas for innovation, and available technology in particular, come from the supply side. Researching supplier web sites to identify existing technology that could be adapted or adopted to the local context, was not considered a major challenge. Most owners and managers are well informed by suppliers about the technology options required for manufacturing SMEs, and the country from which they can be sourced. Another form of mutual interaction within the business system is establishing joint innovation projects. In the interviewed cases, no companies developed collaborative projects, and there were no examples of informal cooperation. Technology spill-over through subcontracting did not take place.

Informal institutions

The role of informal institutions supporting innovation is increasingly acknowledged in innovation in LICs. Informal institutions are broadly understood as links and ties with networks of friends and family and social capital, but are also considered as the informal 'rules of the game' including traditions, culture, habits and mental models (Scott, 2001).

Most company owners mentioned that friends and family were critical in the set-up and survival of the business. These networks provide a safety net as well as encouragement and stimulation. This informal institutional context, acknowledged in DUI practices described by Lundvall (2009), takes over the role of the insecure formal institutional context and provides stability and predictability.

Beyond family and friends, informal channels and contacts within the business sector and government agencies are essential for getting orders and winning tenders. The interviewed companies source credit mostly from informal financial institutions, as bank interest rates are too high and have complicated loan conditions. Most of the companies were given informal loans and gifts by family and friends. Informal money lenders, or 'Shylocks', demand even higher interest rates, but provide flexibility.

As is often observed, many businesses in Nairobi have Indian owners, forming a strong community. The Indian population came to Kenya as early as the 1940s, brought by the British colonists for railway construction projects. Many families have been in Kenya for generations and gained Kenyan nationality. Over time, newer Indian arrivals settled in Kenya, principally to start a business. The original Kenyan population accepts the presence of Indians and takes a pragmatic attitude - *"The Indians provide jobs and stimulate economic development"*. During the interviews, no conflicts were mentioned between the groups - *"there are more conflicts between the indigenous local tribes in Kenya"*. Many mention that the Indian population is well integrated in Kenyan economic life and society. At the same time, the Indian community is quite a close and independent community – there are few interracial marriages, for instance. They informally help each other in setting up business, and often live in the same areas, families taking care of each other's children.

4 Innovation systems

The 'Innovation System' team produced six scientific papers with special reference to Kenya. The first paper analyses the relationship between firms' human capital endowments and firm-level practices to improve innovative output. The second paper reviewed regional institutional quality involving data from Kenya, Tanzania and Uganda. The third paper addresses research and development within firms decrease technical efficiency. The fourth paper investigated the bi-directional relationship between innovation and exporting in four countries in Sub-Saharan Africa. The fifth paper assesses whether innovation directly influences exporting behavior, because firms apply innovation as a strategy for gaining an international market share. The sixth paper analyzes 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.

The research within the 'Innovation Systems' theme was based on several existing as well as original datasets collected in Kenya within the project framework. In cooperation with the World Bank, as survey among 549 firms in Kenya was carried out. In additional three waves of data were used comprising data from the 2013 World Bank Enterprise Survey, the 2013 Innovation Follow-up Survey module, and the 2015 Innovation Capabilities Survey.

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 Human capital and innovation

The first scientific paper focuses on the role of internal human capital, or the skills, abilities and knowledge of the employees, as an important source for innovation within firms. The existing studies offer little insight into the relationship between human capital and innovation at the firm level, particularly in Low Income Countries (LICs). This is especially important because most innovation within manufacturing SMEs in LICs occurs incrementally via learning by doing, for which human capital at the firm level is critical. In the paper entitled 'Human capital and innovation in developing countries: a firm level study' Van Uden and co-authors analysed the relationship between firms' human capital endowments and firm-level practices to improve innovative output. The data collected (survey) concerned a sample of SMEs in Kenya, Tanzania and Uganda (2,076 SMEs in total).

Research findings

Regarding the question whether employee schooling is a critical factor, the research shows that a higher level of schooling enhances employees' ability to understand, create and process information more quickly within the firm than individuals without education. This is conducive to innovation, since it is a knowledge-based activity. The research showed a marginally significant effect of employee schooling level within firms on the likelihood of being innovative. Employee schooling is a relatively unimportant factor for innovation within SMEs in Kenya, Tanzania and Uganda.

Formal company training refers to the extra training that employees receive from the firm and provides employees with specific knowledge, because many skills are not learned during general basic education. The research demonstrates a strong relationship between formal company training and the probability of producing

innovative output compared to firms that do not provide formal training. Having a company training programme more than doubles the likelihood of a firm being innovative, from 23% to 47%.

Slack time gives employees the resources to work on their own ideas and encourages creativity to transform the available and general technological knowledge stock. The research found that a firm that gives slack time to its employees has a higher probability of producing innovative output compared to firms that do not give slack time to their employees. The size of this effect is even more pronounced than that of formal training: offering employees slack time results in an increase in the likelihood of being innovative from 23% to 54%.

Interaction effects: The research found that employee slack time in combination with the amount of employee schooling within a firm does not strengthen the other factor's effect on the probability of producing innovative output in the manufacturing industry. However, any level of employee schooling or offering employee slack time will increase a firm's likelihood of being innovative. For firms that already offer employee slack, a strategy of hiring more educated employees might have negative consequences for innovativeness. It was assumed that offering both formal training and employee slack time would be counterproductive, as formal training might reduce individual creativity, on which employee slack relies.

Policy implications

Van Uden and co-authors show that the internal human capacity of the SMEs surveyed in Kenya, Tanzania and Uganda has a significant impact on the innovative output. In fact, the study shows that the internal practices for stimulating knowledge development and creativity for innovative ideas, such as formal company training and providing slack time, have a more profound relationship with innovation than traditional factors such as formal education and formal R&D.

The importance of the internal practices revealed in the study appears to be somewhat at odds with current innovation policy thinking, which is based on an innovation systems approach focusing on technology development through setting up networks of formal R&D and educational institutions around the firm. In fact, the small incremental product and process innovations and adaptation of existing technology observed in the SMEs were not the result of innovation system institutions; rather from internal learning by doing, using and interacting. This study suggests that SMEs equally (or perhaps more) benefit from policies that strengthen their internal human capacity, rather than from policies promoting surrounding R&D institutions. This implicitly leaves the initiative and 'ownership' of the innovation process (technology development) much more within the SME.

Formal company training can be either general training that upgrades the capabilities of the whole workforce or specific training that improves specific knowledge or skills. Promoting the creativeness and innovative output of employees can be a learning objective of both forms of company training.

Government agencies could develop special policies and programmes that encourage and support SMEs in providing formal company training. This could take the form of awareness raising programmes explaining the particular benefit of company training for innovative output by employees. Government or development agency policies and programmes could assist in the development of formats and curriculum for such in-company training programmes. Governments could introduce certain tax advantages, subsidies or other incentives for supporting company training. Such tax advantages could be linked to innovative output.

With regard to SMEs' managers and branch organisations, their internal/company policies could focus on conducting formal training linked to the creativeness and innovative output of employees. This training could reflect and encourage a proactive and creative attitude and the freedom to develop ideas on the shop floor.

Instead of passive employees working in a formal top-down management structure, a changed mentality enables employees to take ownership and initiative. Management could encourage creative thinking by their employees to stimulate innovation. Within business, managers can initiate a change of attitude and organisational culture from top-down towards allowing some freedom and ownership in the innovation process and technology development; allowing failures and rewarding innovative output; drawing on employee creativity and establishing internal procedures to encourage innovation.

More indirectly, innovation policy could address state provision of primary and secondary education. Instead of a focus on technical training and science and mathematics, there could be an additional priority to develop pupils and students to be creative, work in teams, and to take the initiative proactively once slack time is allowed.

4.2 Institutions and innovation

The second scientific paper within the "Innovation Systems' theme explores whether the value of firm resources can be more meaningfully understood in the context of the broader institutional environment. For this reason, institutional quality within a firm's region of operation is likely to influence the innovation activities of the firm. Whilst country-level institutional quality is of key importance, variations in institutional quality are likely to be observed across regions in a country due to differences in formal and informal institutions that are territory specific. Moreover, regional variation in institutional quality has been attributed to differences in the implementation and enforcement of formal legislative or regulatory frameworks. Additionally, the various manifestations of cultural, political and economic systems in regions within developing countries contribute to these differences.

In the second paper research, a team of researchers from the University of Nairobi and Radboud University Nijmegen analysed the interplay between a phenomenon known as Regional Institutional Quality (RIQ), firms' resources and innovative activity. The original working paper is entitled 'Institutions, Resources and Innovation in Developing Countries: A Firm Level Approach' (2014) by Laura Barasa, Peter Kimuyu, Patrick Vermeulen, Joris Knoben and Bethuel Kinyanjui. This policy brief provides the research approach, main outcomes and policy implications of the paper.

Research approach and findings

RIQ in the research framework particularly relates to the degree of regulatory quality, the rule of law and levels of corruption. The key argument is that well-functioning institutions are crucial for innovation. Therefore, firms are likely to be more successful in extracting value from their resources for innovation in regions with a high degree of institutional quality. The micro-level relationship among firm-level resources, RIQ and innovation in LICs has received little attention in the past. One major reason for this has been the absence of firm-level data relating to innovation in LICs. Furthermore, a majority of studies on the subject of innovation have been conducted in the context of developed countries, focusing on the determinants of innovation (findings of such studies have limited policy implications for LICs). As such, the research examines how firm-level resources interact with institutional quality to explain innovation. The extent to which institutions influence the degree to

which firms are able to extract value from their resources for innovation remains unexplored, particularly in the context of developing countries.

The research hypothesises that a high degree of RIQ enhances the effect of firm-level resources on innovation. Previous studies find that firm-level resources that have been found to drive innovation include internal R&D, training, human capital, information search and communication facilities. This DFID research focuses on three firm-level resources including internal R&D, the education level of employees and quality certification. In particular, the research examines the moderating role institutions play with regards to the innovation process involving the generation of innovative output from firm-level resources. Thus, a high degree of institutional quality is imperative for innovation because it mitigates uncertainty surrounding innovation activities.

The research is conducted in the context of LICs, which are characterised by a scarcity of resources such as inadequate human capital, low rates of R&D, a low degree of institutional quality demonstrated by widespread corruption, a low degree of regulatory quality and a weak rule of law. In fact, previous studies argue that differences in institutional quality explain the varied growth rates in developing countries. Various empirical studies place emphasis on the critical role institutions play in fostering entrepreneurial activity and innovation in developing countries. The data used for analysis concerned firm-level data from the World Bank Enterprise Survey and the Innovation Follow-up Survey, for the years 2010 to 2012, for Kenya, Tanzania and Uganda.

In relation to the hypothesised interaction between firm-level resources and RIQ, the research team found the following as a result of the analysis:

- An interaction effect between internal R&D and RIQ. Firms situated in an environment with a low degree of institutional quality have a lower likelihood of conducting and benefitting from R&D. In particular, a corrupt environment imposes a variety of transaction costs on firms and limits the incentive for investing in R&D and innovation. Furthermore, a lack of legislative transparency creates uncertainty, discouraging firms from investing in R&D. Nevertheless, a strong rule of law that reins in corruption and abuse of tax credits by firms is likely to enhance internal R&D.

- An interaction effect relating to employee education levels and RIQ. A firm with well-educated employees is likely to be more innovative in an environment with a high degree of RIQ. The employee education level reinforces innovation activities in a firm whose environment features a high degree of RIQ. Such an environment enables employees to use their knowledge and skills more productively and fosters innovation in a firm.

- An interaction effect of RIQ moderating the effect of quality certification. Obtaining quality certification is conditional on strict adherence to established standards and procedures. Yet, if auditors granting certification are corrupt and allow firms to implement quality standards only superficially, quality certification is unlikely to influence innovation. Notwithstanding, the effect of quality certification on innovation is reinforced by a high degree of RIQ because low levels of corruption, a high degree of regulatory quality and a strong rule of law have been associated with innovation.

Policy implications

With regard to promoting innovation among manufacturing SMEs, it is vital that that more light is shed on the variation in institutional quality in regions within developing countries. It is particularly critical to address the

extent to which RIQ influences innovation in developing countries, given that institutions are essential to shaping entrepreneurial activity encompassing innovation. The main outcome of this original research into RIQ in LICs is that the effect of firm-level resources on innovation is positively moderated by institutions. Thus RIQ plays a distinct role with respect to the extent to which firms successfully extract value from resources into innovative output in the context of developing countries. The value of firm-level resources significantly depends on the institutional environment within which the firm operates.

Taking into account the observed variation in RIQ in Kenya, Tanzania and Uganda, it is crucial for policy makers to focus on strengthening institutions by fighting corruption, enforcing the rule of law and fostering regulatory quality. This is not only important at the national level, but is also beneficial at the regional level. Thus, focusing on promoting good governance at the regional level may reduce the variation observed in innovation in the individual countries. A similar outcome is observed in the complementary qualitative research part of the DFID project (case studies and in-depth interviews). SME owners referred to the fact that the formal government institutions, represented by the government officials, make their business environment even more challenging. Business and tax regulations are unclear. While entrepreneurs in any country will usually complain about government taxes, the situation is even more stressful and unpredictable in cases of bribery and corruption. While entrepreneurs need a formal institutional context that assures stability and predictability, the reality in many East African countries seems to be the reverse, bringing extra uncertainty and risk.

Several SME owners and managers suggested that only creating a stable and predictable institutional context would already be an efficient and effective way to promote innovation. 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.

Overall, stronger institutions provide a sound business environment that stimulates entrepreneurial activity and innovation at the firm level. Well-functioning institutions serve to increase the value of firm-level resources with regards to innovation because firms are better placed for appropriating value from their resources into innovative output. This strengthens the argument of the importance of implementation and enforcement. If all countries were able to increase their overall RIQ to that of the highest region in their own country, the probable benefits in terms of increased innovation would be tremendous. Policy makers could make ‘best practices’ out of the regional implementation and enforcement of their national institutional policies and facilitate the spread of these best practices across the rest of their country.

4.3 R&D and technical efficiency

In the third scientific paper within the “Innovation Systems’ theme investigates the interactions of Research and Development (R&D), foreign technology and technical efficiency in firms in Kenya, Tanzania and Uganda. The original working paper is entitled ‘R&D, Foreign Technology and Technical Efficiency in Developing Countries’ (2015) by Laura Barasa, Peter Kimuyu, Bethuel Kinyanjui, Patrick Vermeulen and Joris Knoben.

Research findings

The team examined whether innovation activities including internal research and development (R&D) and adoption of foreign technology have differential effects on technical efficiency (how efficiently a firm converts inputs of capital and labour into outputs). A first finding of the study was that R&D actually significantly decreased technical efficiency. This is surprising because it has been previously suggested that inefficiency in

manufacturing firms in Africa arises from a lack of organized R&D and low levels of investment in internal R&D. Possible explanations could be that investment in R&D only has a lagged impact on efficiency, or that R&D spending by an individual firm may increase the efficiency of the firm relative to others (by virtue of the way efficiency in the sector is measured.

The adoption of foreign technology has a positive, but not statistically significant effect on technical efficiency. This may indicate that foreign technology imported from advanced economies require additional skills to match the African context of firms. The combination of internal R&D and the adoption of foreign technology is found to significantly decrease technical efficiency. Additionally, low rates of human capital found in Africa, necessary to make the adoption of advanced foreign technology worthwhile, may indicate a lack of capacity for sophisticated R&D activities.

Policy implications

The results of the study indicate that internal R&D has a negative effect on technical efficiency. Firms may engage in R&D activities that are not conducive to increasing efficiency. Apparently, the R&D is not focusing on process innovation with a view to increasing productivity and efficiency, but likely on other forms of innovation such as product innovation. In factor-driven economies like Kenya, Uganda and Tanzania such product innovations, following the introduction of technologies that develop products from locally available raw materials, is a common phenomenon indeed.

This is confirmed in the EIP-LIC qualitative studies in Kenya and Tanzania; innovating entrepreneurs seek to compete with imports of manufactured goods, which could be produced locally. The entrepreneurs indicate that they only require the technology enabling them to actually manufacture the product. This R&D motive was much more the case than increasing the efficiency of the production process to increase efficiency.

Innovation support policies and programmes in those countries could take this more nuanced view on the types of innovation into account in the development of their programmes. Alternatively, government support may be imperative for fostering engagement in R&D activities that improve efficiency, if companies entered a more efficiency-driven way of operation. Another position is that the operational environment may be the underlying factor behind the apparent mismatch between internal R&D and efficiency

The ‘usual suspects’ in the environment include limited access to credit and inputs, low levels of human capital, poor infrastructure and poor governance. Entrepreneurs may hope to increase efficiency through their R&D efforts, but eventually it does not materialize. This constitutes an argument for strengthening basic conditions for economic development and institutional reforms aimed at strengthening government. Likewise the internal absorptive capacity of enterprise may hamper the optimal use of the R&D.

Investing in internal R&D in combination with adoption of foreign technology is not conducive to mitigating inefficiency in manufacturing firms in developing countries. Notwithstanding, where internal R&D is absorptive in nature foreign technology may be modified to meet the needs of manufacturing firms that will in turn increase efficiency in developing countries.

4.4 External knowledge sources

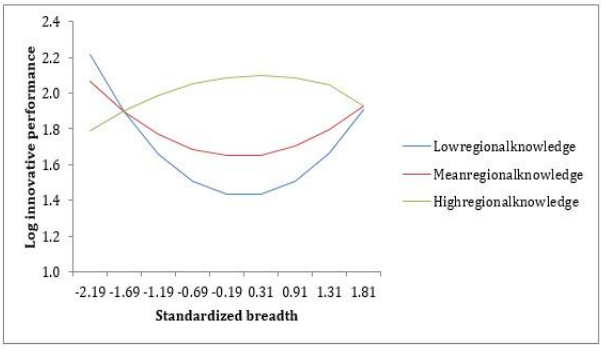
The fourth scientific paper within the 'Innovation Systems' theme addresses the importance of external knowledge sources to firm-level innovation has been for long underlined by economic and management researchers as well as business practitioners. Despite open innovation's increasing prominence in both practice and research, the role of the context in which open innovation in developing countries is conducted is not well investigated. A team of researchers of Radboud University Nijmegen carried out a study on external knowledge sources and highlighted context when considering the relationship between openness and innovative performance. The original working paper of the study is entitled 'External Knowledge Sources and the Cost and Benefits of Innovation in Developing Countries' (2015) by Annelies van Uden, Joris Knoben and Patrick Vermeulen. This policy brief summarizes the research methods and outcomes of the study and discusses several policy implications.

Research findings

Based on an analysis of 683 firms in five developing countries, the team found that that regional knowledge availability influences the success of openness. The study indicates that this relationship is contingent on the context in which the firm is active. In regions with a high knowledge availability the relationship between openness and innovation is similar to the one found in Western countries, which adds to the external validity of this relationship.

The study shows that firms located in regions where regional knowledge availability is lower, are more innovative when they are not using search breadth and only really low levels of search depth, indicating that in some environments it is better for a firm to be closed for innovation. These results contrast most previous research about open innovation, which highlighted the benefits and the positive relationship with innovative performance. It shows that in regions with high knowledge availability, the inverted U-shape found in Western countries is also valid there. However, we also find that in regions with moderate or low knowledge availability the inverted U-shape turns into a U-shaped relationship.

Indicating that in regions with less knowledge available, an open innovation strategy does not have a positive effect on innovation and it can be better to focus on fewer, deeper relationships rather than a very broad engagement with many other actors. The study is important for the open innovation literature by showing that regional knowledge availability strongly influences the relationship between openness and innovation.



Search breadth at different levels of regional knowledge availability

Policy implications

External sources provide the firm with new ideas and help achieve innovation. However, innovation policies in LICs can benefit from the study's findings; if external knowledge sources are lacking, openness has a less favourable effect. The study provides evidence that knowledge availability is indeed a regional characteristic that is of significant importance for the value of openness.

Consequently the regional availability of knowledge should be considered in (open) innovation policies. Interestingly, the research results indicate that openness can even be a harmful strategy, which has to be acknowledged by policy makers as well.

The moderation effect of regional knowledge availability results in a negative relationship between external search breadth and innovation. In regions where knowledge availability is lower, being open has more costs than benefits. These findings supports the recent literature that stresses the downsides of openness. This implies that openness should not be used in environments where external knowledge availability is lower. Especially in the context of developing countries, the innovation policies and strategies promoting openness could be much less effective than in developed countries.

This study adds to the generalizability of the relationship between openness and innovation outcomes. The findings indicate that also in non-Western countries this relationship only holds in regions where knowledge availability is high, which is comparable to the Western context. In policy making, the context should be considered explicitly when establishing a relationship between openness and innovation. For governments, the concept of openness is not one to one replicable in a different context and collaboration with other partners could result in lower innovative performance. Promoting the knowledge availability is another policy avenue in pursuing open innovation. Typically, education, information infrastructure and generic economic development policies are prerequisites in a regional context.

Validating the policy implications on the ground, the qualitative studies of EIP-LIC, in particular Kenya and Ghana, confirm that owners and managers in certain areas who were less open enjoyed more benefits in the process of trying and introducing new technology and products. Several company owners learned it the hard way – *"they [competitors] came to tap my ideas. In one event the students from a university in Accra took my idea and design for a machine."*

4.5 Innovation and export

The fifth scientific paper within the 'Innovation Systems' theme assesses whether innovation directly influences exporting behavior, because firms apply innovation as a strategy for gaining an international market share. A firm's ability to successfully compete on the international market is influenced by its capacity of introducing and marketing both new and improved products.

Actually, the link between innovation and exporting has received considerable attention. One strand of research investigates complementarity between exporting and innovation while the other examines the direction of causality. Nevertheless, few studies take into account the possibility of both causalities occurring simultaneously. Furthermore, a majority of these studies have been conducted in developed countries. For instance, previous studies find evidence of learning by exporting in Sub-Saharan Africa (SSA) implying that participation on international markets facilitates knowledge flows from customers and competitors. Yet, it remains unclear how this mechanism affects the exporting-innovation relation.

In the Fifth paper, a team of researchers from University of Nairobi and Radboud University investigated bi-directional relationship between innovation and exporting in four countries in Sub-Saharan Africa. Specifically, the research addressed the question whether there is a positive relationship between innovation and subsequent exporting and that this relationship is mediated by market creation and with customer feedback mediating this relation. The original working paper is entitled 'Export and Innovation in Sub-Saharan Africa' (2017) by By

Laura Barasa, Bethuel Kinyanjui, Joris Knoben, Peter Kimuyu and Patrick Vermeulen . The study sample consists of firms located in SSA including Ghana, Kenya, Tanzania, and Uganda.

Research findings

The research finds that the relation between innovation and subsequent exporting is positive and significant. However, we find a positive but non-significant relation between exporting and subsequent innovation. These relations broadly nuance a relationship between innovation and exporting.

We also find evidence that market creation mediates the innovation-exporting relationship since the innovation process entails the introduction of new products and services on the marketplace. The market creation significantly mediates about 32.5% of the effect of innovation on subsequent exporting. In agreement with this, our results suggest that the technology-push mechanism accounts for the relationship between innovation and subsequent exporting in the context of SSA.

Similarly but to a much larger extent, customer feedback is found to significantly mediate about 67.4%of the effect of exporting on subsequent innovation. Furthermore, we find evidence that customer feedback mediates the relation between exporting and innovation to a large extent (67.4%) suggesting that the demand-pull mechanism is very critical in explaining this relationship. Taking into cognizance that the demand-pull mechanism has received scant attention over the past years this finding gives rise to an important theoretical implication arising from the empirical evidence of the demand-pull mechanism in SSA. We argue that the recognition of market needs arising from customers on the export market constitutes a major driving force of innovation in SSA.

Apart from contributing to the debate on the innovation-exporting relationship in the context of SSA, our paper goes a step further to shift focus on disentangling the mechanisms underlying this interrelationship. This is an area of study that has received scant attention particularly in the African context.

Policy implications

The findings reveal that whilst the main effect for the innovation-exporting relationship is significant, the reverse relation remains unclear. Notwithstanding, the positive albeit non- significant relation between exporting and innovation provides some nuanced support for the existence of a bi-directional relationship. Furthermore, the technology-push mechanism underlies the innovation-exporting relation to a medium extent. Hence, innovation policies aimed at fostering product innovation by providing incentives may be crucial for exporting. Such policies may be useful in fostering the development of innovations with a high degree of novelty and are likely to promote exporting through the creation of new market space.

Moreover, the study provides evidence that the demand-pull mechanism underlies the exporting-innovation relationship. Customer feedback mediates the exporting-innovation relation to a very large extent. Therefore, state capital expenditure focusing on information and communications technology infrastructure investment is vital in enabling faster response to market needs. Additionally, export promotion policies encompassing instruments such as export subsidies are likely to play a key role in stimulating innovation in SSA.

4.6 Gender diversity and innovation

In the sixth paper within the ‘Innovation Systems’ them 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 Knoben.

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 Kenya. The first paper in the use of mobile phone technology and its impact trade credit for economic development and growth. The second paper analysed the determinants of - and the barriers to - the adoption of a profitable financial technology by SMEs in Kenya. The third paper investigated the role of financial constraints in firms' skilled labour demand. 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 Mobile money and trade credit

Both in development research and policy, there is an increasing interest in the use of mobile phone technology in Low Income Countries (LICs) and its impact on economic development and growth. Mobile money, as one manifestation of such technology, stimulates welfare of households and small business in many African countries and consequently increases the circulation of money in poorer communities. Increasing evidence shows that it also promotes savings in households via formal bank accounts. Individuals use mobile money for safety considerations, when travelling for instance. Moreover, mobile money technology provides additional advantages such as enabling easy access to market information, market prices, and enhancing market participation of farmers in remote communities.

One notable example of mobile money technology developed in Kenya is M-Pesa (M stands for mobile and pesa means money in Swahili). It is an SMS-based money transfer and storage tool. After its launch in 2007, M-Pesa rapidly became a popular way of making payments by households. Its involves less risk than informal cash payment methods, storing money in mobile form implies more security than holding cash, and using M-Pesa costs less than bank transfers. In 2011, 70 percent of adult population in Kenya had an M-Pesa account.

Actual growth numbers for the Kenyan economy suggest that the introduction of M-Pesa explains 14% of per-capita real income growth and 3.4% of the total factor productivity growth between 2006 and 2013, underscoring the quite large economic effect of mobile money technology. However, the use of M-Pesa by Kenyan businesses has been less slower compared to its use in Kenyan households.

Business surveys show that only one out of three SMEs in Kenya adopts and uses the M-Pesa technology to run its financial transactions. For the first scientific paper, a team of researchers from the Tilburg University, Cass Business School (City University London), Financial Sector Deepening (FSD) Kenya and Wageningen University carried out a study in 2013 analyzing the business use of M-Pesa in Kenya.

The underlying hypothesis of the study was that the availability of a mobile money technology such as M-Pesa can significantly contribute to firm and ultimately macroeconomic performance. The original working paper is entitled 'Mobile Money, Trade Credit and Economic Development: Theory and Evidence (2014)' by Thorsten Beck, Haki Pamuk, Ravindra Ramrattan[2] and Burak Uras. This policy brief provides the research approach, main outcomes and policy implications of the paper.

[2] It is important to note that before the completion of one of the IP-LIC research activities in Kenya, a team member and co-author of the finance team, Mr. Ravindra Ramrattan, lost his life at the tragic Westgate Mall terrorist attacks in Nairobi, Kenya.

Research approach and findings

The paper focuses on access to trade credit in particular since an increasing body of literature stresses the significant role of trade credit in economic development in low income countries. Among other lenders in financing credit-constrained firms, suppliers often provide a low-barrier channel to get access to credit, which makes trade credit prevalent in financially less developed countries where the majority has limited if any access to formal bank credit. Unlike credit from official financial institutions, trade credit does not rely on formal collateral but on trust and reputation.

The research team wondered specifically whether the use of electronic money within their business helps entrepreneurs to access such trade credit. The research concentrated on the relationship of SMEs with their suppliers and measured the evolution of the M-Pesa technology as a payment method while making input purchases. The study analysed the role of theft too and its interaction with M-Pesa technology to explain the impact of M-Pesa on trade-credit connectedness in an economy and the resulting development consequences. Data from the World Bank's Enterprise Survey suggests that every year Kenyan manufacturing firms loose about 2 percent of product values due to theft - which equals to twice the world average - from sales to remote domestic markets.

The team used both a dynamic general equilibrium model of entrepreneurial finance as well as empirical data from a novel SME survey from Kenya (FinAcess Business 2013). The details of the modelling and statistical analyses of the data are presented in the working paper.

Key outcomes

The research team assessed a positive relation between the use of mobile money 'M-Pesa', as a payment method when purchasing inputs from suppliers, and the access to trade credit among SMEs. In fact, both the model and the empirical observation show this positive relationship. This empirical finding is consistent with causality going into either direction. Having a trade credit relationship with suppliers exhibits thus a strong positive relation with enterprises' M-Pesa use as well. The researchers elaborate and explain in their working paper that the use of M-Pesa is causing less problems and frictions in transactions with suppliers. Consequently it is also lowering transaction costs and thus relevant for macroeconomic development in Kenya.

In an effort to verify the relationship, shutting down the M-Pesa technology within the research context also lowers the fraction of trade-credit relationships. The decline in trade credit relationships further suppresses the macroeconomic development to a significant extent. This quantitative result underlines the strong interaction between trade credit and M-Pesa.

The paper also shows that, in addition to enhancing information flows between economic agents, mobile phone technologies may also help foster economic and financial relationships between enterprises in developing countries. Moreover, theft raises the likelihood of default and constrains entrepreneurial trade-credit opportunities. A theoretical implication of the research is that the use of mobile money lowers the probability of theft and alleviates trade credit constraints, thereby stimulating entrepreneurial performance.

In sum, the key theoretical result from the model is that access to trade credit generates demand to use M-Pesa as a payment method with suppliers and the use of M-Pesa in turn raises the value of a credit relationship and hence the willingness to apply for trade credit.

Policy implications

Overall, given the limited use of mobile money in SMEs for their financial transactions, compared to households in Kenya, policy makers within governments, donors, NGOs policies and programs could explicitly focus on promoting the use of it within SMEs. The research suggests that particular policy impact could be achieved if the promotion of mobile money technology takes place in combination with trade credit promotion. Policies and programs promoting the use of mobile money within SMES could particularly focus on those firms that have already established trade relationships with a view to assure greater policy impact.

These policy recommendations are derived from the probability of using mobile money when purchasing goods being significantly higher for businesses with a trade credit relationship with their suppliers. Regarding the economic significance of mobile money technology, the promotion of these more secure payment systems particularly allowing to improve on risky cash holdings and allow for more efficient transfers, can have economically meaningful implications for firm and macroeconomic development.

The research also provides input for the actual policy debate on financial inclusion relevant in many LICs in many developing countries. While for a long time there has been a focus on credit services for micro- and small entrepreneurs, over the past years the policy debate has broadened to other financial services and mechanisms. The research shows the importance of trade credit, providing efficient payment services as a means to help firms expand their network and production. The research contributes to this debate, supported by an expanding literature, by underlining the importance of trade credit and the promise, which digital payment systems can hold. Mainstream literature has focused on the lack of access to credit services by enterprises as important growth constraint in developing countries, a policy implication of this research is the importance of effective payment services, through trade credit, for expanding economic and financial transactions in an economy.

Additional EIP-LIC insights

Bringing in additional insights from other DFID EIP-LIC research activities of Tilburg University, a qualitative exploration of research and policy issues concerning innovation in manufacturing SMEs in Kenya, a short study within the DFID project, confirms that mobile banking is not so much used for business transactions, although most company owners do see its advantages. In particular, mobile banking avoids staff having to carry cash, according to SME owners, which is usually the case after delivery of products by the company's drivers.

Despite the fact that mobile money is more secure, in terms of theft, SME owners are still reluctant to use mobile banking for their business because of security weaknesses. There are still certain 'tricks' to wheedling money from account holders. The qualitative study includes a case of a company that does credit sales. At the same time, this company has several clients who are problematic and do not pay.

5.2 Technology adoption and mobile money

Understanding the constraints that firms in developing countries face to adopt productive technologies is crucial for designing appropriate development policies. Over the last decades there have been important advancements that deepened the understanding of the drivers and the barriers of technology adoption, including mobile technologies. For instance, mobile-money is an emerging phenomenon offering the option money transfers via simple cell-phone text-messages.

This technology was amongst others launched in Kenya in 2007 under the name of M-PESA. Since then, it has quickly reached remarkable adoption rates among Kenyan households. As of 2016 in more than 95% of the households this technology has been adopted. The use of mobile-money among Kenyan businesses, however, is relatively low. Less than 40% of the small and medium sized enterprises (SMEs) report using M-Pesa services when transacting with their customers or with their suppliers.

For the second paper within the "Finance for Productivity Growth' theme, a team of researchers from Tilburg University investigated the determinants of - and the barriers to - the adoption of a profitable financial technology by SMEs in Kenya. Specifically, the study involved a field experiment focusing on the adoption of mobile-money as a payment technology by restaurants and pharmacies in Nairobi. The original working paper is entitled 'Technology Adoption by Small and Medium Businesses: Experimental Evidence from Mobile Money in Kenya' (2017) by Patricio Dalton, Haki Pamuk, Daan van Soest, Ravindra Ramrattan and Burak Uras.

Research approach and findings

The field experiment studied what factors foster adoption of mobile money technologies by SMEs, and what the barriers to adoption are. The research team offered a randomly selected sample of restaurants and pharmacies the possibility to sign up, on their behalf, for a novel mobile-money technology which allows an efficient mobile-money based transaction between a business and a customer. A key feature of M-Pesa is that it is profitable, it does not involve any risk, and it has no registration fee. In short, the intervention eliminates the transaction costs associated with the adoption of the technology.

The study found that over a 60% of the restaurants owners/managers decided to sign up for this new technology, while the adoption rates turned out to be about 20% among pharmacies. Moreover, study provides causal evidence that small bureaucratic hassles and lack of information constitute a major barrier for adopting this profitable technology. The team further found that neither risk, time preferences or trust are important factors. Small situational barriers play a decisive role in preventing people to take advantage of profitable available options.

The motivations of those business owners who decided not to adopt the technology remain somewhat unclear. One plausible explanation of the non-adoption behaviour is status quo bias. If the business took the status quo (i.e. no technology) as a reference point, then any change from the status quo, in this case adopting the novel technology, would be perceived as a loss. If the business owners were loss averse, they would be less likely to adopt.

Policy implications

The research suggests that policy and programs to promote new technology adoption could be best designed by addressing the (situational) barriers, particularly bureaucratic hassles and lack of information. A government program providing the mobile technology for free, which is a relatively low-cost intervention, would bring substantial commercial benefits for the SMEs. Moreover, such intervention will repay itself in terms of increased taxation revenues. Providing the technology for free might also result that at a certain point in time a 'tipping point' will be reached; the remaining SMEs switch to the mobile technology because over it has become common practice. This will also moderate the effect of the status quo bias.

Along with providing the technology for free, an additional policy recommendation involves the lowering of the bureaucracy, and likely the application procedures for the mobile banking accounts; A one-stop shop for getting the mobile technology with flexible guarantee requirements, for instance offered as a package with a trial period. The lack of information can be addressed effectively once the application bureaucracy is eased. Information campaign to reach out and assist the SME owners to apply for mobile banking accounts.

5.3 Finance and demand for skill

Sub-Saharan Africa experienced a decade of growth between 2000 and 2012, in which average annual GDP growth was over 4.5%. However, recent studies indicate that this growth has not translated into similarly high growth rates in job creation. Current growth comes largely from a small base of industry and the manufacturing sector, which will not come close to absorbing the millions of new workers entering the labour force each year. What is even more challenging is that many educated and skilled workers in Africa fail to find employment. The supply of highly skilled human capital who remain unemployed raises the question of whether there is a shortage of firm-level demand for skill in African economies.

Academic studies stress the importance of access to external funding for firm-level investment decisions, economic development and growth. What about the interactions between access to finance and employment creation for educated workers? There is little research addressing the effect of financing constraints on hiring decisions, especially of skilled workers.

For the second paper within the "Finance for Productivity Growth' theme, a team of researchers from Cass Business School (City University London) and Tilburg University investigated the role of financial constraints in firms' skilled labour demand. Specifically, using a small business survey from Uganda, the research explored whether skilled job creation rises with access to external finance. The original working paper is entitled 'Finance and Demand for Skill: Evidence from Uganda' (2016) by Thorsten Beck, Mikael Homanen and Burak Uras.

Research approach and findings

The research shows that that the extent to which micro and small businesses expand skilled employment, as their sales and profits increase, depends significantly on access to external funding. Firms with positive performance and a bank loan hire more trained and experienced employees. Thus, growing and profitable small businesses create more jobs for trained and experienced workers - which is interpreted as demand for skill - if they have access to external finance.

The analysis does not reveal a significant relationship in the case of hiring casual employees or family and friends in the informal context, suggesting that financing constraints are more likely to bind in the context of employment contracts associated with experienced and trained employees with high human capital intensity. The results also suggest that financially constrained firms save their excess resources instead of investing in a more sophisticated and skilled workforce.

Policy implications

The research findings underline the importance of well-developed financial systems for policies focusing on job creation. Firms with greater financial flexibility are more likely to hire skilled labour once their performance improves. For policy makers focusing on the challenge of creating formal and permanent jobs in a developing society, devising a complementary financial sector policy is equally important. The policy should go beyond helping firms directly to strengthening efficient financial systems and credit programmes as well.

Better access to external funding can thus be an accelerator of human capital investment demand and growth. Policy makers must also acknowledge that firms who are financially constrained save a greater proportion of their additional profits (or pay other expenses associated with financial constraints) and therefore cannot invest further in greater levels of employment; if access to finance is difficult, one could question the optimal effectiveness of employment creation policies.

For government, interest rates by state banks. would be a first point of attention in policy efforts to create formal employment of higher skilled labour. Against this background, policy monitoring systems for employment creation could include the degree of access to finance. Looking at it from the other side, formal credit policies and programmes could include formal job creation, since they are linked.

Better performance and financial access do not explain the hiring rates of informal employees, which include casual and family employees. Labour creation policies should thus acknowledge the different policy instruments for creating employment for higher educated and skilled workers on the one hand, and informal employment on the other.

In many developing countries, young people are educated and governments need to find ways to employ these highly qualified workers. With better access to finance, a firm's workforce can become more permanent and potentially more stable as well. As firms grow and become profitable, employment opportunities will increase for those who are formally trained, educated and more experienced. The policy relevance of such stable employment for higher educated staff centres on greater commitment of staff in firms. This will particularly positively affect firms' survival and innovation efforts, and is thus a vital issue for policy makers in many nations, and especially in developing countries.

References

Çapoğlu, C. 2009. The Meaning of Innovation and Entrepreneurship in Developing Countries. *International Studies In Entrepreneurship* 21: 85-91.

Carayannis, E. G., E. Gonzalez and John Wetter. 2003. "The Nature and Dynamics of Discontinuous and Disruptive Innovations from a Learning and Knowledge Management Perspective." In *The International Handbook on Innovation* edited by Larisa Shavinia. London: Elseviers Science Ltd.

Chaminade, C., B.-Å. Lundvall, J. Vang and K. J. Joseph. 2010. 'Designing Innovation Policies for Development: Towards a Systemic Experimentation Based Approach'. In: Lundvall, B. Å., K. J. Joseph, C. Chaminade and J. Vang (eds.) *Handbook of Innovation Systems and Developing Countries*, Cheltenham: Edward Elgar, pp. 360-379

Cirera, X., & Muzi, S. (2016). *Measuring firm-level innovation using short questionnaires: Evidence from an experiment* (Policy Research Working Paper 7696). Washington, DC: World Bank Group.

Fainshmidt, S., Pezeshkan, A., Frazier, L., Nair, A. & Markowski, E. (2016) Dynamic capabilities and organizational performance: A meta-analytic evaluation and Extension. *Journal of Management Studies, 53*(8), 1348-1380.

Freeman, Ch.. 1987. *Technology Policy and Economic Performance: Lessons from Japan*. London and New York, NY: Pinter Publishers.

Gereffi, G. 1994 'The organisation of buyer driven global commodity chains: how US retailers shape overseas production networks'. In *Commodity Chains and Global Capitalism* edited by G. Gereffi and M. Korzeniewicz, Westport, CT: Praeger, pp. 95–122.

Helfat, C., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D., Winter S. (2007). *Dynamic capabilities: Understanding strategic in organizations.* Blackwell: Oxford, UK.

Kotabe, M. and K.S. Swan. 1995. The role of strategic alliances in high technology new product development. *Strategic Management Journal* 16(8): 621-36.

Kuhlmann, S. , P. Shapira and R. Smits. 2010. 'Introduction. A Systemic Perspective: The Innovation Policy Dance', in R. Smits, S., Kuhlmann and P. Shapira, *The Theory and Practice of Innovation Policy*, PRIME Series on Research and Innovation Policy in Europe.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. 1997. Trust in large organizations. *American Economics Review, Papers and Proceedings, 137*(2), 333 - 338.

Lundvall, B.-Å. 1992. *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter Publishers.

Lundvall, B.-Å., K. Joseph, C. Chaminade and J. Vang. 2009. *Handbook of Innovation Systems and Developing Countries - Building Domestic Capabilities in a Global Setting*. Celtenham: Edward Elgar Publishing.

OECD. 2005. The Measurement of Scientific and Technological activities, proposed guidelines for collecting and interpreting technological innovation data – Oslo Manual. Paris: Organization for Economic Co-operation and Development (OECD), Eurostat.

Oslo Manual: Guidelines for collecting and interpreting innovation data (3rd ed.). (2005). Paris: Organisation for Economic Co-operation and Development.

Porter, Michael. 1985. *The Competitive Advantage: Creating and Sustaining Superior Performance*. New York, NY: Free Press.

Scott, W. R. 2001. *Institutions and organizations* (2nd ed.). Thousand Oaks: SAGE.

Szirmai A., W. Naudé and M. Goedhuys. 2011. 'Entrepreneurship, Innovation, and Economic Development: An Overview', In Szirmai, A., W. Naudé and M. Goedhuys (eds.) *Entrepreneurship, Innovation, and Economic Development*. Oxford: Oxford University Press, pp. 3-32

Teece, D. J. 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal* 28(13): 1319–1350.

Yin, R. 2003. *Case Study Research: Design and methods*. Thousand Oaks, CA: Sage Publications.

World Bank. 2010. Innovation Policy: A Guide for Developing Countries. World Bank. https://openknowledge.worldbank.org/handle/10986/2460

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'

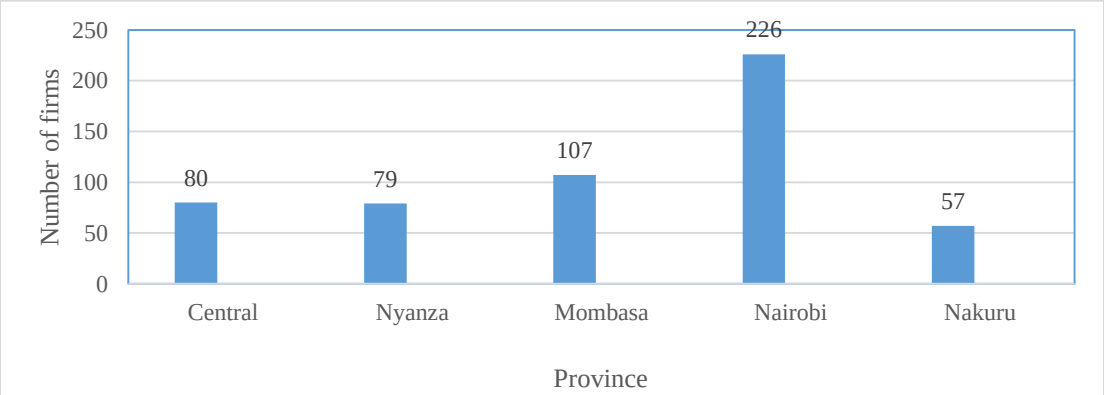
1.	Beck, T. H. L., H. Pamuk, R.B. Uras. 2014 Entrepreneurial Saving Practices and Business Investment: Theory and Evidence from Tanzanian MSEs. Tilburg: Tilburg University. Paper accepted in journal "Review of Development Economics"
2.	Beck, T. H. L. and M. Hoseini. 2014. Informality and Access to Finance: 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
8.	Beck. T., M. Hoseini and B. Uras. 2017. Trade credit and access to finance of retailers in Ethiopia. DFID Working paper, Tilburg University
9.	Dalton, P., H. Pamuk, D. van Soest, R. Ramrattan and B. Uras. The effect of Mobile Money on Small and Medium Businesses: Experimental Evidence from Kenya.
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: Highlights of DFID/World Bank EIP-LIC survey Kenya

Annex 2 describes the salient features of 549 firms in Kenya to provide an understanding of the context of innovation. Three waves of data comprising data from the 2013 World Bank Enterprise Survey (WBES), the 2013 Innovation Follow-up Survey (IFS) module, and the 2015 Innovation Capabilities Survey (ICS) are used for preparing this report. The WBES collects data focusing on an economy's business environment and investment climate. The World Bank has conducted firm-level surveys since the 1990's, however, since 2005 data collection efforts have been centralized and instruments standardized for establishing comparability of data across countries. The IFS was launched in 2011 to collect data on firm-level innovation and has so far been conducted in 19 countries in Africa and South Asia.[3] The WBES involves administering firm-level surveys to a representative sample of firms in the non-agricultural formal sector in an economy comprising firms in the manufacturing, retail and service sector. In addition, WBES are stratified according to the sector of activity, firm size and geographical location of the firm. IFS respondents are a subset of the original WBES and were randomly selected to form a sample of 75 percent of the ES respondents (www.enterprisesurveys.org). The ICS is a follow-up and complementary to the IFS. The ICS comprises randomly selected respondents from the IFS sample making its sample a subset of the IFS. The ICS focuses on innovative activities and innovative capabilities of manufacturing firms, and is a collaboration between the World Bank, Tilburg University, and Radboud University Nijmegen within the 'Enabling Innovation and Productivity Growth in Low Income Countries' project funded by the United Kingdom's Department for International Development (DFID).[4] The raw dataset used in this report was created by merging the three waves of data collected from the WBES, the IFS, and the ICS by means of the unique firm identifiers for each province.[5] Figure 1 reports the number of firms in each province after merging the three datasets.[6] Nairobi has the largest number of firms. This may be attributed to the fact that it is the capital city of Kenya.

Figure 1. Distribution of firms by province



[3] These countries include Ghana, Tanzania, Uganda, Kenya, Congo DRC, Ethiopia, Malawi, Rwanda, Sierra Leone, South Sudan, Sudan, Namibia, Nigeria, Zambia, and Zimbabwe in Africa; and Bangladesh, Nepal, India, and Pakistan in South Asia.

[4] This project was undertaken to study the innovative capability of manufacturing firms in ten case countries including Ghana, Tanzania, Uganda, Kenya, South Africa, and Ethiopia from Africa, Bangladesh, and India from South Asia and, Vietnam and Indonesia from East Asia and Pacific http://www.tilburguniversity.edu/dfid-innovation-and-growth/.

[5] The 2010 Constitution of Kenya set forth a system of devolved governance that saw the establishment of 47 county governments which replaced the provinces after the 2013 general elections. The surveys used in this report were carried out prior to this change hence the provincial data.

[6] Due to missing observations, the number of firms in the subsequent sections does not always add up to 2,090.

General description of the sample

Distribution of firms by sector and province

Table 1 shows the sectoral distribution of firms in each province as reported in the WBES. The distribution of firms is similar for the five provinces with the largest number of firms falling in the manufacturing industry for Central, Mombasa, Nairobi, and Nakuru. On the other hand, Nyanza has the largest number of firms falling in the retail industry. One possible explanation is that the geographical location of Nyanza is much farther from major ports and airports relative to Mombasa, Nairobi, Nakuru, and Central. Table 1 also reveals that the food sector is the largest in four provinces. The Central province has the highest number of firms in this sector. This is possibly because the Central province is a predominantly agricultural region. The precision instruments sector has the lowest number of firms in the entire sample.

Table 1. Distribution of firms by sector and province

Industry	Code	Sector	Central	Nyanza	Mombasa	Nairobi	Nakuru	Total
Manufacturing	15	Food	51	16	15	22	17	121
	17	Textiles	5	0	3	16	3	27
	19	Leather	1	1	1	2	1	6
	20	Wood	0	0	3	1	1	5
	21	Paper	0	0	0	2	0	2
	22	Publishing, printing, and recorded	2	0	1	4	2	9
	23	Refined petroleum product	0	0	0	3	0	3
	24	Chemicals	0	2	3	21	2	28
	25	Plastics & rubber	0	0	2	5	1	8
	26	Non metallic mineral products	1	0	1	3	1	6
	27	Basic metals	0	0	3	2	0	5
	28	Fabricated metal products	0	2	3	3	2	10
	29	Machinery and equipment (29 & 30)	1	5	5	8	1	20
	31	Electronics (31 & 32)	1	0	2	3	1	7
	33	Precision instruments	0	0	1	0	0	1
	34	Transport machines (34 & 35)	0	3	5	8	0	16
	36	Furniture	0	0	1	5	2	8
Retail	52	Retail	9	34	15	49	15	122
Other services	51	Wholesale	4	7	8	19	0	38
	72	IT	0	0	0	7	0	7
	55	Hotel and restaurants: section H	4	7	11	20	4	46
	50	Services of motor vehicles	1	2	4	15	3	25
	45	Construction Section F	0	0	0	4	0	4
	60	Transport Section I: (60-64)	0	0	20	4	1	25
		Total	80	79	107	226	57	549

Descriptive statistics

Table 2 reports the descriptive statistics on some of the variables in our sample. These are from the WBES. The majority of the firms are small and medium sized. Table 2 shows that one half of the firms have less than 20 fulltime employees in 2012. A quarter of the firms have more than 60 fulltime employees. The largest firm reported having 5500 fulltime employees. Sales turnover in 2012 exhibits heterogeneity. The minimum sales turnover was KShs.150000. The median firm in the sample reported a sales turnover of KShs.40 million whilst the average sales turnover in the same period was KShs.1.18 billion. Table 2 also shows that one half of the firms have been in operation for less than 16 years with the average being about 21 years. Hence, most of the firms in our sample are relatively young. The oldest firm is 106 years old. Labour productivity, calculated as sales turnover divided by the number of fulltime employees also exhibits heterogeneity. The minimum labour

productivity is about KShs.3000. The median firm reports a labour productivity of KShs.107000 against a mean of about KShs.18 million. The maximum value for labour productivity is KShs.1.725 billion. The textiles sector records the highest labour productivity whilst the fabricated metal products sector posts the lowest labour productivity. An interesting observation is that more than one half of the firms experienced a decrease in turnover growth over the period 2009-12 with 452 firms reporting sales turnover in both years. Lastly, out of 532 firms that reported the number of fulltime employees in both 2009 and 2012, only 217 firms report the same number of employees.

Table 2. Descriptive statistics

Variable	min	p25	p50	p75	max	mean	N
Turnover 2012*	150	9000	40000	230000	120000000	1180000	475
Employment 2012*	1	8	20	60	5500	76.86	546
Age	1	8	16	29	106	21.91	541
Labour productivity***	3	714	107	5000	1725000	18060.81	473
Turnover growth 2009-12	-0.99	-0.64	-0.34	0.33	749	5.59	452
Employment growth 2009-12	-0.86	0.00	0.00	0.24	3.33	0.15	532

*Turnover is reported in Kenya Shillings and is divided by 1000

**Firms are categorized as small (1-19 employees), medium (20-99 employees), and large (100+ employees)

***Labour productivity is calculated as Turnover 2012 divided by number of fulltime employees in 2012

Sales and exports

Table 3 reports the proportion of sales that are exported directly and indirectly (i.e. by third parties). These measures give an indication of the intensity of foreign trade as reported in the WBES. Central province reports the highest percentage of direct exports (33.3%). This could be explained by the fact that the Central province is the leading producer of coffee and tea which constitute major exports in Kenya. Nyanza on the other hand reports relatively low direct exports (2.9%). This is likely to be because there are no major ports and/or airports in close proximity. Mombasa reports the highest percentage of indirect exports. This implies that there are many exporting intermediaries based in Mombasa because of its proximity to the port.

Table 3. Export status

Province	Direct exports	Indirect exports	N
Central	33.3%	13.4%	73
Nyanza	2.9%	2.4%	47
Mombasa	14.9%	25.3%	100
Nairobi	5.7%	7.6%	202
Nakuru	4.9%	2.9%	42
Total	12.3%	10.3	464

Table 4 reports export status of manufacturing firms located in different regions in the world (www.enterprisesurveys.org). In comparison to the values reported in Table 4, we observe the proportion of total sales that are exported directly in Kenya (12.3%) is much higher than that for firms in East Asia and Pacific, Europe & Central Asia, Latin America & Caribbean, Middle East & North America, South Asia, and Sub-Saharan Africa (SSA). Similarly, it can be observed that indirect exports (10.3%) reported in Table 3 is much higher in our sample than what is reported by all the regions as shown in Table 4. There is a possibility that a

large proportion of goods produced by firms in our sample is intended for third party exporters that aids firms circumventing a weak customs and trade regulatory environment.

Table 4. Export status by region

Region	Direct exports	Indirect exports
East Asia and Pacific	6.5%	2.1%
Europe & Central Asia	5.4%	2.7%
Latin America & Caribbean	4.7%	2.5%
Middle East & North America	8.5%	2.5%
South Asia	5.0%	4.0%
Sub-Saharan Africa	4.2%	2.9%

Supplies and imports

Table 5 reports the proportion of material inputs and supplies purchased from domestic or foreign origin. These measures are also reported in the WBES. Nairobi and Mombasa report the highest percentage of imported inputs (39% and 29% respectively). Contrastingly, Nakuru reports the lowest percentage of imported inputs (19%). Firms in Nairobi and Mombasa have close proximity to major ports and airports. Hence, it is likely that firms purchase foreign inputs at lower prices relative to the other provinces. Furthermore, these firms face relatively low transport costs. It can also be observed that very few firms report on this indicator. Nevertheless, more than one half of the inputs are of domestic origin for all the provinces. The possible explanation for this observation is that the sampled firms may be facing a large number of alternative suppliers domestically. Firms may also be purchasing their inputs from local importers.

Table 5. Origin of inputs and supplies

Province	Foreign origin	Domestic origin	N
Central	21%	79%	61
Nyanza	22%	78%	27
Mombasa	29%	71%	46
Nairobi	39%	61%	105
Nakuru	19%	81%	31
Total	29%	71%	270

Table 6 shows the proportion of total material inputs and supplies by origin for firms located in different regions (www.enterprisesurveys.org). With the exception of SSA which seems to depend on inputs of foreign origin to a large extent, we observe relatively little variation in the reported proportions shown in Table 5 and regional data in Table 6.

Table 6. Origin of inputs and supplies by region

Region	Foreign origin	Domestic origin
East Asia and Pacific	25.4%	74.6%
Europe & Central Asia	38.0%	62.0%
Latin America & Caribbean	35.1%	64.9%
Middle East & North America	43.9%	56.1%
South Asia	24.0%	76.0%
Sub-Saharan Africa	64.8%	35.2%

Innovation

Product and process innovation

Measures reported in this section are from the IFS. As shown in Table 7, a majority of firms report on whether they have introduced new or significantly improved products or services, and processes. Nairobi reports the highest percentages for both product innovation (56%) and process innovation (34%). Hence, more than one half of the firms in Nairobi reported product innovation. Nakuru has the lowest rate of product innovation (26%) and process innovation (18%). There is more variation in the rate of product innovation relative to process innovation. A comparison between the rates of innovation in our sample and those of the EU-28 enterprises based on the Community Innovation Survey (CIS) for the period 2010 through 2012 (ec.europa.eu) reveals striking differences in reported rates of innovation. In particular, the average rate of both product and process innovation in Kenya is markedly higher than the average rate of innovation observed in EU-28. Cirera and Muzi (2016) argue that such high levels of self-reported innovation in developing countries partly arise from a rather subjective definition of an innovation in the surveys especially since innovations are likely to be more incremental and less radical. Nevertheless, the definition of innovation in both the IFS and CIS is guided by the Oslo Manual (2005) which defines innovation as the implementation of new products and services or significant changes in existing products and services.

Table 7. Product and process innovation

Province	Product innovation	Process innovation	N
Central	28.75%	22.50%	80
Nyanza	32.47%	20.78%	77
Mombasa	42.45%	27.36%	106
Nairobi	55.80%	34.38%	224
Nakuru	25.45%	18.18%	55
Total	42.80%	27.68%	542
EU-28	23.70%	21.40%	

Table 8 shows the market orientation of product and process innovations from the IFS. Very few firms report whether the innovations are new to the local, national, or international market. A large percentage of firms indicate that both product and process innovations are new to the local market and to a smaller extent new to the national market. A very small proportion of the firms report that innovations are new to the international market. This may indicate that innovations have a relatively low degree of novelty.

Table 8. Product and process innovation market orientation

Province	Product innovation				Process innovation			
	Local	National	International	N	Local	National	International	N
Central	55%	27%	9%	22	48%	17%	9%	23
Nyanza	32%	5%	5%	22	33%	15%	4%	27
Mombasa	48%	43%	14%	44	49%	27%	8%	37
Nairobi	39%	29%	6%	117	27%	21%	4%	101
Nakuru	36%	14%	7%	14	27%	13%	7%	15
Total	42%	24%	8%	219	37%	19%	6%	203

Objectives of innovation

Figure 2 describes the reasons for firms introducing their main innovative products and services from the IFS. The main objective for product innovation is to open up new markets or increase market share which exhibits very little variation between the provinces. Furthermore, extending the range of products or services, and increasing competitiveness by introducing products or services offered by competitors in the market are important reasons for product innovation. Few firms report replacing a product or service already offered by the firm as a reason for product innovation. Notwithstanding, this objective seems relatively more important in Nyanza.

Figure 2. Objectives of product innovation

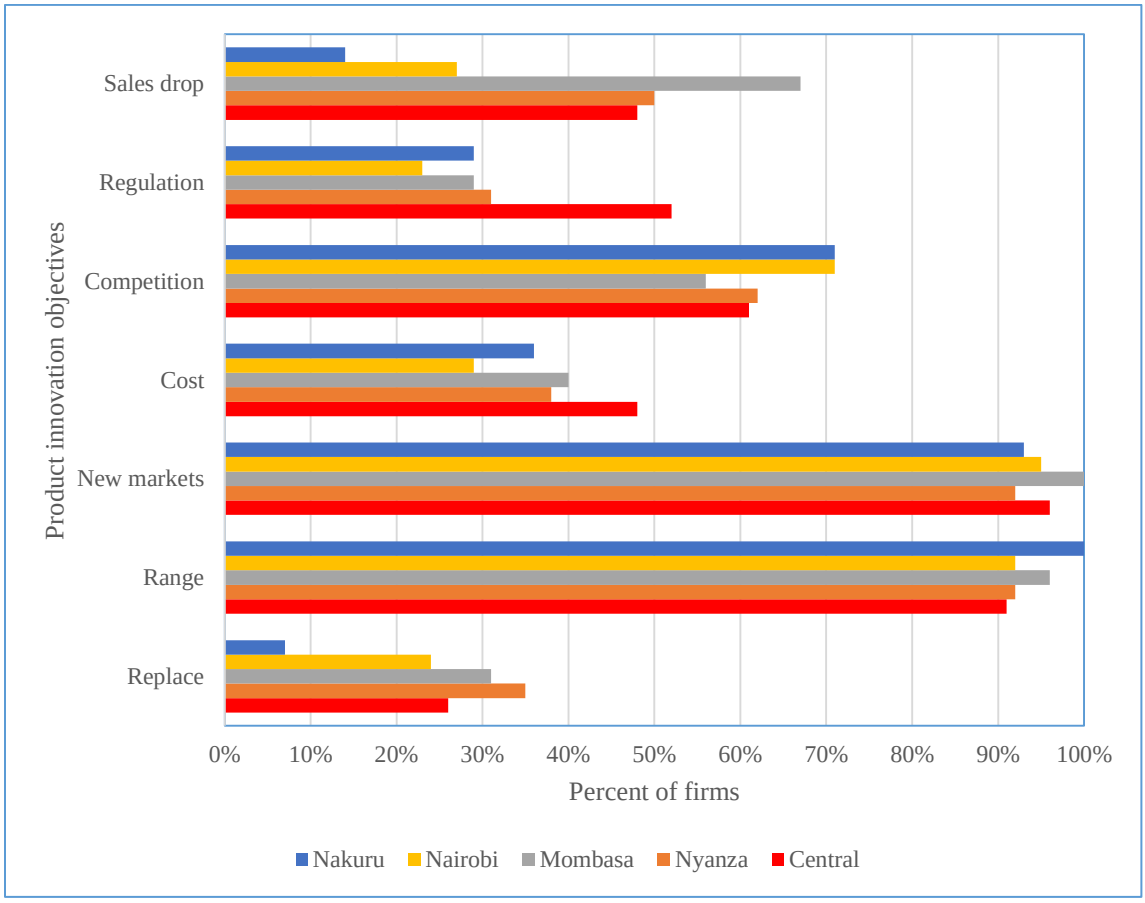
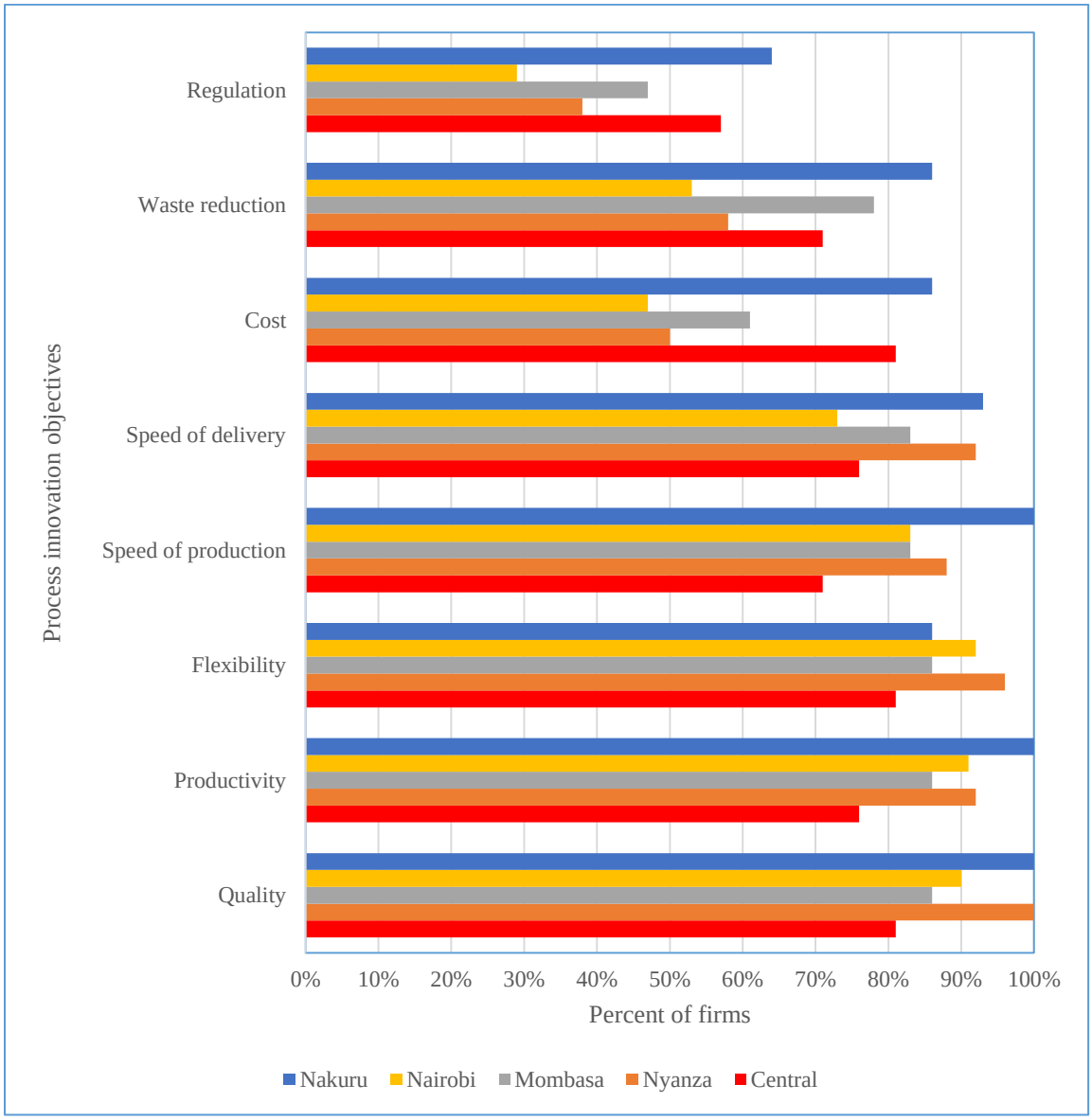


Figure 3 reports the main reasons for introducing process innovation in the firm from the IFS. A high percentage of the firms report that the main reason was to increase the quality of products or services already offered by the firm. Increasing productivity, production flexibility, increasing the speed of production or offering services, and speed of delivery to customers are also major reasons for introducing process innovations. There is very little variation between the provinces in these five objectives. A much smaller percentage of firms report complying with regulations and standards as a reason for process innovation. This may indicate a low degree of compliance with regulations and standards encompassing safety and environmental regulations due to poorly functioning quality assurance institutions in Kenya.

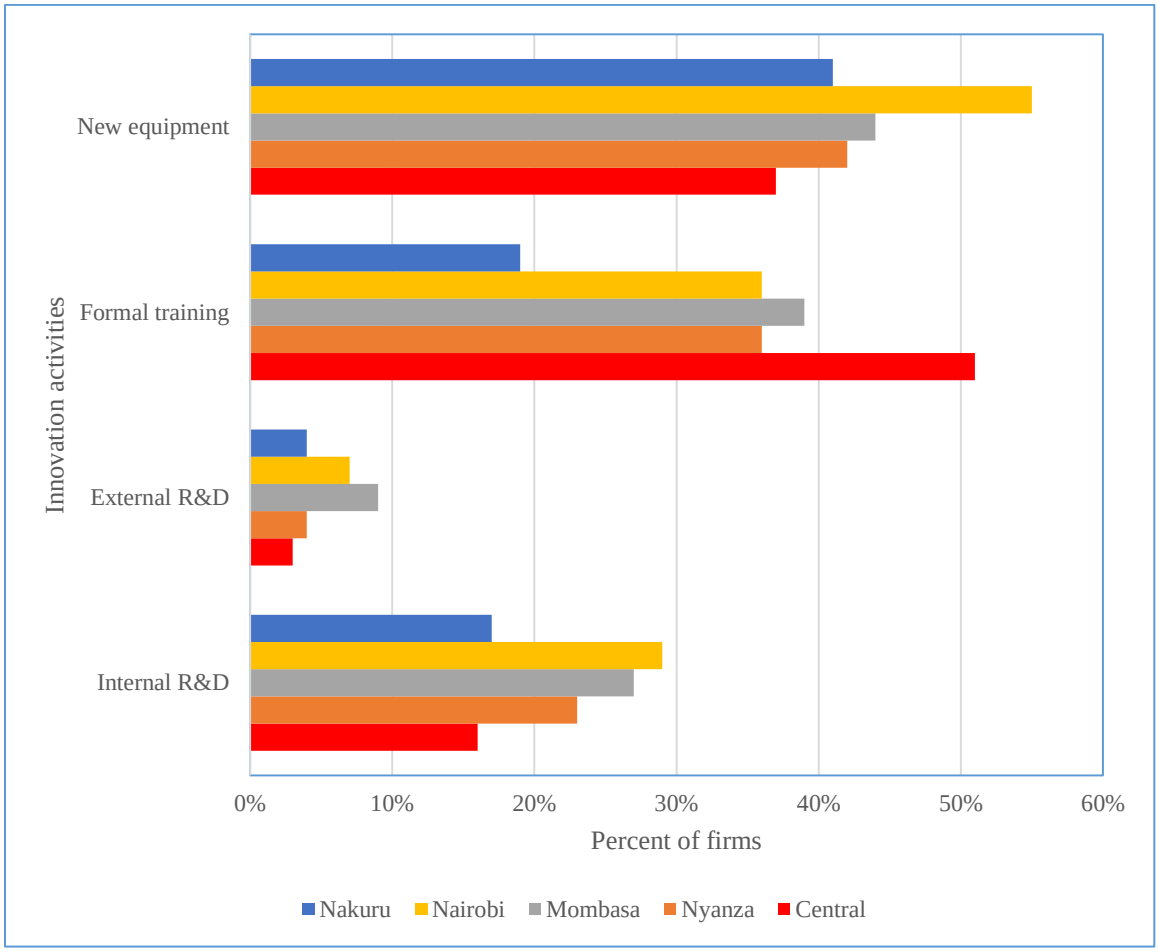
Figure 3. Objectives of process innovation



Innovation activities

Figure 4 reports on the activities associated with the development or production of product/service or process innovations reported in the IFS. The provinces exhibit relatively small differences in the reported measures. The most important innovation activity is the purchase of new equipment, machinery or software, followed by formal training, internal R&D, and external R&D respectively. External R&D relating to firms engaging public or private enterprises that are paid for the development of innovations seems to be of very low importance in all the provinces. It is likely that the costs associated with external R&D are high.

Figure 4. Innovation Activities



Sources of information for innovation

The most important sources of information or ideas for innovation activity by province as reported in the IFS are shown in Figure 5. A majority of firms rely on customer feedback for innovation. The second most important source of information is the internet, followed by products or services that are already available in the market, and business associations and conferences/exhibitions respectively. The least important sources of information or ideas for innovation include universities/research institutes, government ministries or programs, and recent hires from other firms. This may imply weak linkages between firms and universities/research institutes, and government ministries.

Figure 5. Sources of information for innovation by province

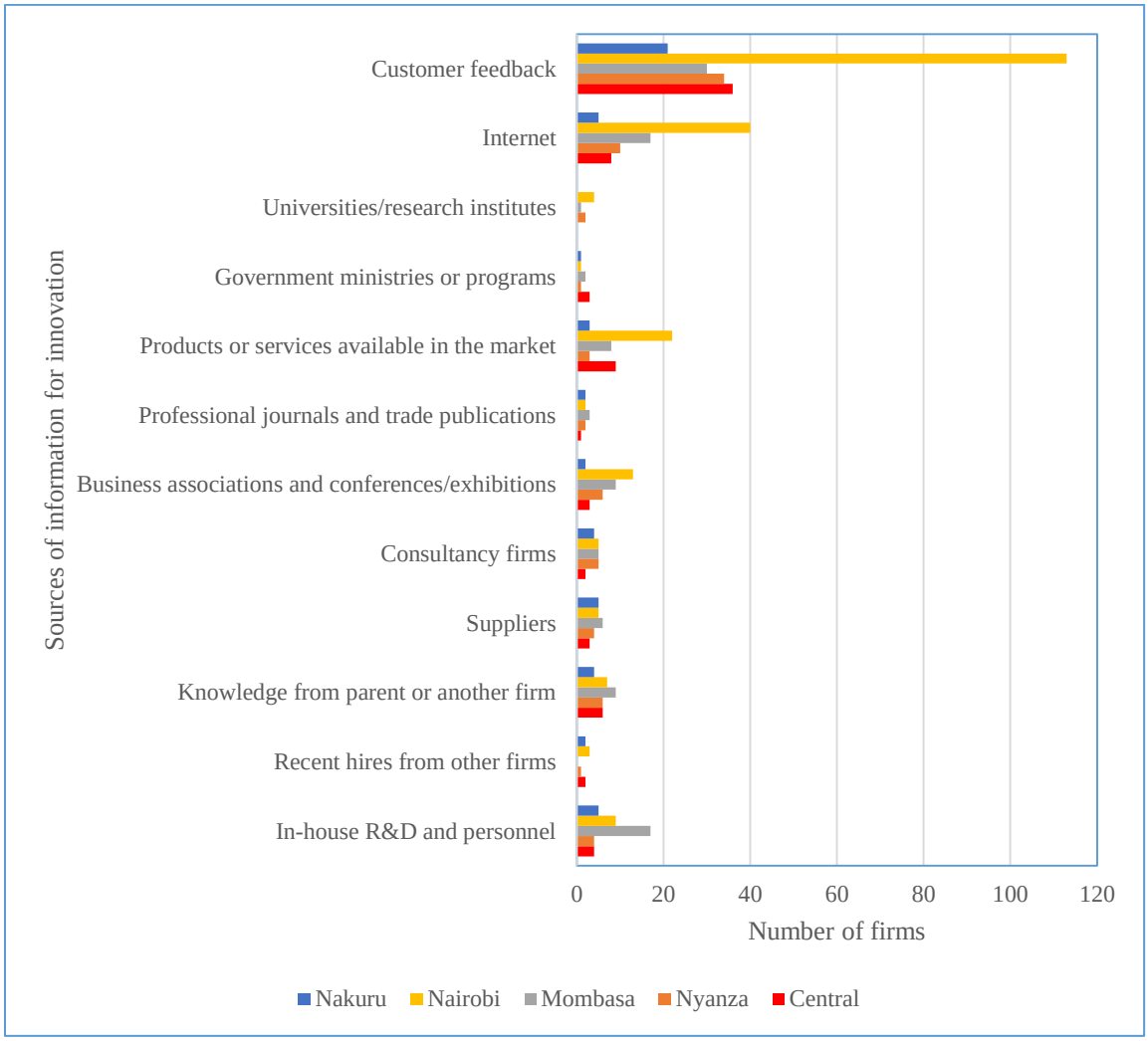
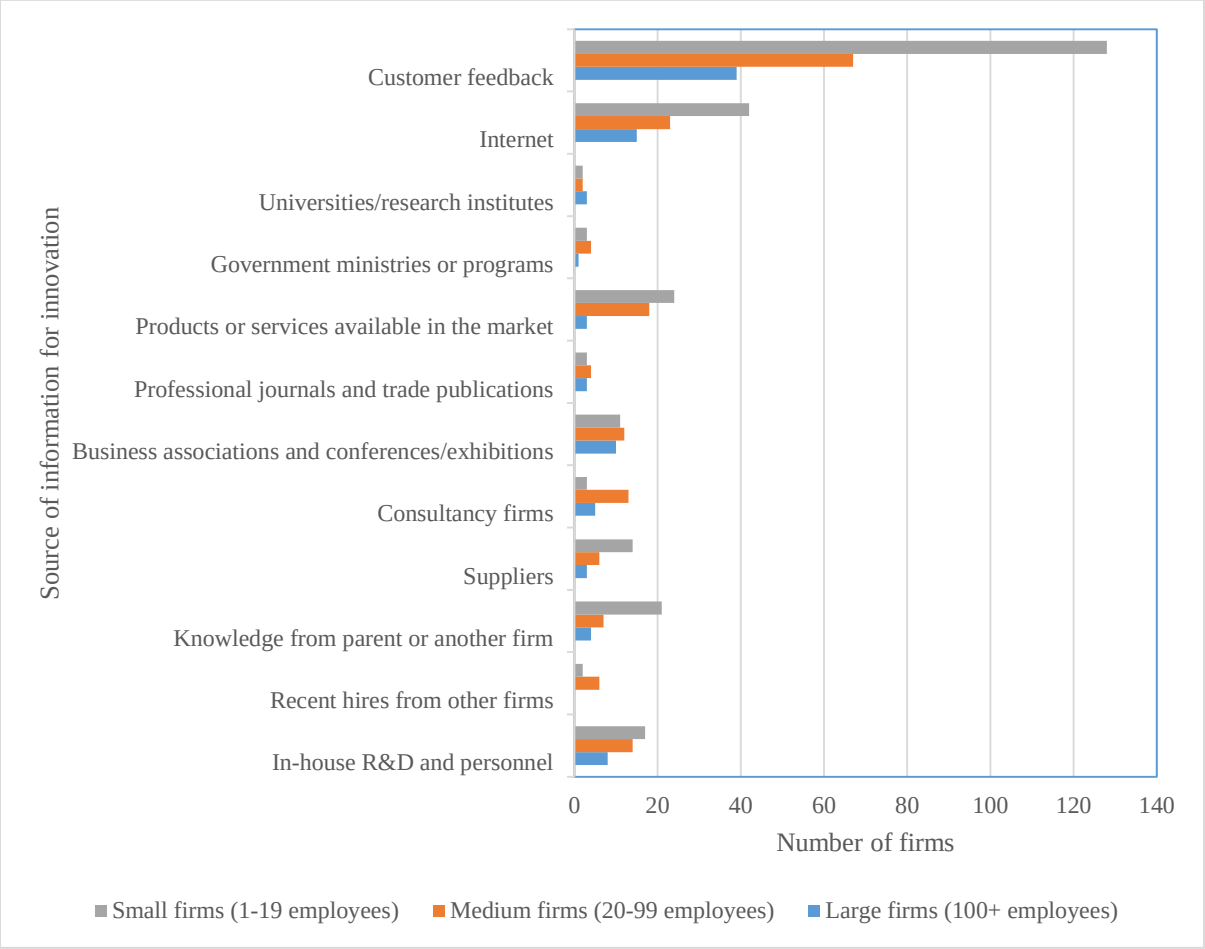


Figure 6 shows the distribution of the source of information for innovation activity by size of the firm. Customer feedback and the internet remain the most important sources of information for all categories of firms consisting of small, medium, and large farms. Notwithstanding, whilst universities and research institutes remain the least important sources of information for innovation activity for all small firms and medium firms, the least important source of information for innovation for large firms include recent hires from other firms and government ministries or programs.

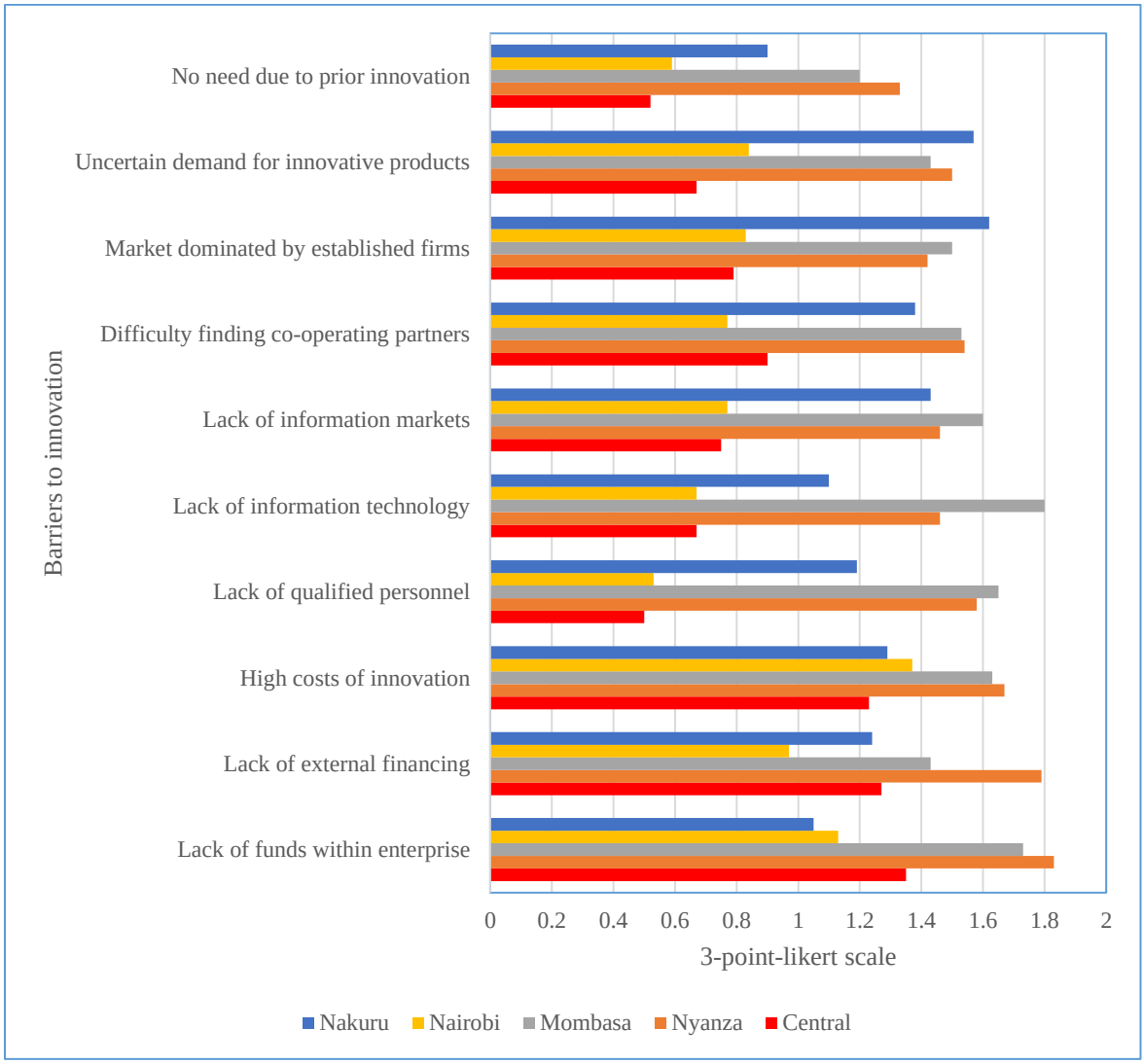
Figure 6. Sources of information for innovation by size



Barriers to innovation

Figure 7 reports on factors hampering innovation. A 3-point-likert scale ranging from not important to very important in the ICS instrument is used to measure factors that impede innovation. Firms in Central and Nyanza report that lack of funds within the enterprise followed by lack of external financing are very important barriers to innovation. Firms in Mombasa on the other hand report that lack of information technology followed by lack of funds within the enterprise as the main barriers to innovation. Firms in Nairobi report high costs of innovation and lack of funds within the enterprise as the most important barriers to innovation. Hence, a common barrier for Central, Nyanza, Mombasa and Nairobi relates to lack of internal funds. Contrastingly, the two most important barriers to innovation for firms in Nakuru include market dominance by established firms and uncertain demand for innovative products. These observations indicate that firms attach varying importance to different obstacles. The least important barrier to innovation for Central and Nairobi is no need for innovation due to prior innovation. Nyanza, Mombasa, and Nakuru report lack of qualified personnel as the least important barrier.

Figure 7. Barriers to innovation



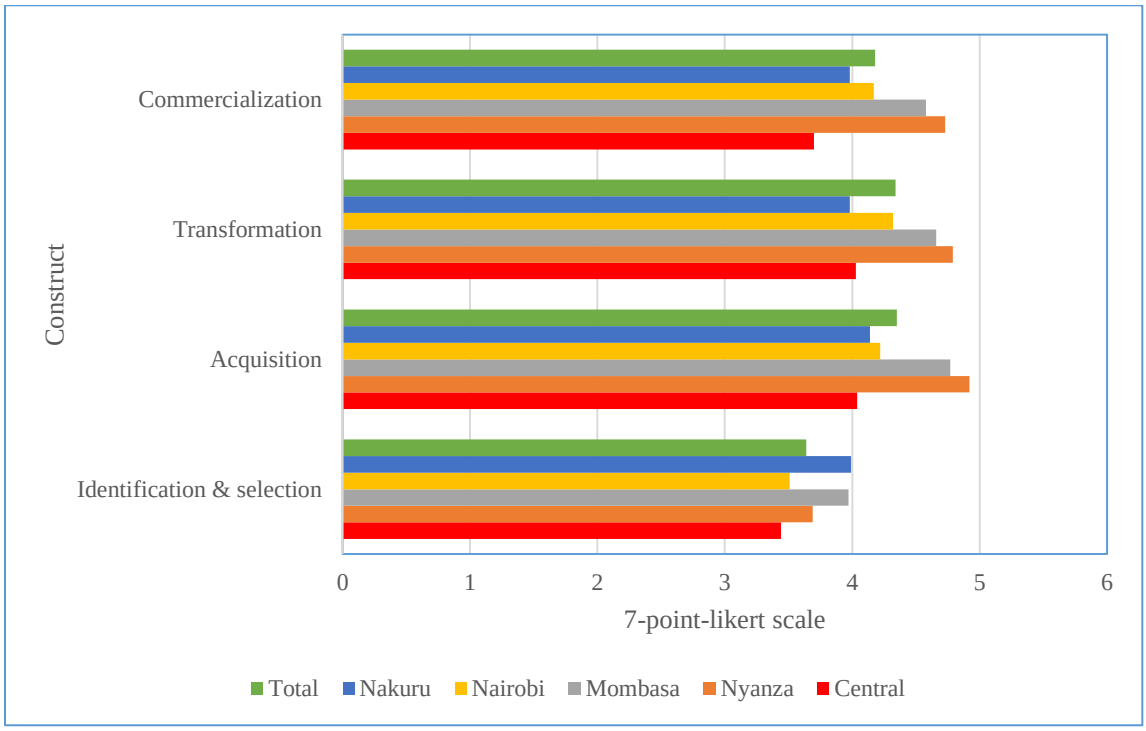
Internal and external factors

Dynamics capabilities

The role of firm capabilities has become more important in developing economies in recent years (Fainshmidt, Pezeshkan, Frazier, Nair, & Markowski, 2016). A dynamic capability refers to the capacity of an organization to purposefully create, extend, or modify its resource base (Helfat et al., 2007). In our survey, dynamic capabilities are reported using four constructs including identification and selection of knowledge, knowledge acquisition, knowledge transformation, and commercialization of products. Various items in the ICS instrument measured on a 7-point-likert scale ranging from completely disagree to completely agree are used for measuring each construct. Specifically, 5 items are used for measuring the firm's ability for identifying and selecting knowledge, 3 items are used for measuring the firm's ability for acquiring knowledge, and 4 items are used for measuring both the ability of transforming knowledge and commercializing products. The average values of the

items within each construct measuring dynamic capabilities are shown in Figure 8. Nakuru scores highly on "Identification & selection" of knowledge. Notwithstanding, Nyanza scores highly on the remaining three constructs including "Acquisition", "Transformation", and "Commercialization". Central posts the lowest scores on Identification & selection" of knowledge, "Acquisition", and "Commercialization" whilst Nakuru has the lowest score on "Transformation". On the overall, firms report a high ability of acquiring knowledge, and transforming knowledge. Contrastingly, they report a much lower ability of identifying and selecting knowledge. A high mean value on knowledge acquisition indicates that firms have a high ability of acquiring new and relevant knowledge from external sources for perceiving market opportunities. Additionally, a high ability of knowledge transformation suggests that firms recombine knowledge due to sound knowledge management systems. Furthermore, firms may have departments or coordinators who diffuse and disseminate knowledge effectively indicating that different departments work together with ease. A low ability for identification and selection of knowledge on the other hand may indicate poor networks between firms and scientific and research institutes coupled with poor access to specialised journals and magazines. It may also be the case that firms conduct technological audits ineffectively or that firms lack the ability for monitoring customers and client's needs.

Figure 8. Dynamic capabilities



Trust

Table 9 reports the extent to which a firm trusts it partners, and other organizations in their business dealings. Four items measured on a 7-point-likert scale ranging from completely disagree to completely agree in the ICS instrument relating to the extent to which firms regard their partners as trustworthy, frank and truthful, honest, and including the extent to which firms trust other organizations are used to construct an averaged value for measuring trust. Nyanza and Nakuru report the highest mean value on trust. On the other hand, Central reports the lowest mean value on trust. It is noteworthy that the mean values are above average implying a relatively

high level of trust. Nevertheless, none of the firms in Central, Nyanza, Nairobi and Nakuru reported that they completely disagreed that that their business partners were trustworthy. This indicates relatively similar levels of trust among firms in the four provinces.

Table 9. Trust

Province	min	max	mean	sd	N
Central	2.5	5	3.89	0.6439	48
Nyanza	3.25	6	4.50	0.6255	24
Mombasa	0	6	4.45	0.9611	40
Nairobi	2.25	6	4.43	0.6789	86
Nakuru	3.75	5	4.50	0.4330	21
Total	0	6	4.33	0.7404	219

We compare mean values of trust in partners, and other organizations in their business dealings with mean values of political trust reported in Table 10 to establish whether there is a general attitude of trust or distrust in government. We use the ES instrument to construct a measure of political trust that relates to the respondents evaluation of business-government dealings. This is also a measure of regional institutional quality (RIQ) that we examine in the second section of the report. An average of six items measured on a 5-point-likert scale ranging from "no obstacle" to "very severe obstacle" indicating the "degree to which e.g. corruption is an obstacle to the operations of the firm" is used for measuring political trust. Government performance relating to perceived corruption, judicial efficiency, and bureaucratic quality has been found to be associated with trust (La-Porta, Lopez-de-Silanes, Shleifer, & Vishny, 1997). Hence, government institutions will most likely not be perceived as an obstacle where we have high levels of trust. Table 10 strikingly reveals that the mean values for political trust are below average for all the provinces. This implies poorly-functioning government institutions. Notwithstanding, Table 10 shows that Mombasa and Nairobi report the highest level of political trust. This may suggest that government institutions are relatively transparent in their dealings. A comparison of mean values of trust in business partners (Table 9) and political trust (Table 10) reveals that Nakuru and Nyanza report high levels of trust in business partners, but a much lower levels of trust in government institutions. Contrastingly, Mombasa and Nairobi report low levels of trust in business partners, but relatively high levels of trust in government institutions. These observations suggest that Nyanza, Mombasa, Nairobi and Nakuru have opposing attitudes of trust towards business partners, and political institutions. On the other hand, Central reports the lowest level of trust in both business partners and government institutions. Nyanza and Mombasa retain relatively stable rankings in both measures of trust implying consistency in trusting business partners, and government institutions. This may indicate a relatively business-friendly and predictable business environment for firms in Nyanza and Mombasa as opposed to firms in Central, Nairobi, and Nakuru province.

Table 10. Political trust

Province	min	max	mean	sd	N
Central	0	4	1.27	0.7299	80
Nyanza	0	4	1.33	0.9878	79
Mombasa	0	4	1.37	0.7972	107
Nairobi	0	4	1.37	0.7958	226
Nakuru	0	3.67	1.28	0.7773	57
Total	0	4	1.34	0.8136	549

Relationship with customers and institutional actors

Relationships with buyers, suppliers, competitors, and institutional actors indicate the degree of firm embeddedness in local networks of economic activity. Four items measured on a 7-point-likert scale ranging from completely disagree to completely agree from the ICS instrument are used to construct an averaged value measuring whether the firms "have very well established relations" with these external actors. Table 11 shows that Nyanza reports the highest mean value on this indicator. Hence, firms in Nyanza have relatively close relations with external actors. On the other hand, Central has the lowest mean value suggesting relatively distant relations with external actors. It can also be observed that none of the provinces completely disagree that they have well established relations with external actors. Moreover, all the provinces score mean values that are above average. This implies a somewhat high degree of embeddedness suggesting that firms are likely to benefit from information and opportunities in their local networks of economic activity.

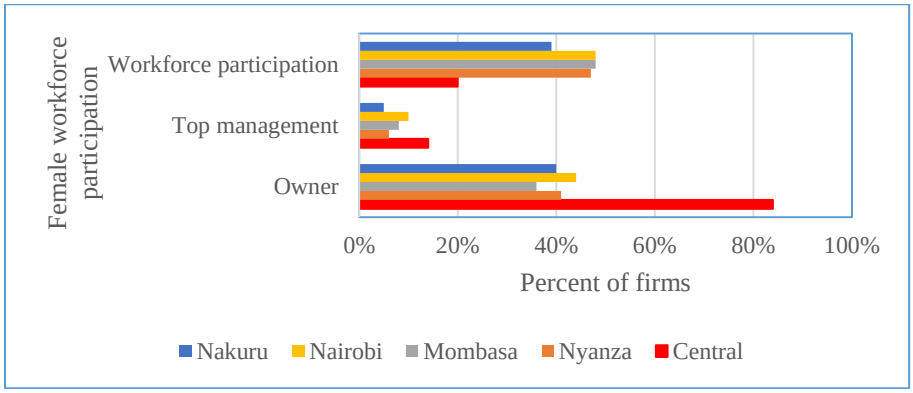
Table 11. Relationship with external actors

Province	min	max	mean	sd	N
Central	2.5	5.25	3.86	0.5787	48
Nyanza	3.25	6	4.81	0.6437	24
Mombasa	0.25	5.75	4.51	0.8824	40
Nairobi	2.25	5.5	4.33	0.6395	86
Nakuru	3.5	5	4.26	0.3990	21
Total	0.25	6	4.30	0.7139	219

Gender diversity

Figure 9 reports female participation at three hierarchical levels in the organization comprising ownership of the firm, participation in the top management, and participation in the overall workforce as reported in the WBES. A very large percentage of firms in Central are owned by women. Nairobi posts the second highest score. We note that Nairobi scores much lower than Central. Similarly, Central has the highest percentage of female participation as top managers followed by Nairobi. A possible explanation for this is that to large extent, the Central region in Kenya is inhabited by matriarchal communities whilst Nairobi is the capital city and generally cosmopolitan. Contrastingly, Central reports the lowest female workforce participation. Mombasa and Nairobi report the highest scores on the same measure. Nyanza follows closely on this measure. This may be attributed to the level of urbanization in the regions given that Mombasa, Nairobi, and Kisumu (a capital city located in Nyanza region) are the three capital cities in Kenya. Notwithstanding, female participation is below average for all the regions in all the three measures and particularly in top management participation.

Figure 9. Female workforce participation



Annex 3: EIP-LIC evidence addressing the original DFID research questions

Annex 3 seeks to answer several questions relating to firm-level and regional-level factors that drive innovation in Kenya by means of simple regressions. In addition, we examine how public-private sector linkages influence the development of innovations. We also investigate the significance of factors that firms perceive as critical barriers to the process of innovation and the diffusion of technology.

Firm characteristics, regional factors and innovation activities

In this section we address the following research question: "What firm-level and regional-level factors including size, ownership, market orientation, labour skills availability, gender, firm location, ties between public/private sector, role of intermediaries etc. hinder or foster the engagement of firms in innovative activities?" As such, we seek to examine the firm-level and regional-level factors that are associated with firms engaging in innovation activities.

Firm-level factors include age, size, percentage of foreign ownership, percentage of fulltime employees with high school education, and access to a line of credit or loan from a financial institution Regional-factors comprise location of the firm which includes urban or rural, regional level of knowledge creation, and RIQ. We use a clustered robust standard errors logit model to examine whether these factors foster or hinder innovation activities including internal R&D, external R&D, formal training, and purchase of new equipment for the development of innovations. Standard errors are clustered at the regional level (province) to account for correlation between residuals at the firm-level and at the regional-level. Table 12 reports the results of our estimation. For the firm-level factors we observe that the coefficient for size is positive and significant across all models indicating that larger firms have a higher likelihood of engaging in innovation activities.

Table 12. Logistic regression coefficients (n = 549)

Variable	Internal R&D		External R&D		Formal training		New equipment	
Firm-level factors								
Age (log)	0.094	(0.163)	-0.261	(0.227)	0.021	(0.115)	-0.285***	(0.104)
Size (log)	0.173***	(0.046)	0.470***	(0.113)	0.380***	(0.040)	0.405***	(0.066)
Foreign ownership	0.003	(0.003)	-0.015***	(0.004)	-0.007*	(0.004)	0.002	(0.002)
Education	0.008**	(0.004)	0.003	(0.005)	0.007	(0.004)	0.006	(0.003)
Access to credit	-0.018	(0.272)	-0.113	(0.346)	0.433**	(0.177)	0.505***	(0.169)
Regional-level factors								
Location	-0.195	(0.298)	1.124***	(0.332)	0.958*	(0.575)	-0.230	(0.260)
Knowledge creation	0.0556	(0.050)	-0.099*	(0.051)	-0.245***	(0.066)	0.028	(0.027)
RIQ	-0.411	(1.288)	-1.322	(1.842)	-11.36***	(2.942)	-1.685	(1.357)
Constant	-3.755**	(1.508)	-1.756	(1.809)	6.088***	(1.825)	-1.346	(1.107)

Clustered robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

The coefficient for education is also positive and significant in relation to internal R&D. Hence, firms with a large proportion of employees with high school education have a higher likelihood of engaging in internal R&D. None of the regional-level factors are significant in this model. The coefficient for foreign ownership is positive

and significant in the external R&D model. Hence, a larger proportion of foreign owners reduces the likelihood of engaging in external R&D which involves engaging the services of public or private enterprises for the development of innovative output. This may be as a result of foreign direct investment that reduces the need for investing in external R&D. For the regional-level factors, location is positive and significant. Hence, firms located in urban areas are more likely to engage in external R&D. This may be due to the degree of urbanization of such regions. Furthermore, the coefficient for knowledge creation is negative and significant. Knowledge creation relates to the regional internal R&D by firms. Hence, we infer that there is an inverse relationship between internal R&D and external R&D despite the levels of measurement being different. We also observe that the coefficient for foreign ownership is negative and significant in the formal training model. This may arise where technical support is offered by foreign owners. The coefficient for access to credit is positive and significant in the formal training model. This implies that firms rely on credit to train their employees for the development of innovative output. Similarly, access to credit is positive and significant in the new equipment model. This indicates that firms have access to credit for purchasing equipment, machinery, and software for developing innovations. The coefficient for location is positive and significant in the formal training model. It is likely that firms in urban areas have more access to training opportunities. Notwithstanding, the coefficient for knowledge creation is negative and significant in this model. A possible explanation for this could be that there are many knowledge sharing channels within a region, which increase firms' ability for benefitting from each other's knowledge that ultimately reduces the need for formal training. We also observe that the coefficient for RIQ is negative and significant in this model. A probable explanation for this may be that a high degree of RIQ reduces risks associated with entering into contracts for the production of innovative output. Hence, firms are more likely to engage independent skilled personnel for innovation purposes on a contractual basis as opposed to offering their employees training for the development of innovations. The coefficient for age is negative and significant in the new equipment model. This suggests that older firms are have a lower likelihood of investing in new equipment. None of the regional-level factors are significant.

Hence, from these results we conclude that the size of the firm is an important firm-level factor across all innovation activities. Furthermore, foreign ownership and knowledge creation have deleterious effects on external R&D and formal training in context of manufacturing firms in Kenya. It is also striking that firms rely on credit for formal training and purchase of new equipment and that location is important for external R&D and formal training.

Commercialization of innovative output

This section answers the following research question: "Which firm-level and regional-level factors hinder or foster the extent to which firms successfully commercialize the outcomes of their innovation activities?" We examine the relationship between firm-level and regional-level factors, and commercialization of innovative output by means of an OLS regression model. The measure of the extent to which firms can commercialize its innovative outputs is described in section I. This measure relates to the ability of firms capturing value from their innovative output. Hence, commercialization is conditioned upon innovation activities yielding successful outcomes. Nonetheless, we run a simple OLS regression to explore this relationship. Table 13 reports the results of our estimation. We observe that size is the only firm-level factor that has a significant effect on commercialization. Hence, larger firms have a higher likelihood of successfully commercializing their innovative output. A probable explanation could be that larger firms are likely to have sales and marketing departments.

Table 13. OLS regression coefficients (n = 219)

Variable	Commercialization	
Firm-level factors		
Age (log)	-0.055	(0.066)
Size (log)	0.091**	(0.044)
Foreign ownership	-0.001	(0.002)
Education	0.001	(0.002)
Access to credit	-0.043	(0.099)
Regional-level factors		
Location	-0.499**	(0.236)
Knowledge creation	0.100***	(0.029)
RIQ	3.452***	(1.280)
Constant	0.897	(0.871)

Robust standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Among the regional-level factors, we find that location has a negative and significant effect on commercialization. This is counterintuitive as one would expect that firms in urban areas have access to larger markets are therefore a higher ability to commercialize innovative output successfully. Notwithstanding, it may be the case that firms in urban areas face intense competition that impedes commercialization efforts. Also, it may be the case that commercialization is more expensive in a more urbanized setting. In this estimation, knowledge creation has a positive and highly significant effect on commercialization. Considering that knowledge creation is conditioned on regional internal R&D, one may argue that firms engaging in internal R&D develop their products with the aim of capturing value from innovative output. We also note that RIQ has a positive and highly significant effect on commercialization. Hence, we may infer that firms have a higher ability of appropriating returns from innovative output in an environment with strong institutions (Barasa, Knoben, Vermeulen, Kimuyu, & Kinyanjui, 2017).

Thus, as a firm-level factor, the size of the firm is important for commercializing innovative output. Furthermore, knowledge creation and RIQ are a crucial regional-level factor for successful commercialization of innovative products and services. Notwithstanding, urbanization seems to hinder the extent to which firms can successfully commercialize innovative output.

In-house innovation collaborative innovation, and technology acquisition

This section addresses the following research question: "What is the impact of in-house innovation activities versus collaborative innovation activities or technology acquisition activities on the innovation performance of firms in developing countries?" In-house innovation activities relates to a firm developing innovative products or services entirely on its own. Collaborative innovation activities on the other hand indicate that firms cooperated with other external actors including firms, universities/research institutes, private consulting companies, individuals or government enterprises to develop their innovative output. Technology acquisition on the other hand relates to firms acquiring foreign technology including equipment and machinery for their production processes. Innovation performance is measured as the number of innovative products/services introduced by the firm. Table 14 shows that firms engaging in-house innovation activities and collaborative innovation activities have lower innovative output relative to those that have acquired foreign technology. This suggests that firms in low income countries such as Kenya benefit from incorporating foreign technology in their production processes.

Table 14. OLS regression coefficients (n = 186)

Variable	Innovation output	
Firm-level factors		
Age (log)	0.116	(0.178)
Size (log)	0.110	(0.062)
Foreign ownership	-0.003	(0.003)
Education	0.006*	(0.003)
Access to credit	-0.008	(0.156)
Regional-level factors		
Location	0.223	(0.458)
Knowledge creation	-0.060	(0.048)
RIQ	-4.781	(3.451)
Innovation activities (Reference: Foreign technology acquisition)		
In-house activities	-0.533**	(0.127)
Collaborative activities	-1.127**	(0.403)
Constant	3.884	(1.823)

Clustered robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Based on the results of our estimation, we conclude that technology acquisition is critical for increasing innovative output relative to in-house and collaborative activities. This is particularly relevant in the context of developing countries given that our descriptive statistics revealed that countries in SSA heavily depend on imported inputs and supplies relative to countries in other regions.

Economic spillovers and innovation

This section answers the following research question: "What is the role of economic spillovers within clusters of firms in fostering economic growth and innovation?" Table 15 reports on our estimation of the effects of spillovers generated by cooperative relationships with customers and suppliers on innovative performance. Cooperative relationships relate to the number of firms reporting that the main important source of information or idea for any innovative activity in their firms was from customers or suppliers.

Table 15. Logistic regression coefficients (n = 549)

Variable	Innovation	
Firm-level factors		
Age (log)	-0.130	(0.201)
Size (log)	0.264***	(0.065)
Foreign ownership	0.00001	(0.003)
Education	0.009***	(0.003)
Access to credit	0.335***	(0.128)
Regional-level factors		
Location	0.167	(0.371)
Knowledge creation	0.010	(0.049)
RIQ	-7.232***	(2.149)
Cooperative relationships		
Customer	-0.514	(0.428)
Supplier	-0.220	(0.576)
Cooperation for innovation		
Firms	0.786**	(0.312)
Private consulting company/individuals	0.931*	(0.497)
Universities/research institutions	-0.154	(0.908)
Constant	0.142	(2.012)

Clustered robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Additionally, spillovers arising from cooperating with other firms, universities/research institutes, and consultancy firms in developing main innovative products are also reported. Innovation performance is a binary variable which indicates whether a firm introduced any new product or service. Coefficients of cooperating with customers and suppliers are not statistically significant. Nevertheless, the coefficients for cooperating with other firms and consultancies are positive and statistically significant. This implies that spillovers arising from collaborating for innovation between firms is important for Kenya. Additionally, firms benefit more from consultancies especially because they are likely harbour more technical knowhow and experience with regards to innovation.

Based on our estimation, we conclude that horizontal spillovers arising from firms and consultants are more critical for innovation performance relative to vertical spillovers from customers and suppliers. In particular, innovation ideas from other firms and consultants have significant effects on innovation performance for manufacturing firms in Kenya.

Barriers to innovation and technology diffusion

This section addresses the following research question: "What are the most critical barriers to the process of innovation and the diffusion of technology in low income country setting?" Table 16 reports the results of our estimation of the relation between barriers of innovation, and technology diffusion. Innovation performance is measured as the number of innovative output and technology diffusion relates to firms adapting or reproducing a product or service already sold by another firm. We observe the most critical barriers to the innovation process include market dominance by established firms, followed by difficulty in finding co-operating partners such as universities and research institutes. Notwithstanding, the most critical barrier to technology diffusion is lack of information technology.

Table 16. OLS/ Logistic regression coefficients (n = 104)

Variable	Innovative output		Technology diffusion	
Firm-level factors				
Age (log)	-0.088	(0.193)	0.331**	(0.143)
Size (log)	0.091	(0.053)	-0.080	(0.075)
Foreign ownership	-0.002	(0.002)	0.006	(0.006)
Education	0.004	(0.006)	-0.012	(0.010)
Access to credit	0.220	(0.422)	-0.333**	(0.152)
Regional-level factors				
Location	-0.483***	(0.069)	-1.060	(1.062)
Knowledge creation (log)	-0.600*	(0.268)	-0.006	(0.850)
RIQ	-4.963	(2.770)	-8.083	(5.129)
Barriers to innovation				
Lack of funds within enterprise	0.587**	(0.179)	-0.103	(0.278)
Lack of external financing	-0.359	(0.268)	0.443	(0.428)
High costs of innovation	0.121	(0.213)	-0.343	(0.385)
Lack of qualified personnel	0.00311	(0.150)	-0.137	(0.546)
Lack of information technology	0.202	(0.284)	-0.927**	(0.414)
Lack of information markets	-0.111	(0.270)	0.260	(0.610)
Difficulty finding co-operating partners	-0.378*	(0.143)	0.473	(0.637)
Market dominated by established firms	-0.474**	(0.168)	-0.374	(0.562)
Uncertain demand for innovative products	0.799**	(0.216)	0.474	(0.506)
No need due to prior innovation	-0.308	(0.191)	0.673***	(0.170)
Constant	4.338**	(1.107)	3.325**	(1.438)

Clustered robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

We therefore conclude that the most critical barrier to process of innovation is market dominance by established firms. This implies that dominating firms may already have established market networks which other firms

cannot penetrate with ease. Furthermore, difficulty in finding co-operating partners implies weak linkages between firms, and universities and research institutes. Furthermore, the use of information technology is an important mode of communicating information on new products and services is critical for diffusion of technology in Kenya.

Linkages with external agents and innovation

Here, we address the following research question: "What types of links between public/private sector, universities, government, NGOs and the private sector are more conducive to innovation activity? What is the role of universities for facilitating/propagating innovation in LICs? What is the role of the private sector?" In some instances, firms collaborate with external agents for realizing the development of innovative products or services. External agents comprise domestic and foreign firms, domestic and foreign academic and research institutions, private consulting company/individuals, and the government. Very few firms report on these measures of co-operation in the development of innovations. In fact, no firm reports collaborating with the government in developing its main innovative product or service. Table 17 reports the results of our estimation of the relation between the highlighted linkages and innovative activity in the firms.

Table 17. Logistic regression coefficients (n = 549)

Variable	Internal R&D		External R&D		Formal training		New equipment	
Firm-level factors								
Age (log)	0.071	(0.128)	-0.329	(0.228)	0.005	(0.119)	-0.304***	(0.114)
Size (log)	0.167**	(0.079)	0.486***	(0.141)	0.382***	(0.076)	0.408***	(0.076)
Foreign ownership	0.004	(0.004)	-0.015	(0.012)	-0.006	(0.005)	0.002	(0.004)
Education	0.007*	(0.004)	0.002	(0.008)	0.007*	(0.004)	0.005	(0.003)
Access to credit	-0.002	(0.215)	-0.098	(0.397)	0.436**	(0.194)	0.510***	(0.189)
Regional-level factors								
Location	-0.261	(0.538)	1.123	(1.134)	0.940*	(0.499)	-0.258	(0.467)
Knowledge creation	0.068	(0.079)	-0.104	(0.160)	-0.245***	(0.068)	0.029	(0.065)
RIQ	0.315	(3.379)	-1.167	(6.502)	-11.32***	(3.012)	-1.671	(2.798)
Linkages								
Academic/research institutions	-1.845	(1.276)	0.009	(1.275)	0.619	(0.900)	0.565	(0.936)
Firms	1.109*	(0.586)	1.584**	(0.741)	0.397	(0.553)	0.832	(0.557)
Private consultants	3.104**	(1.276)	-0.452	(1.267)	0.571	(0.841)		
Constant	-4.161*	(2.454)	-1.518	(4.847)	6.127***	(2.043)	-1.314	(1.990)

Standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

We observe that firms collaborating with domestic or foreign firms, and firms collaborating with private consulting company/individuals have a higher likelihood of engaging in internal R&D. Linkages that exert significant effects on external R&D include collaboration with foreign or domestic firms. Notwithstanding, none of the linkages have significant effects on formal training and purchase of new equipment for innovation.

Thus, different types of linkages matter for different innovation activities in the context of innovation in LICs. Linkages with private consultants have a much larger effect on internal R&D. Linkages with other firms are also

very important for internal R&D and external R&D. The role of academic and research institutions has no effect on innovation activities undertaken by firms. This may indicate that there are very weak linkages between academia, research institutions and firms in Kenya. Furthermore, linkages do not affect formal training and purchase of new equipment for innovation.

The role of demand side versus supply side policies

In this section we address the following research question: "What is the role of the demand side versus the supply side policies (e.g. AMC, tax credit on R&D, technoparks, export processing zones, trade preferences). In what sectors/contexts can they be applied? What are the lessons? Governmental support for innovation activities is reported by few firms in the sample. Specifically, several firms report receiving funding from government agencies/departments for innovation. Additionally, some firms report receiving non-financial support from government for innovation related activities. Non-financial support includes training in the use of innovation equipment, assistance in research and product development, and assistance and training for marketing innovations. Table 18 reports the results of our estimation of the relation between the two forms of government support and innovation performance, which indicates whether or not a firm introduced an innovative in period of the survey. The coefficient for funding from government agencies/departments is positive and statistically significant. Notwithstanding, the coefficient for non-financial support is not significant.

Table 18. OLS regression coefficients (n=549)

Variable	Innovation	
Firm-level factors		
Age (log)	-0.123	(0.114)
Size (log)	0.285***	(0.074)
Foreign ownership	0.0003	(0.004)
Education	0.009**	(0.004)
Access to credit	0.377**	(0.192)
Location	0.174	(0.482)
Knowledge creation	0.021	(0.069)
RIQ	-5.035*	(3.026)
Non-financial support	-0.367	(0.426)
Financial support	1.386*	(0.743)
Constant	-0.952	(2.134)

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Thus, considering that a majority of the firms in the sample fall in the manufacturing industry, one may argue that financial support from government agencies or departments is imperative for increased innovative output in this industry. Financial support of innovation activities from the government involves investing in internal R&D, formal training, and commercialization of innovative output, all of which increase the likelihood of innovation.

Gender diversity and innovation

In this section we address the following question: "What is the role of gender diversity in fostering innovation performance for firms in developing countries?" Table 19 provides an overview of how gender diversity impacts innovation performance which is measured as the introduction of new products or services. Gender diversity relates to female participation in the ownership of the firm, top management and overall workforce. Innovation

is measured as whether or not a firm introduced new products or services. We find that the coefficient for female ownership is positive and significant. Notwithstanding, the coefficients for female participation in top management and the workforce are not significant.

Table 19. Logistic regression coefficients (n=235)

Variable	Innovation	
Firm-level factors		
Age (log)	-0.277	(0.259)
Size (log)	0.183**	(0.086)
Foreign ownership	-0.0004	(0.003)
Education	0.002	(0.007)
Access to credit	0.303	(0.271)
Regional-level factors		
Location	0.433	(0.268)
Knowledge creation	0.051	(0.052)
RIQ	-0.971	(1.330)
Gender diversity		
Female ownership	0.456*	(0.266)
Female top manager	-0.255	(0.291)
Female workforce participation	0.145	(0.197)
Constant	-1.865	(1.670)

Clustered robust standard errors in parentheses

* p<0.10, ** p<0.05, *** p<0.01

These results suggest that firms with a more gender diverse ownership structure are significantly more likely to introduce a new product or service. Essentially, female owned firms have a higher likelihood of introducing innovations in the context of developing countries. Considering the positive but nonsignificant relation between female participation and innovation nonsignificant, one may argue that this may be attributed to low participation rates. Furthermore, the negative but nonsignificant relation between female participation in the top management and innovation may hint towards gender imbalance in the top management with women being few and thus receiving little support relative to their male counterparts.