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

Country Report Uganda

December 2017

Research project funded by the UK's Department for International Development (DFID/grant number PO 5639) implemented by Tilburg University and Radboud University Nijmegen

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 Uganda. The research output on Uganda was amongst others the result of a fruitful cooperation with the Makarere University Business School (MUBS), in particular Prof. Wasswa Balunywa, the Principal of MUBS and Dr. Vincent Bagire. The valuable knowledge and experience of participating senior researchers Sarah Kyejjusa, Diana Ntamu (Director of the Entrepreneurship Centre) and Hojops Odoch was absolutely essential in organizing the research activities in Uganda.

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 Uganda 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
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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 'Uganda Country Report' presents an overview of the scientific output and policy implications relating to Uganda. The scientific output comprises a qualitative research report, six papers within the 'Innovation Systems' theme involving data from Uganda, and three papers within the 'Finance and Productivity Growth' theme, one specifically on Uganda and two using data from the neighbouring countries, Kenya and Ethiopia. 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 Uganda are presented in Annex 2.

Qualitative research

The qualitative research findings of the project are written down in a report accessible via the project website. It is based on data collected through open semi-structured interviews with owners and managers of SMEs in Kampala 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 Uganda, as perceived by manufacturing SME owners and managers. Specifically, the case descriptions illustrate the different ways in which companies in Uganda introduce new products, processes, technology, or machinery.

The cases show that the innovations in the Ugandan cases are not 'new to the world' high tech innovations, 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 terms of these innovation manifestations, Uganda fits best in the classification of a factor-driven economy competing on factor endowments, unskilled labour and natural resources. As a country becomes more competitive, productivity will increase and wages will rise with the advancing development. Imported products remain cheaper, while some owners mention that these have inferior quality. Interestingly, in such a context, innovation would be one way to make more efficient use of resources and processes and compete with imports on the local market. An innovation focus on quality would be a logical way forward.

Innovation systems

In the framework of the 'Innovation Systems' research theme, six scientific papers (downloadable from the project website) were developed involving quantitative data on Uganda. 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 Uganda, Kenya and Tanzania. 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 using data from Uganda 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, amongst others in Uganda 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 first scientific paper within the 'Finance for Productivity Growth' theme investigates interactions between access to finance and employment creation for educated workers in Uganda. 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.

The second paper focuses on access to trade credit involving data from Kenya, a neighbouring country of Uganda. An increasing body of literature stresses the significant role this plays in economic development in LICs, including Uganda. 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 third scientific paper within the 'Finance for Productivity Growth' theme with relevance for Uganda, investigated the relationship between bank credit and trade credit in the context of neighbouring country Ethiopia. Specifically, the research question addressed whether usage of trade credit decreases with access to bank credit, or whether the use of trade credit and bank credit are

positively associated. The findings suggest that bank finance and trade credit are substitutes in Ethiopia. In locations with lesser access to formal bank finance, the use of trade credit is higher. The extension of trade credit by suppliers generates a credible signal to banks with regard to the customers' creditworthiness, which can make trade credit and bank credit complementary on the individual firm-level. For informal retailers, bank credit acts as a counterpart to trade credit in the sense that higher bank loan exposure is associated with greater access to trade credit. For formal firms, however, the research reveals that having more bank loans is not a significant explanatory factor of the use of trade credit. Having a relationship with a bank can also act as a signal of the creditworthiness of firms to their suppliers and reduce the agency problems associated with trade credit. An important issue for studying trade credit as a form of financing is its substitutability versus complementarity with respect to bank credit. The researchers find that trade credit usage is more prevalent in locations with lower access to finance, consistent with the substitutability theory.

Financial inclusion has been a key topic in development policy debates in many underdeveloped countries, but most policy initiatives address the direct effect of bank credit constraints. This research stresses the importance of the role of informality in understanding the association between trade credit and bank credit. Informal firms feature non-transparent operations and rely on cash-based transactions, partly to hide from tax authorities and partly due to the unavailability of bank accounts. Operational transparency is a major element in accessing external finance, because without transparent (formal) accounting standards, creditors cannot determine the quality of borrowers. Informal sector promotion policies could focus on the notions and necessity of transparent operations though awareness, training and education policies. Facilitating trade credit and bank credit could mutually strengthen each other, for instance, in combined policy and development programmes integrating the two. Policies to expand financial inclusion by increasing operational transparency might alleviate the agency problems of informal enterprises vis-à-vis suppliers and enable them to obtain not only formal finance from banks but also informal finance in the form of trade credit. For the formal sector, however, the research suggests less expected policy impact. Although obtaining a bank loan is positively associated with receiving trade credit for informal firms, the team does not find a similar significant link for the sample of formal firms.

DFID/World Bank EIP-LIC survey Uganda

For a decade, the World Bank has conducted enterprise surveys in Africa and Asia to understand economic development and business management features. As a focus of further inquiry, the World Bank launched a series of Innovation Follow up Surveys (IFSs) in 2011 to collect data on firm-level innovation several countries Africa and South Asia. The subsequent ICS Innovation Capabilities Survey (ICS) is a follow-up and complementary to the IFS. The ICS implementation in Uganda in 2014 was a joint effort of the World Bank and the DFID EIP-LIC project. 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.

ICS includes data from companies in the main regions in Uganda, represented by the major towns, namely Kampala, Lira, Mbale, Jinja, Mbarara and Wakiso. The data involve firms in manufacturing, particularly furniture, fabrication, equipment, craft making, construction and printing. The data show significant innovations in processing and packaging, internship, new product development, training and new equipment. The owners' and managers' objectives to innovate concerned increasing sales, improvements in process, help communities, overcome regulations, competition and access new markets. The survey further includes sources of

Various key variables are included in the dataset as presented in Annex 2 including the source of information for the innovations, barriers to innovation, dynamic capabilities and trust and relationships with external actors.

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 'Uganda Country Report' presents a summary of the key findings of EIP-LIC research of Uganda 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 Uganda. Annex 2 present the key survey findings as well as the data addressing the research question articulated by DFID in the original project proposal.

2 Project approach and methodology

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

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

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

Project organisation

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

Partnerships were formed with the University of Nairobi (Kenya), University of Pretoria (South Africa), University of Dar es Salaam (Tanzania), University of Ghana, National Economics University Hanoi (Vietnam), University Indonesia, Ahmedabad University (India), Chittagong Independent University (Bangladesh), and Makerere University Business School (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 Uganda 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 Uganda.

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 Uganda

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 Uganda. 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 Uganda involved a series of 13 interviews with managers and/or owners of manufacturing SME in Kampala and around. The qualitative data collection through interviews took place from 13 to 23 January 2017. 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 Uganda, accessible via the project website, three cases are presented below to provide some insight on the daily realities of SMEs in manufacturing.

3.2 Selected cases

Case 1: Construction materials – stone veneer (28 employees)

The first case concerns a company producing stone veneer. The owner started this business in 2010 together with his wife, cutting stones with a grinder in the front yard of his home. After initial commercial successes, he moved into a larger workshop and bought his first professional machinery – *"now we have several stone cutting machines, as you can see in the workshop."* The company has 28

permanent workers at present. The work processes are jointly supervised by the couple. She attends the accounts while he concentrates on technical part of the work.

The company cuts and polishes or carves the stones according to each client's order. The veneer is produced according to international standards in terms of size and thickness – *"the thickness is critical to avoid too much weight. The thinner the better."* The company cuts about 8 different kinds of rocks: granite, marble and limestone, amongst others. Small trucks deliver the rocks from different locations in Uganda. From the raw material, the owner develops 38 different product types of stone veneer. Apart from the rocks, the main inputs are diamond cutting rings, electricity and water.

The company supplies to various clients including real estate developers, contractors, professional builders, architects and engineers – *"I also have an institutional buyer in Nairobi, who needs 2,000 stones every month."* The owner does not market his products *"because I have sufficient clients and I have limited capacity. I am hidden."* Customers find him via word of mouth.

The exactness of the stone cutting, which determines the quality, has been the strength of the company, according to the owner. Other competitors in the neighbourhood also make stone veneer, but his is produced with great precision. The other competitors only work in sandstone and kaolin, which is softer, and only use hand tools. Over the years, the owner has invested in special machines that can handle hard stone such as granite – *"that is how we distinguish ourselves from other stone producers."*

The owner rents the plot of land where the workshop is located, but plans to move to an industrial area in the near future, because there is no room for expansion at his current location. Moreover, the premises are in a residential area, which poses an environmental challenge in terms of noise – *"children live around here and they have to go to school in the morning. Sometimes the noise is 24 hours a day."*

In 2013, he secured a contract for a large order with a value of 300,000 dollars from a real estate developer who was building a shopping mall in Kigali (Rwanda) – *"we supplied 6,000 m^2 of veneer for the outside walls, shop fronts and floors."* The developer paid partly upfront, which enabled the owner to buy advanced machinery. He is still working with the same stone sawing machines today.

The Kigali contract was hard as well as rewarding work. At that time, the company employed 35 people. He got the contract as a result of a meeting of the Uganda-Rwanda Business Forum, where he met a Rwandan businessman who introduced him to the Chinese contractor in Kigali. The owner got in touch with him to see some samples. *"The chairman looked at me and said, 'Can I gamble with you?'"*

The owner was based permanently in Kigali for the duration of the project, to ensure that everything went well – *"we were the small guys at the site."* His wife remained in Kampala taking care of other customers' needs and ensuring that production went on well to send supplies to the site in Kigali His employees worked in three shifts for 24 hours a day. Whenever there was a small problem, he would solve it on the spot – *"not for only my stones but the rest of the builders."* The owner learned a lot of things and *"the work went very well because the developer was supportive."*

He finished the contract properly because he wanted to show professionalism. As a result of the Kigali contract, he managed to attract new customers.

Internal capabilities

The owner was educated in economics and business administration at university level and also did a course in fine arts. His first job was in logistics and procurement, working in several locations in Kampala, Mombasa and the United Arab Emirates. During his work and travels, he came across companies producing stone veneer, which gave him the idea to start for himself.

The owner has organised the business according to what he learned in business administration. He established an organisational structure and set up several departments including operations, human resources, finance and marketing – *"I had this idea that I should organise things well while I am still small."* There are various explicitly defined positions and job descriptions in the company, such as factory manager, product quality supervisor, floor manager and senior sales managers.

The owner is seeking to recruit a geologist to assess the quality of the stones. One issue is that he wants to penetrate a new higher segment in the market. For this, he has to know the physical qualities and strengths of the stones, but the owner himself has gained only basic practical knowledge – *"I am not a geologist but when I look at the stone I can tell you this is granite."*

The owner takes good care of his staff. Meals are provided, there is health insurance *"and when they fall sick, we bring them to the hospital."* One human resources staff member is responsible for welfare. The employees are provided with gloves, noise and eye protection – *"ever since we started, the only person we have sacked is one individual who never complied with the safety guidance."*

Most of the technology involves a lot of manual work – *"I know there are some better machines but there is no need to introduce them."* New advanced machines are expensive, which he cannot afford within his current limitations on expansion, but *"with new machines, the production volume would increase a lot."*

The company controls for quality as the stones are packed on pallets. Precision cutting of the stone veneer into the desired size is essential – *"the stones should fit well."* One staff member puts the stones into the square metre for this purpose – *"every stone is checked."*

The owner is currently updating his product catalogue. He has engaged experts from the National Environment Management Authority to measure production emissions. For the new catalogue, he wants to include data about carbon emissions, so that clients can see that the products are developed in a responsible way.

External business and institutional context

The owner has few interactions with the government and is unaware of innovation policies or programmes targeted at manufacturing enterprises. Several ministers came to talk with him, but he has little interest in this – *"here, there is something wrong with the intentions of the people in government."*

According to the owner, everything starts and ends with the president. He believes that the president himself has good intentions. However, in the end nothing happens and money disappears. People in Uganda do their own thing and few feel a need to contact the government – *"I don't have time to go chasing people who have bad intentions."*

The owner does not have credit from a bank, having had bad experiences in the past when the banks were only looking at collateral, and particularly the machines. He had one bank employee who was sceptical about the value of the company's machines. *"He asked, if you default, who will buy the machine? I was dealing with the wrong guy."* Actually, the clients pay upfront so there are no problems with cash flow and debtors. Only when he has a big contract will he go to the bank and get working capital – *"I haven't gone out to get capital to buy machinery."*

Case 2: Textiles – gowns and clinical coats (25 employees)

This company produces a variety of textile products. The interview is held with the founder and director. Since the start of the business in 1987, the core products have been PhD and ceremonial gowns. The tailoring of these gowns is complicated and a certain quality is required – *"we've been here for a long time, so many institutions prefer to give us orders for the ceremonial and PhD gowns."* The company has recently enlarged the range of products to include fashionable bags and cushions. To stay in business, the company also has another line of products: clinical professional clothes for hospitals.

Tailoring was the owner's hobby when she was a little girl – *"I started sewing at the age of about 8."* In high school, she studied tailoring subjects. She made dresses for her friends at no cost – *"looking at somebody with a dress I made was very encouraging."* In university, she kept up the hobby but studied science, graduating with a BSc in chemistry. After graduating, she taught chemistry in a secondary school for some years.

In 1985, while accompanying her husband during his PhD studies in the UK, she attended a diploma course of a few months at a fashion design school in London. She started working for several textile factories, but had a rough start, with complicated sewing machines and strict supervisors. Nonetheless, she feels that the experience in London was critical for her – *"because the textile industry works very fast and efficiently, which is something we need in Uganda*." She came back to Uganda in 1986 and opened her company. She saved money in the UK, which allowed her to bring back 3 industrial machines.

Some time later, she met an American lady who gave US$5,000 for her to develop the business, which meant she did not need bank credit to set up her tailoring workshop.

Initially, she started in a shop in the centre of Kampala, tailoring to order. People came in and ordered what they wanted – *"we became very popular and we got many customers."* However, the location proved problematic in terms of safety, with high burglary rates, so she and her husband decided to move to the outskirts of Kampala.

The new location was not as easy to find for her customers, so she changed from 'clothes to order' to making her own designs – *"people can come, see and just buy from the stock we have on display."* However, this new approach did not work well. After a while, people would ask in the display room full of clothes – *"don't you have anything new?"* Then the idea came to make graduation gowns, because the design does not change and can be made in large quantities.

In the early nineties, Makerere University in Kampala used to import these gowns from the UK. She contacted the university but *"it wasn't easy to let us sell to them because they considered the imported products better than ours."* She told the university representatives that the imported gowns are very expensive and not even produced in the UK (she found out that the imported gowns from the UK were actually made in developing countries such as India). With this argument, she secured her first order of 200 gowns. The PhD gown is a special and complicated design. The university gave the 'secret' design to the company. Shortly thereafter, Makerere University started buying more gowns. Individual graduates also placed orders – *"we became popular because of our proximity to Makerere University."*

In the early '90s, she gained an MBA from Makerere to help develop her management skills – *"during that period, we made a lot of improvements in our workshop."* The cost of the MBA was affordable because the business revenue meant she could easily pay the tuition fees. The MBA helped her to organise her business, to develop mass production, and to improve staff management.

She involved the staff in solving internal problems and sought their ideas in new product development – *"I used much of what they advised to improve."* She also regulated the working day – *"we used to come in at any time."* She set the rule that work starts at 8 o'clock and begins with a prayer – *"each of them can lead the prayer and this improves their communication skills and their confidence and they really work together, starting from God."*

Occasionally, she sells gowns to a university in Malawi. She sends the final products by DHL, but this is too expensive, in her view.

In future, she would like to export more, but she considers export to be difficult, in terms of identifying customers and working across borders – *"you are not so sure whether the other person will pay."*

Internal capability and innovation

At present, 25 people are now working in the company, mostly women. In the past, the company hired more casual workers in the event of a big order. There are 5 staff involved in the management and administration, an accountant works three days a week and one member of staff manning the front reception. The owner was trained in customer care. She and her husband are the managing directors. Her husband used to work with Makerere University in a technical physics field, but has now retired from the university and is engaged in consultancy. He has little involvement in the daily operation of the business.

The company trains the production staff extensively. The owner explains that her experience in the UK helped her to train her employees to work faster. The company gets interns – *"they come in for an internship and we mentor them and we show them how to run a textile business."* The owner is not afraid that they might go away and start up their own businesses. She believes that her years of experience give her a competitive advantage.

She sees that staff training results in higher productivity. In the past, the staff made 5 clinical coats a day, whereas nowadays they can make 20 – *"production capacity is growing because of the people getting this experience."* The contracts for clinical coats are not very large. The company needs more orders, as *"our capacity is bigger than we use."* She is actively trying to secure more contracts and has developed new marketing models – *"we have Facebook, Instagram and a website."*

External business and institutional context

There are many challenges in business and *"Uganda is a very difficult environment."* One problem is the frequency of the power cuts – *"you cannot rely on it when you are under pressure."* The company has a small generator. It does not have a large capacity but can run some of the machines. Electricity is also too expensive, according to the owner.

Most of the time, the company uses local suppliers who have imported fabrics and materials available. The fabrics come from China and India via Dubai. The quality is not reliable, however, as the suppliers do not buy the quality that the owner desires – *"it seems that they are buying for themselves."* Another problem is the high cost of borrowing, so the company does not have credit from a bank.

The owner feels that there are too many taxes. As a business develops, it must register for VAT, which is required to work with large institutions such as Makerere University. VAT is 18%. There is also the requirement to pay a 10% contribution to the national social security fund (NSSF) for each of the workers' salaries. There is income tax and a city council tax – *"you really find it challenging to grow."* The tax regulations are very strict. VAT is due on the 15th of every month and late payment incurs a fine of 200,000 shillings – *"it pinches, so you make sure you are on time."*

There are now many firms making graduation gowns, offering products are lower prices, but the owner is quite confident that her quality is better than many of these competitors. The market is growing because there are more new universities. When she started, there were only 3: Makerere, Nkumba and Kyambogo. The company now also produces PhD gowns for Mbarara University – *"I don't know whether they have PhDs at other universities yet."*

The owner sees that the manufacturing sector is still very small in Uganda. There are a lot of agricultural products but these are exported and manufactured overseas, then imported as manufactured goods. It is difficult for a manufacturing business to grow because of the problems in the business environment.

Management and entrepreneurship education is also new, with Ugandan students only recently learning business administration and management, which are really useful for starting a business. Moreover, manufacturing as a business is relatively new for Ugandans – *"before the 1970s, only Indians were doing it"* but they were all expelled in the '70s by Idi Amin. After Idi Amin was sent out of the country, the Ugandan business community took off. The new generation of entrepreneurs is still young – *"I remember I was in the second cohort of MBAs at Makerere – which meant really that was the start."*

The company is a member of the Uganda Manufacturers' Association (UMA), USSIA and Uganda Women Entrepreneurs' Association (UWEA). She goes to regular meetings and gains good advice and contacts. Other helpful networks, according to the owner, include the Private Sector Foundation Uganda (PSFU). There is also the Uganda Investment Authority, which supports help foreign investors – *"foreigners enjoy better investment conditions than we do."* Foreigners also enjoy tax holidays – "*there is no fair competition."*

Case 3: Food processing – soya beverages and cakes (80 employees)

The company is located close to Kampala. The interview is held with the owner, who also acts as managing director. The owner runs the business with his wife. In 1978, he was a young road construction worker *"digging trenches and breaking stones."* Seeing his fellow workers buying roasted soya nuts and peanuts across the road, he identified an opportunity to produce and sell them himself, so he started to sell roasted nuts as a side-line. After initial losses and a learning period, he began to make *"really serious profits."* People started to place orders and requests for packing the nuts in a particular way.

In 1979, shortly after his first successes, Uganda descended into political chaos when Idi Amin was removed from power – *"everything was disorganised in Uganda and everyone went out of business."* The owner went to Kenya and came back four years later – *"I was back to zero, no job, no business."*

He picked up the idea of producing and selling food again, and set up a small venture baking and selling cakes. His mother provided him with a simple traditional oven – *"a drum with a compartment of fire on the top, fire at the bottom and chambers for bread in the middle."* His business, informal at first, grew slowly but surely. At one point, while doing different jobs in between, he realised that this food processing had become his destiny in life – *"so I had to concentrate on it."* In 1986, he officially registered his business with the USSIA.

Internal capabilities and innovation

In his formal business, the owner experimented with new products – *"by the time you come up with one successful product, there are a lot of failures behind it."* One day he developed a special formulation for a cake snack. He did it casually: just picking some ingredients, mixing them together and baking it. The result turned out to be good – *"I couldn't believe it was me who did it."* He started to produce the cake snacks on a larger scale and the *"product picked up really well*". He started expanding and had 20 people working for him in 1995.

Then one day, the majority of his staff suddenly resigned. It turned out that they had started in business themselves using the owner's cake formula and selling it to the same customers. The owner was quite frustrated and stopped his business. After a while, realising that his former workers were not able to maintain quality, he started again. He successfully regained his customers and continued to grow. Currently the business employs 80 people, including a sales and marketing team of 25 people. Having learned his lesson to keep the formulas secret, he now concludes written non-disclosure agreements with his staff.

Today, the company produces several key products that the owner developed himself. One of them is the Soya Cup, a drinking product that tastes like coffee – *"the aroma is close but doesn't have caffeine like coffee."* The product is a beverage made from soya beans to be used with plain water or milk – *"the Soya Cup accounts for 50% of all our sales."* People in Uganda are increasingly trying to avoid caffeine.

The company also produces brown butter, a spread for bread or a sauce base that is a combination of soya beans, ground nuts and sesame. Another important product is Soy Millet, a porridge from pre-cooked and roasted maize, soya beans and millet. Other products include muffins and cakes.

The main ingredient of all the products is soya. The owner became *"a soya guy"* because he realised that soya is by far the most nutritious product available in Uganda.

It has a much higher protein content than other cereals and vegetables, but has an unpleasant smell. To address this taste issue, the owner started to develop products which eliminate the soya flavour and came up with a solution to use local spices to neutralise the flavour.

Uganda is one of the top 4 major soya producers in Africa (with Zimbabwe, Nigeria and South Africa). However, the supply of locally produced soya is not always reliable in terms of quality and volume. Soya is seasonal and 50% of the beans are exported. The owner is not happy with the fact that raw beans are exported from Uganda – *"we are not only exporting beans cheaply but also exporting jobs."* He

sees the necessity for Uganda to add value to the country and export finished products – *"the industrialisation of this country is the way to go for us to get real value from our agricultural production."*

The company targets the Ugandan domestic market, selling directly to supermarkets, retailers, some schools, a few NGOs, and also individual customers via a small company shop. In terms of marketing, the products are advertised on radio and TV. The company has several company cars for delivery – *"in the morning they go and distribute, then they come back in the afternoon or in the evening."* The company does not have specialised distributors.

The company does not yet export, but the owner has plans to develop this. He knows that there is a market *"out there."* Occasionally, individual customers buy his products and take them overseas – *"if you live in Chicago and you come to Kampala looking for and buying my products, then […] I could have a market in the US."* At the same time, the owner is aware of the export challenges he is facing. He has to meet international food quality standards.

He knows that the packaging should be improved, to be more attractive. Another challenge is meeting production volumes if an international buyer places a large order.

The owner sees his business as a family enterprise. His son works with him, taking evening classes in the university so that during the day he can work in the factory. His daughters also work in the company. The owner has a clear succession plan.

The owner mentions that his focus on and persistence in business is a key success factor. Over the years, he became knowledgeable about food processing. Although his formal education is limited to primary school level, he has trained himself by attending short courses and linking up with people with specialised expertise in food – "*I knew I needed to team up with people and organisations who can really help me to develop and redeem the time I lost in school."*

External business and institutional context

The owner is actively establishing linkages on an international scale, such as the World Initiative for Soya for Human Health, the American Soya Association and Soya Southern Africa. He attends international fairs and forums and takes the opportunity to make presentations. He was introduced to academics from the University of Illinois who were doing research into soya beans – *"that was is a golden opportunity."* From that time, they started collaborating. Visiting the US, he met a professor in food science who suggested new ideas for soya products – *"he gave me ideas just walking down the corridor."* He works with research institutes in Uganda but they provide little input. Researchers from Makerere University have tried to make soya milk for a long time but never succeeded, whereas *"mine is on the market."*

The company and products are registered as trade names. The owner did not file patents for his products because the process is quite expensive and complicated. Some competitors have tried to copy them – *"they have put a product on the market calling it soya cup and they don't know that I have registered it as a trademark."* The owner sometimes takes action to prevent this, but it is very expensive.

The financing of his business has been challenging since the beginning. In the past, he had savings from his jobs.

He borrowed from money lenders – *"these guys used to charge 20% per month."* In an effort to get a bank loan, because he did not have a credit rating, he sought help from the Uganda Development Trust. Unfortunately, his financial records were not understandable by outsiders – *"I used to keep records in a way I understood."*

Today, he is able to secure bank credit, although the lack of sufficient guarantees and collateral remains a limitation. Moreover, the interest rate is too high, according to the owner – *"in Uganda, the interest rate is 26% per year while in Kenya it is 16%, so how can you compete in the region?"* The owner sees the high interest rate as the main reason why businesses in Uganda are stagnant – *"we are not working for ourselves but working for banks."* The owner's latest idea is to approach private equity funders –"*if we have good ideas like these ones – there are people who have the money but do not know what to do with it."* The owner tries to find partnerships to avoid having to use banks.

The owner feels the business environment is politically acceptable, although the government lacks the means and capacity to provide direct support to his business. He feels the high taxes are unacceptable – *"the taxes are killers."* As many businesses are not paying taxes at all, he would recommend that the government widen the tax base so that more people pay tax – *"why narrow it up and make it so complicated for a few?"*

The USSIA offered him several business development services, including courses on how to bring products to market, marketing and financial management –*"the guys from the association did a very good job."* He is looking at examples of *"big businesses of big people."* He also partners with the Uganda Manufacturers' Association (UMA) and the Private Sector Foundation. His operation is small but he has the ambition to expand it.

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 Ugandan 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 Ugandan 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.

Analysing the three Ugandan cases for newness, process and value creation is one possible way to assess whether the observed new phenomena within the companies qualify for innovation or not:

1. The veneer stone company case did innovate in terms of new products of process technology. However, more importantly was that the company introduced a management, business administration and marketing techniques and principles to organize his business. The neighbouring stone veneer businesses are household and informally organized. This makes the business more advanced in terms of competitiveness. This could be qualified as a management innovation, which would classify in Kaplinsky as business practice innovation.

2. The textile company introduced some new technology for the company and new products (gowns) for the new market. Another notable innovation was, after a MBA study, the introduction of new management systems and way of organizing the business which enabled her to raise productivity of the company a lot.

3. The food processing company has introduced several new products on the Ugandan markets. These products were developed by the owner, who gain a lot of experience over the years. He discover a way to reduce the smell of soya in his products which is an example of process innovation. For the production, the company has quite advanced machinery.

Internal capabilities

In all cases, it is the owner who initiates, coordinates and manages the new ideas, including preparations for the innovation, technical details, and the product launch. Several companies have a design or R&D department or a specialist employee with this function.

The Ugandan workforce mostly comprises unskilled labourers. Most owners pay their employees based on output, not a fixed salary within fixed contracts. Several owners face difficulties of the unskilled workforce and the high turn-over rate of the unskilled production workers. The recruitment of workers is therefore an ongoing concern for the owners and managers. Sometimes the employees provide innovative ideas, to a greater or lesser extent. Several owners, however, stress the limited creativity of their workers and refer to a passive attitude. Most owners and managers do train the employees on-the-job, but this does not involve the development of creativity. Getting higher educated staff is a problem since the graduate employees have primarily theoretical knowledge and few practical skills.

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 Uganda today. Despite these shortcomings, few 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. Some owners acknowledge the potential innovation capacity within the workforce, but this is not applied in practice.

Typically, the Ugandan companies possess technology and machinery that they have had for a long time. The technology is still able to deliver a certain minimum quality of the products. Occasionally, new machinery is bought from profits and savings. The interviewed owners and managers are well-informed about technological possibilities though the internet or informal contacts. They actually have ideas and plans for upgrading and expanding their companies. However, new (technological frontier) machines are relatively too expensive and advanced compared to the expected returns on investment on the short run. With regard to the long run, the macro-economic and institutional context does not provide sufficient confidence to do such extensive investments. They are only confident about the stability of the short-term.

External business environment and formal and informal institutions

All SME owners have more or less the same negative perception of government policies, legal regulations and systems. There is no clear regulatory or policy framework for manufacturing SMEs. Many ministries and governmental agencies have different regulations that are not predictable. All the entrepreneurs complain about the high costs of production, such as electricity costs.

Several of them hold a negative perception about the ever-changing government policies and regulations. There is no clarity about the changes and SME owners have to sort out themselves, which turns out to be very time-consuming. Many ministries and governmental agencies have different and unpredictable regulations. They also indicate that the business and institutional environment prevents them from innovating and growing their business. All mention the issue of competition with imports. The costs of production in Tanzania are high.

Most business were member of the Uganda Small-Scale Industry Association (USSIA) and had regular interactions, which help in solving technical issues or networking for clientele. No interviewed company received support from the government, and the owners and managers concerned regret that. They feel that they have to survive on their own. While most of them think that is reasonable, some support in terms of credit or technical support would have been welcome.

The banking system is not an attractive source of finance for SMEs. The high interest rates and complex paperwork is an critical issue. Instead, most SME entrepreneurs find investment money from savings and via informal loans from family members. They usually invest incrementally just before or after receiving large orders.

Branch associations are an important source of information and business contacts and contracts for the owners and managers of the cases. Most of them are member of an association. Interaction with formal technology institutions, as suggested in innovation systems literature (Lundvall, 1997), does not happen. Many SMEs owners and managers indicate that they would like to cooperate with universities to undertake research at their premises, for sharing the research insights for instance. There is very little spill-over of technology as a result of cooperation between firms, subcontracting or other forms of collaboration within value chains, business clusters or networks.

Policy issues – insights for policy makers to consider

One question that remains is the extent to what government will be able to do to reach SMEs. Various ministries within the Ugandan government have defined and implemented innovation policy. However, it seems not to reach the SME owners interviewed. Some SME owners and managers are aware of R&D centres and the programmes to aiming at technology development for SMEs. Maybe because one reason is that the technology is done in a technocratic top-down way. The companies are seldom consulted, in fact they prefer to stay at a distance from the formal institutions.

They are aware of the state of the art technology but they cannot afford the machines because of the high costs. Moreover the one that have the money available do not invest because of the uncertain future, both in macroeconomics terms. Also the government does not provide assurance on the stability of the 'rules of the game'. Most SMEs do what they do and do not further expand because of challenging business conditions.

As argued in the introduction of this report, it is desirable to develop innovation within manufacturing SMEs. Some believe that technological innovation is critical for SME development and catch-up in LICs. Technological innovation has, however, been traditionally concentrated in developed countries, given the costs and risks involved in stimulating technological innovation. Foreign sources of technology account for a large part of productivity growth in most countries. Therefore, the development process in Uganda could be supported by tapping existing technical and product knowledge.

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

It seems that the notion of growth as 'manna from heaven' as reflected in convergence theory, see the earlier rejected exogenous growth model of Solow and Swan (Fagerberg et al. 2010), might work after all because of the free and widespread access to knowledge and technologies via the internet. The knowledge itself is available for local companies in Uganda. The institutional context, providing trust, predictability, stability and access to finance is more of a problem in preventing investment in technology and innovation and thus 'convergence' from happening. At the same time, maybe the 'manna from heaven', thus technology developed elsewhere, does not address the local needs or issues.

Innovation climate

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

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

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

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

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

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

4 Innovation systems

The 'Innovation System' team produced seven scientific papers with special reference to Uganda. 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 Uganda, Kenya and Tanzania. 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.

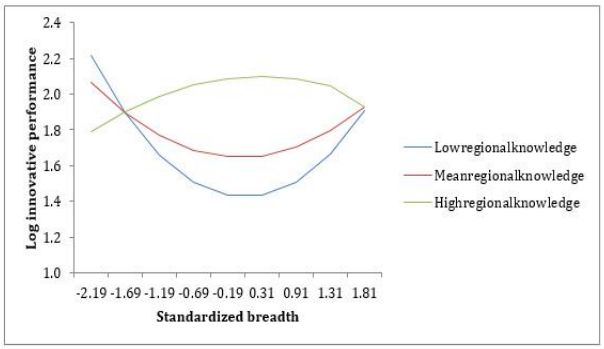
Research findings

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 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.

5.2 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 and Burak Uras. This policy brief provides the research approach, main outcomes and policy implications of the paper.

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.

5.3 Trade credit and access to finance

Many African countries have achieved promising economic growth rates in recent years. However, credit market imperfections are still persistent, resulting in limited access to formal bank credit for many firms, especially small and micro enterprises. Trade credit, as a method of direct 'in-kind' business financing, can

be popular as an alternative to bank credit in locations with limited financial sector development. From this perspective, trade credit and bank credit can be considered substitutes.

In the framework of a DFID-funded research project entitled 'Enabling Innovation and Productivity Growth in Low Income Countries (EIP-LIC)', a team of researchers from Cass Business School (University of London), the Institute for Management and Planning Studies (Iran), and Tilburg University investigated the relationship between bank credit and trade credit in the context of a developing county. Specifically, the research question addressed whether usage of trade credit decreases with access to bank credit, or whether the use of trade credit and bank credit are positively associated. The research further highlights the role of formality of firms. The team analysed firm-level data from 5,500 Ethiopian retailers. The original working paper is entitled 'Trade Credit and Access to Finance of Retailers in Ethiopia' (2017) by Thorsten Beck, Mohammad Hoseini and Burak Uras .

Research approach and findings

The findings suggest that bank finance and trade credit are substitutes in Ethiopia. In locations with lesser access to formal bank finance, the use of trade credit is higher. The extension of trade credit by suppliers generates a credible signal to banks with regard to the customers' creditworthiness, which can make trade credit and bank credit complementary on the individual firm-level. For informal retailers, bank credit acts as a counterpart to trade credit in the sense that higher bank loan exposure is associated with greater access to trade credit. For formal firms, however, the research reveals that having more bank loans is not a significant explanatory factor of the use of trade credit. These results could imply that receiving bank credit increases the creditworthiness of informal firms that have less transparent operations and motivates their suppliers to extend them trade credit. Formal firms, on the other hand, are more transparent and the level of obtaining trade credit is mainly restricted by the availability of such sources of external finance in the locality.

Having a relationship with a bank can also act as a signal of the creditworthiness of firms to their suppliers and reduce the agency problems associated with trade credit. An important issue for studying trade credit as a form of financing is its substitutability versus complementarity with respect to bank credit. The researchers find that trade credit usage is more prevalent in locations with lower access to finance, consistent with the substitutability theory. The research, however, also finds that bank credit acts as a complement to trade credit for informal firms who lack transparency and suffer more from agency problems with their suppliers.

Policy implications

Although the link between trade credit and bank credit has been studied in the literature, investigating this relationship in the context of a developing country with low levels of access to finance provides several original insights for policy makers. Financial inclusion has been a key topic in development policy debates in many underdeveloped countries, but most policy initiatives address the direct effect of bank credit constraints.

This research stresses the importance of the role of informality in understanding the association between trade credit and bank credit. Informal firms feature non-transparent operations and rely on cash-based transactions, partly to hide from tax authorities and partly due to the unavailability of bank accounts. Operational transparency is a major element in accessing external finance, because without transparent (formal) accounting standards, creditors cannot determine the quality of borrowers. Informal sector promotion policies could focus on the notions and necessity of transparent operations though awareness, training and education policies.

Facilitating trade credit and bank credit could mutually strengthen each other, for instance, in combined policy and development programmes integrating the two.

Policies to expand financial inclusion by increasing operational transparency might alleviate the agency problems of informal enterprises vis-à-vis suppliers and enable them to obtain not only formal finance from banks but also informal finance in the form of trade credit.

For the formal sector, however, the research suggests less expected policy impact. Although obtaining a bank loan is positively associated with receiving trade credit for informal firms, the team does not find a similar significant link for the sample of formal firms.

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Annexes

Annex 1: Series of EIP-LIC working papers

Innovation systems

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

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

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

'Finance for Productivity Growth'

1.	Beck, T. H. L., H. Pamuk, R.B. Uras. 2014 Entrepreneurial Saving Practices and Business Investment: Theory and Evidence from Tanzanian MSEs. Tilburg: Tilburg University. Paper accepted in journal "Review of Development Economics"
2.	Beck, T. H. L. and M. Hoseini. 2014. Informality and Access to Finance: Evidence from India. Tilburg: Tilburg University.
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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 Uganda

By Vincent Bagire (Makarere University Business School/MUBS)

1. Introduction

This report covers the features from the study of Ugandan firms. The context of innovation is based on three data sets. The first set of data comprises 184 firms from the 2014 Innovation Capabilities Survey (ICS). The second is the follow up qualitative interviews done in 2017in which 13 firms were involved. The report also presents data from the Enterprise Survey data of 2013 with 762 cases. The data shows that firms surveyed were from all the parts of the country. In this report the regions are represented by the major town where the study was centered, namely Kampala, Lira, Mbale, Jinja, Mbarara and Wakiso. The data shows firms from manufacturing in terms of furniture, fabrication, equipment, craft making, construction and printing. Thus there was generally a balance in regional and sector distribution.

The World Bank Enterprise Survey (WBES) collects data focusing on an economy's business environment and investment climate. The World Bank has conducted firm-level surveys for many years. Different waves of studies in the 1990's and through 2000 have enlisted progress in understanding firm level factors. Over the years instruments have been standardized for establishing comparability of data across countries. The Innovation Follow up Survey (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.[2] 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.

Respondents are a subset of the original WBES and are 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 IC 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).[3] In Uganda, the IFS was done in collaboration with Makerere University Business School, who organized for the local program, contacted the firms and a team of scholars witnessed the qualitative interviews that were conducted.

1.1 General description of the sample

1.1.1 Distribution of firms region

The combined data sets shows that firms were from across the country based on major towns. Uganda is divided in administrative districts that provide the key geographical units, in all regions. Major towns could also be based on to denote the political regions. In this case Kampala and Wakiso reflect the capital city and central region respectively, Mbale, the far eastern region, Mbarara for the western; Jinja firms are representative of the east, and finally, Lira reflects the sample of firms in the northern region. The number of firms per region is summarized in Table 1.

[2] 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.

[3] 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/.

Table 1. Sample by towns in Uganda, combined WBES and IFS data

Sampling region from final progress report, combined					
Region/town		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Kampala	74	37.6	37.6	37.6
	Jinja	35	17.8	17.8	55.3
	Lira	14	7.1	7.1	62.4
	Mbale	19	9.6	9.6	72.1
	Mbarara	25	12.7	12.7	84.8
	Wakiso	30	15.2	15.2	100.0
	Total	197	100.0	100.0	

The majority of the firms were obtained from the central and the capital city areas. This is by far the largest region and more vibrant in business activity. It has more urban centers than the other regions. Notably Kampala is the capital city where many enterprises mushroom given the big urban market. Conversely Wakiso is a large urban district that skirts around Kampala city. In the near east is Jinja and having a high number for firms connotes with its historical status. It is traditionally the industrial town of Uganda and home to the country's currently operational hydro electrical dams. In the west covering a big hinterland to the south is Mbarara town. By region characterisation, Mbarara is a big area and with many district towns that are growing rapidly.

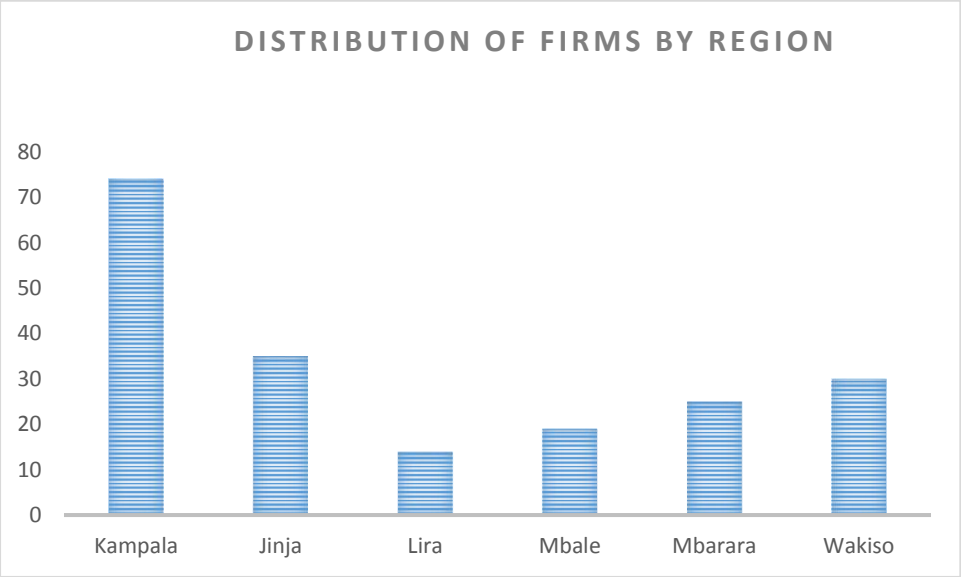


Figure 1. Distribution of firms by major towns denoting regions

Regarding the sample by region and size, excluding the IFS firms, Table 2 and Figure 2 give a further description of the sample firms. The size is measured based on number of employees. Small being equal to or less than five to nineteen; twenty to ninety nine and large had one hundred and above. The firms in Kampala were moderately distributed across the size, although the majority were still in the small size category. Jinja and all the other towns, save for Wakiso has majority in the small size categorization; Wakiso had a majority in medium size. Notably there was no large size firm in Lira, Mbarara and Mbale

in this sample. This analysis implies that across the country, firms employing more than 100 people are still relatively very few.

Table 2. Firm distribution by region and size

	Sample Size			Total
	Small >=5 and <=19	Medium >=20 and <=99	Large >=100	
Kampala	32	16	13	61
Jinja	25	5	5	35
Lira	9	5	0	14
Mbale	18	1	0	19
Mbarara	22	3	0	25
Wakiso	10	18	2	30
Total	116	48	20	184

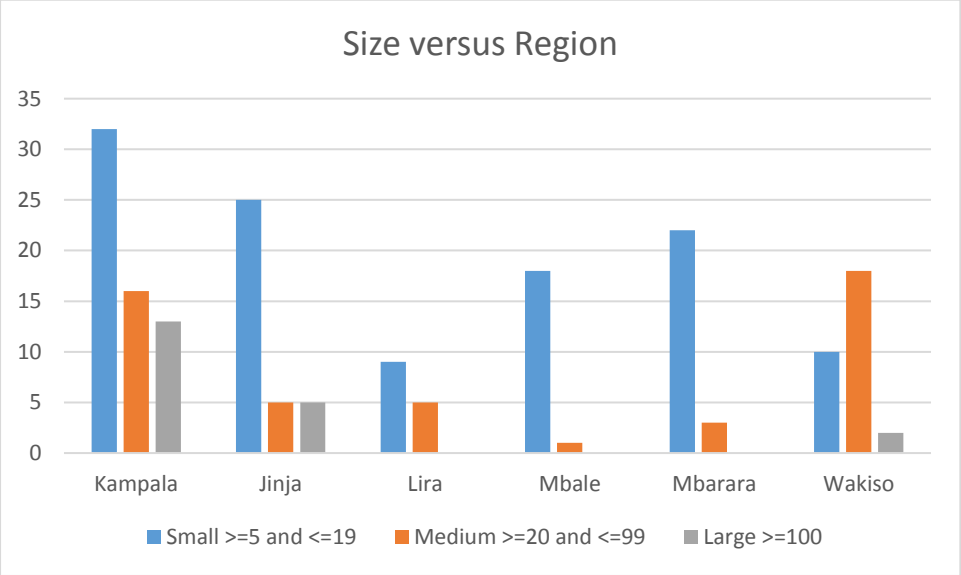


Figure 2. Graph of sample by size and region

Distribution of firms sector

The IFS sample included SMEs falling in different sub sectors within manufacturing and services. It was thus interesting to learn of the comparative innovation efforts across different firms. The firms were in metal fabrication, wood works, textile, construction, printing and craft ware. The majority were in metal works, equipment and fabrications. Notable as well as the firms in the handcrafts and woodwork; these comprised of carpentry, crafts, decorations, earth pieces among others. The summary categorization by sector is shown in Figure 3.

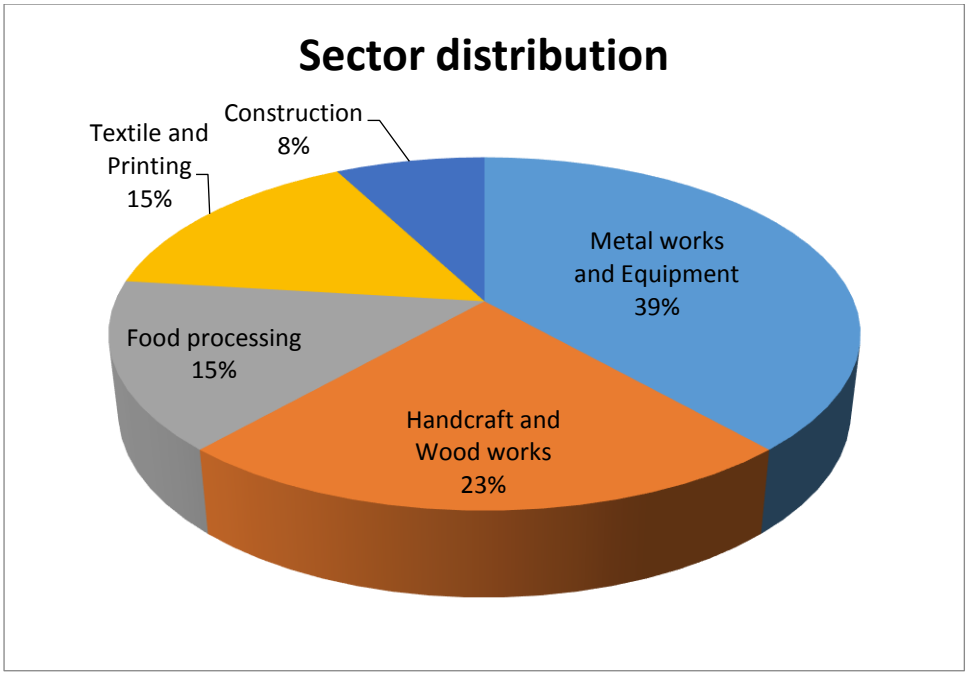


Figure 3. Distribution of firms by sector

Conversely, the ICS survey firms were distributed over a number of sectors. This is summarized in Table 3 showing the sector and the region.

Table 3. ICS sample firms by region and sector

Sector of the Establishment * Sampling region from final progress report Cross tabulation
Count

		Sampling region from final progress report						Total
		Kampala	Jinja	Lira	Mbale	Mbarara	Wakiso	
Sector of the Establishment	1511	3	0	0	0	0	0	3
	1514	0	0	3	0	0	0	3
	1520	1	1	0	0	1	0	3
	1531	2	5	3	3	2	2	17
	1533	0	1	0	0	0	0	1
	1541	4	1	1	1	3	6	16
	1542	0	1	0	0	0	0	1
	1549	0	1	0	0	0	2	3
	1551	1	2	0	0	0	0	3
	1553	0	0	0	0	0	1	1
	1554	2	0	0	0	0	1	3
	1711	15	1	0	2	2	3	23
	1721	2	0	0	0	0	0	2
	1722	1	0	0	0	0	0	1
	1729	3	0	0	0	0	1	4
	1730	0	0	0	0	1	0	1
	1810	4	1	0	1	2	0	8
	1920	0	1	0	0	0	0	1
	2010	1	1	0	0	1	0	3
	2022	0	0	0	1	0	0	1
	2029	1	0	0	0	1	0	2
	2101	1	0	0	0	0	0	1
	2211	2	0	0	0	0	0	2
	2221	1	0	2	0	2	0	5
	2411	1	0	0	0	0	0	1
	2422	1	0	0	0	0	0	1
	2424	0	0	0	0	0	1	1

	2519	0	0	0	1	0	0	1
	2520	0	0	0	0	0	2	2
	2693	2	0	0	0	1	2	5
	2695	1	0	0	0	0	0	1
	2720	0	1	0	0	0	0	1
	2811	0	4	1	1	1	1	8
	2892	0	1	0	0	0	0	1
	2899	4	4	0	3	5	2	18
	2921	0	1	0	0	0	0	1
	2923	0	0	0	1	0	0	1
	3130	1	0	0	0	0	0	1
	3190	1	0	0	0	1	0	2
	3430	1	1	0	0	0	0	2
	3610	4	7	4	5	2	5	27
	3720	1	0	0	0	0	0	1
	4510	0	0	0	0	0	1	1
Total		61	35	14	19	25	30	184

1.2 Exports and Imports

The Ugandan economy is still predominantly import based. The country is land locked and the gate way is through the Seaport of Mombasa through the Republic of Kenya. This in a way limits the level of exports by small producers as the cost from the inland across to the seaport is very high. The economy is also largely agro based with much livelihood on subsistence farming in crop and animal husbandry (PWC, Uganda Economic Outlook, Q2 2017). The country has also went through a turbulent political past prior to the mid 1980's. This political past still defines the business landscape in the country as well as the level of development and industrialization.

Uganda attained independence from Britain in October 1962. It went through some constitutional crisis and was declared a republic in 1966. In 1971, the country entered a remarkable era in history when the first military coup was staged and overthrew an elected government. For next eight years the country suffered bloodbath under military dictatorship. After the overthrow of dictatorship in April 1979 by a combined force of Ugandan exiles and Tanzanian forces, the country witnessed short presidential tenures till an elected government was sworn in in 1980. The new regime however, was faced with guerrilla warfare and was ousted by its own military in 1985; the new military ruler was shortly deposed by the guerrilla forces in January 1986. This political scene left the economy crumbled. Public infrastructure was almost spoilt to non-functional. The country has therefore been in recovery but lately regained its economic path.

National development is still low. This is despite the country being endowed with good climate and vast natural resources. Agro-technology is still low accounting for low productivity hence less value for export. On the other hand, certain foods are imported into the country especially rice and sugar. Equally most manufactured products are imported, including capital goods and industrial inputs. For instance whileas, merchandize in exports increased from USD 147 in 1990 to U$ 501 in 1998, imports increased from U$213 million to U$ 1474 million; a very large disproportionate ratio. Thus we see a great imbalance between the country's exports and imports. The mineral sector is inadequately developed despite the confirmation of rich oil and gas reserves in the Albertine region alongside other scattered mineral deposits countrywide.

The summary of the product exports and imports characteristic in the IFS data set companies are summarized in Table 4.

Table 4. Product exports and import behaviour of the firms

Company	Main business	Products and export level
Stone Works	Stone for construction	Different stone shapes imported to Kenya and Rwanda
Furniture	Wood work in all forms	Started importing finished products from China. Now exporting at low scale to Rwanda and venturing into South Sudan.
African Crafts	Craft designs	Through visitors and interns to Finland, Canada, Germany, USA
Apparel Designers	Textile designs	Have made inroads to export bags, gowns etc. To Tanzania, US, Europe, Malawi and Finland
Energy Stoves	Energy saving stoves	Exported once to South Sudan currently yet to make other external contacts.
Fruit Processing	Fruit juice processing and packing	Export efforts made to Southern Sudan, Kenya and Ghana, other expected
Furniture	Furniture designing	Still depending on local market.
Food Processing	Food processing	Attempted through friends to Canada, US, and regional markets
Equipment Fabrication	Machinery and equipment	Working on ISO certification to launch into export, building capacity
Metal Fabrication	Metal fabrication	Exploring regional market
Tools Manufacturing	Machinery and equipment fabrication	Not ventured, occupied with satisfying local market

In Table 5 is a representation of the export priority areas by the WBES dataset.

Table 5. Export destinations by priority (Percent)

Region	As first main	As second
China	0.5	-
Congo	1.6	1.6
DRC	0.5	-
Germany	0.5	-
India	1.6	-
Kenya	5.4	2.7
Rwanda	1.6	5.4
South Sudan	4.9	1.6
Sudan	6	1.1
Tanzania	1.6	1.1
U.K	0.5	0.5
USA	1.1	-
Burundi	-	0.5
Canada	-	0.5
Nigeria	-	0.5
South Africa	-	1.6

Sampling region from final progress report	Raw materials and intermediate goods of domestic origin (Mean values)	Raw materials and intermediate goods of foreign origin (Mean values)
Kampala (N=61)	61.66	36.41
Jinja (N=35)	73.20	20.06
Lira (N=14)	87.86	12.14
Mbale (N=19)	92.63	7.37
Mbarara (N=25)	70.80	29.20
Wakiso (N=30)	61.07	31.07
Total (N=184)	70.19	26.60

The data confirms that the key destination for Ugandan exports remains Kenya, followed by South Sudan. Other first priority destinations are Congo, Rwanda, USA, India and Tanzania. Conversely, these countries are also second priority destinations.

1.3 Supplies and imports

Table 6 shows the proportionate means for the firms reporting on input supplies purchased from domestic or foreign sources. Across all regions, the means for domestic origin so much outweigh those for foreign origin. Mbale reports the highest mean for domestic followed by Lira. This means that in these two regions, the greatest portion of the raw materials and intermediate goods were of domestic origin. Conversely, in these two regions, the lowest means are reported for raw materials and intermediate goods being of foreign origin. Kampala reports the highest mean for foreign origin, although proportionately lower than the highest score for domestic. Kampala and Wakiso are below the average of the domestic origin source. The possible explanation for this observation lies in the type of industry in question. Most of the raw materials for instance in fabrication and carpentry are locally available. Firms may also be purchasing some of their inputs from local importers.

Table 6 Report on Raw materials and intermediate goods source

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.

The origin of inputs and supplies by region is shown in Table 7.

Table 7. 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%

Table data shows that the highest origin of inputs and supplies is Sub Saharan Africa; South Asia was reported to be the lowest foreign origin.

2 Innovation

2.1 Product and process innovation

Innovations are here discerned from the point of view of process and products, including improvements in service provision. The definition of innovation adopted in this report is based on previous studies especially Oslo Manual (2005). It is defined as the implementation of new products and services, or significant changes in existing products and services. From the Uganda country study are noted various innovations as discerned from the owner managers explanation. These are elaborated below product, process, market, production and customer services.

Product

The cutting and polishing of stone for construction was found to be a key innovation by one company in the study. The stone veneer is produced according to international standards but they have made significant improvements in the product and process. About 8 different kinds of rock, marble and limestone are cut into different shapes to meet the taste of the construction industry. 38 different product types are designed. The owner has also ventured into export to Kenya and Rwanda.

In the wood and furniture works we also identified various product innovations. These included new designs of furniture pieces that are unique on the Ugandan markets. Some of these designs are original as was explained by the owner managers, others are imitations and modifications of westerns models. As explained earlier, the innovations in equipment and machinery was fascinating and so are those in crafts and energy stoves. We found the patenting of the purple coloured energy stove by one company a very bold step of innovation not common in the rest of the country.

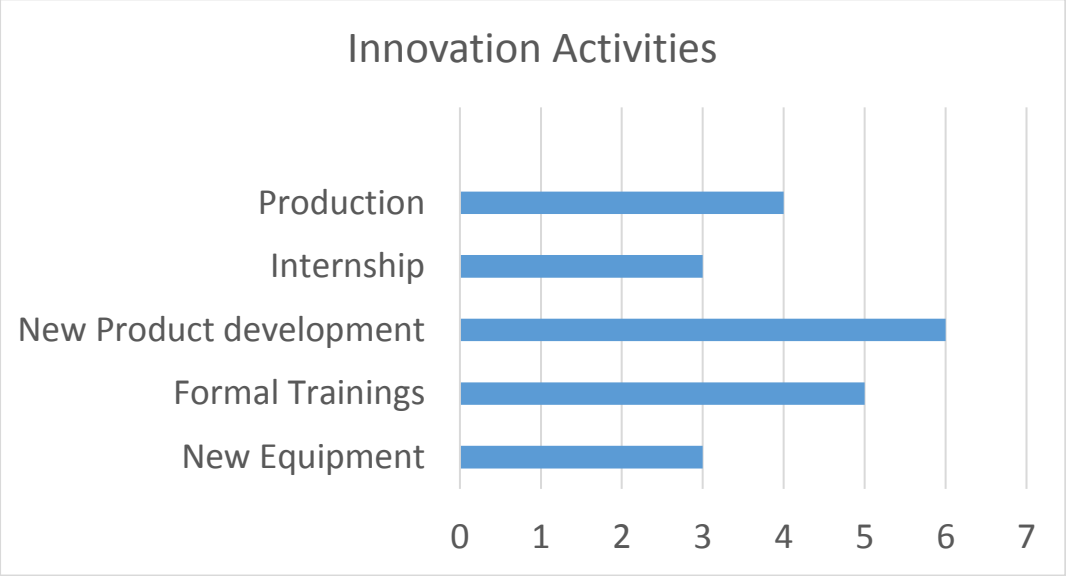


Figure 4- Innovation activities

From the figure above, several activities were listed as carried out towards innovations among the sampled SMEs. As noted earlier the basic understanding of innovation was being able to offer something new from the neighbours. In this case activities were mainly in new product development, followed by formal training. The lowest focus was on new product development.

Formal training activities

This became the second highest scored activity towards innovation, although it was a surprising result. Formal training was done in different ways. Notable was the training organized by international NGOs and agencies like DFID, GIZ from which the entrepreneurs gained immense knowledge for their operations. One entrepreneur for instance, was offered a formal training in Germany and on return has

been able to develop various innovations in solar power energy. At the energy stove company, apprenticeship is the kind of training that is offered; the apprentices go through a long and rigorous training to master the skills. As it was noted, some leave to set up their own enterprises.

Production activities

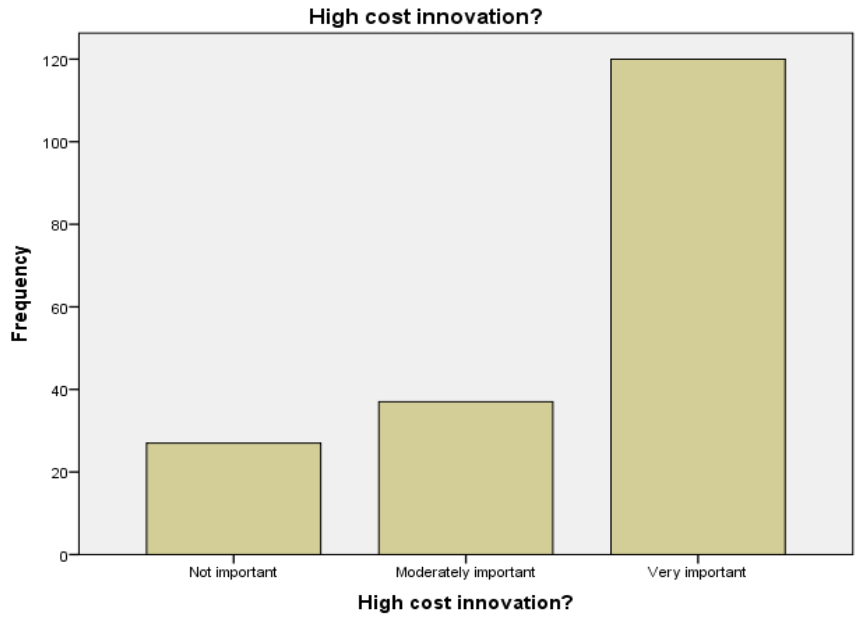
Activities related to production were key drivers to innovation. Many of the enterprises were adopting newer technologies in their production processes. This was at one Printing company where graphical printing and digital machinery had greatly improved quantity and quality; a similar story was shared by Apparel designers whose importation of electrical sewing machines had changed the fashion designs of the graduation gown. Similarly at the Stone Company the powerful cutting and designer machines led to a breakthrough in stone veneers innovations.

Internship activities

This could be categorised as organizational innovation or even training but it emerged with emphasis on its own. It began as a policy by the National Council of Higher Education to encourage skill development among graduates. It has become an innovative activity for companies as well as graduates to develop new ways of doing work through knowledge exchange and learning on the job.

2.2 Effect of cost of innovation in the establishment.

This analysis is based on the WBES dataset. This effect of cost of innovation on the firm establishment is depicted Figure 4 below and summarized in table 8.



It is discerned from the graph that the cost of innovation was felt to be very important among the establishments. Those reporting it to be not important or moderate were relatively very few.

Figure 5. Importance attached to cost of innovation

Table 8 Cost of innovation by region

		High cost innovation?			Total
		Not important	Moderately important	Very important	
Sampling region from final progress report	Kampala	15	4	42	61
	Jinja	7	6	22	35
	Lira	0	4	10	14
	Mbale	1	3	15	19
	Mbarara	1	13	11	25
	Wakiso	3	7	20	30
Total		27	37	120	184

With further analysis of cost of innovation by region, the distribution was very important across the regions with the highest being Kampala and Lira the lowest. This signifies that cost remains a key factor in innovation activities of firms in the survey.

Certainty of innovation

It was also important to establish whether the certainty of innovation for services and goods was at all an issue among the firm in the WBES survey. The results in Table 9 provide key insights on this aggregated by region.

Table 9.Uncertain demand for innovation goods or services

	Frequency	Percent
Not important	49	26.6
Moderately	78	42.4
Very important	57	31.00
Total	184	100

The uncertain demand for the innovation was moderately important. Across the regions, however, Kampala maintained very important for the uncertainty. Other regions however, aligned with the general view of uncertainty of demand being only moderately important.

On whether there was no need for innovation due to prior innovation, the score was higher in Kampala; all the other regions differed and maintained moderate rankings. This could be due to Kampala's population being extremely urban and exposed that they find no need for new innovations due to previous innovations. Also the influence of many goods allows them adequate variety of choices for their consumption. Meanwhile in upcountry towns their consumption is driven by seeing something new, which may drive desire for further innovations.

Table 10. Sampling region from final progress report * Uncertain demand for innovative goods or services?

		Uncertain demand for innovative goods or services?			Total
		Not important	Moderately important	Very important	
Sampling region from final progress report	Kampala	15	20	26	61
	Jinja	17	10	8	35
	Lira	2	10	2	14
	Mbale	4	8	7	19
	Mbarara	2	19	4	25
	Wakiso	9	11	10	30
Total		49	78	57	184

Table 10 shows highest uncertain demand in Kampala and lowest in Lira, compared to the other regions. This may imply the urban and rural contrast being true.

Influence of prior innovation on need for new innovation was discerned through a number of factors as in Table 11.

Table 11. Sampling region from final progress report * No need in innovation due to prior innovations?

		No need in innovation due to prior innovations?			Total
		Not important	Moderately important	Very important	
Sampling region from final progress report	Kampala	22	19	20	61
	Jinja	27	6	2	35
	Lira	9	4	1	14
	Mbale	2	12	5	19
	Mbarara	2	16	7	25
	Wakiso	10	15	5	30
Total		72	72	40	184

Both table 10 and table 11 summarize our discussion on the drivers of innovations. The former highlights the regional viewpoints on uncertainty of demand for innovative goods and services. Uncertain demand was very important in Kampala but not important in Jinja. This is an interesting finding given that Jinja is the second biggest town to Kampala and Uganda's original industrial town. Across the entire data set, the highest viewpoint was moderately important for all the 184 firms and nearly balancing the other two items.

2.3 Objectives of innovation

Figure 6 describes the reasons for firms introducing their main innovative products and services from the IFS. The main objective for product innovation is to improvements in the current product. This may align with the other sub items like market focus and product sales. The only farfetched and with very low score was regulation requirements. Possibly this is view of meeting standards required by various government regulatory bodies, like bureau of standards, environmental management authority and drug authority.

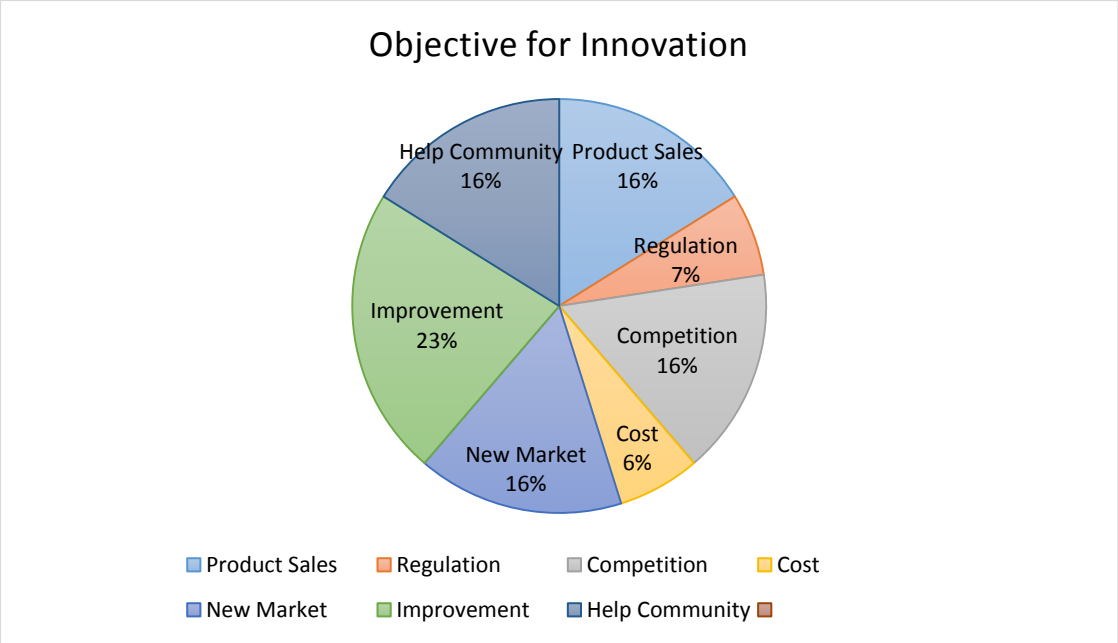


Figure 6. Stated objectives for the innovations

Source of information for innovations

This was an interesting item for the firms. It turned out that sources of information for the innovation are various as illustrated in the Figure 7.

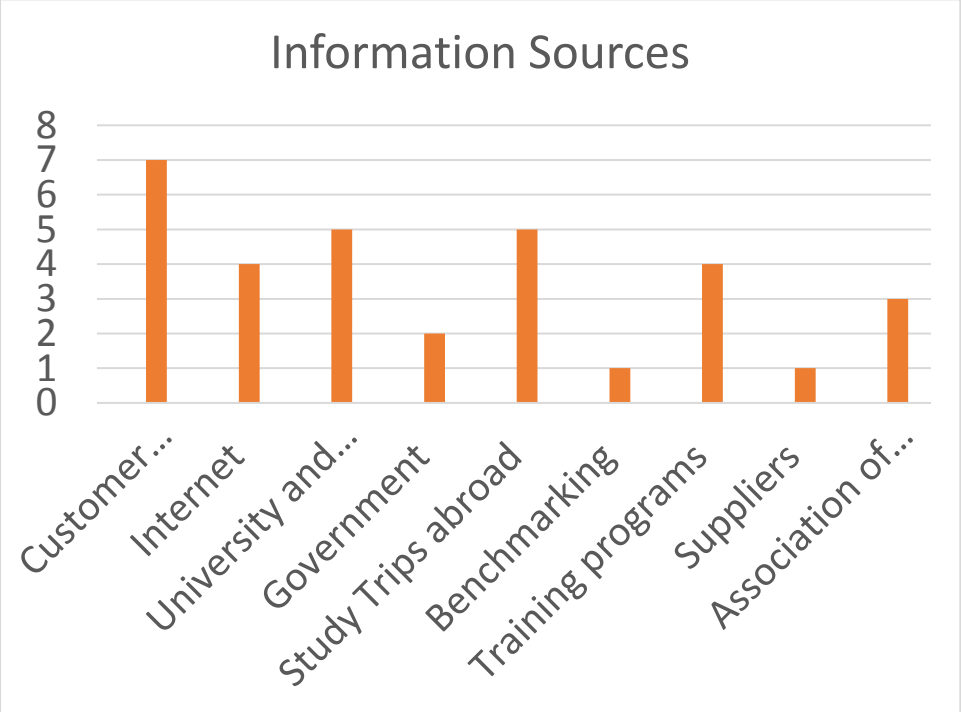


Figure 7. Sources of innovation information

The sources of information for innovation cut across internal and external dimensions. The internal sources were internet search, benchmarking and study trips. Benchmarking was very low, simply that the SMEs do not carry it out as a way for learning. In the external factors suppliers were the lowest; possibly as compared to customers, the latter was the highest, which conforms to norm. Suppliers of materials, power, fuel etc. may not be interested in how much innovation but Customer feedback is essentially critical to pointing out the changing needs. As noted earlier, some owner managers indicated that they learnt a lot when they travelled outside the country.

2.4 Challenges to the local firms in innovation

Table 12. Summary of challenges of innovation

Infrastructure	Lack of good machines that can be used in production
	Transport facilities in terms of transporting materials
	High prices for electricity.
Regulation	Lack of contracts from the government and also jobs being given to only Chinese companies
	The interest rates are quite very high and prohibitive
	The value of the dollar has not been regulated and too high
Institutions	The prices at which the ingredients are bought are too high
	High charges for rent
	High taxes on operations, like the purchase of timbers and high
	Lack of institutions coming to train because much emphasis is put on formal educational institutions only
Competition	Customers are poor can't afford to consume as they used to
	Domination of the market by many people doing the same work
	Lack of clear market, ignorance of the market and people prefer things imported from outside companies

	Small companies that produce poor quality goods on the roads which sell at a low price
	Lack of customers
	Lack of steady market for the produce and the business being flooded was a major hindrance
	Marketing of products, informal sector is still predominant
Organizational	Lack of practical knowledge by the workers hampering innovation
	Lack of well-established capital both material and cash Minimizing jobs among the youth and people losing morale
	Seasonality in the demand for their products by the customers
	A lot of expenditure compared to earnings for example
Economic	Theft within the area is the biggest problem
	The patent laws are weak and there is a lot copying in the industry

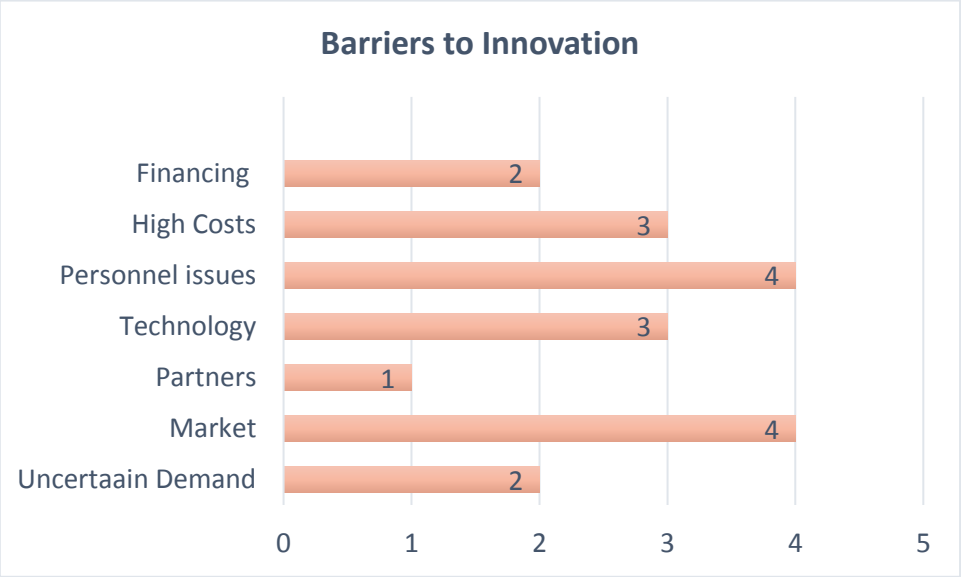


Figure 8. Aggregated Challenges to innovation

Table 12 summarizes the views from the WBES while Figure 8 displays those from the IFS. Both align into internal and external challenges. A number of challenges are to do with the firms' internal capabilities, financing and management. There are however, a number or challenges that are external and thus uncontrollable that continue to hamper innovations in Uganda.

The Government policy direction on BUBU – Buy Uganda, Be Ugandan. This is a new policy that emerged out of complaints by the local entrepreneurs on competitiveness with foreign investors as well as massive import flows of locally available products. It has not picked up well despite the novelty it carries. Government agencies were for example required to buy furniture from the local firms but claims of poor quality and inadequate supplies still fail the implementation of BUBU.

2.5 Dynamic 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 this and other innovation surveys, 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 9. Lira scores highly on most of the variables. It streams highest on commercialization but is close with Wakiso on the others namely "Identification & selection" of knowledge, "Acquisition" and "Transformation". The lowest posts are from Jinja on all the four dimensions. On the overall, firms report the lowest ability of identifying and selection of knowledge, and transforming knowledge. Conversely, they report generally average ability of acquiring knowledge. This low score on identification and selection of knowledge may imply that the firms are unable to perceive market opportunities. Conversely, the high scores on acquisition of knowledge confirm innovations that eventually get to the market, as commercialization is equally high. Overall by total, there were high abilities for all capabilities indicating rich networks between firms and scientific and research institutes.

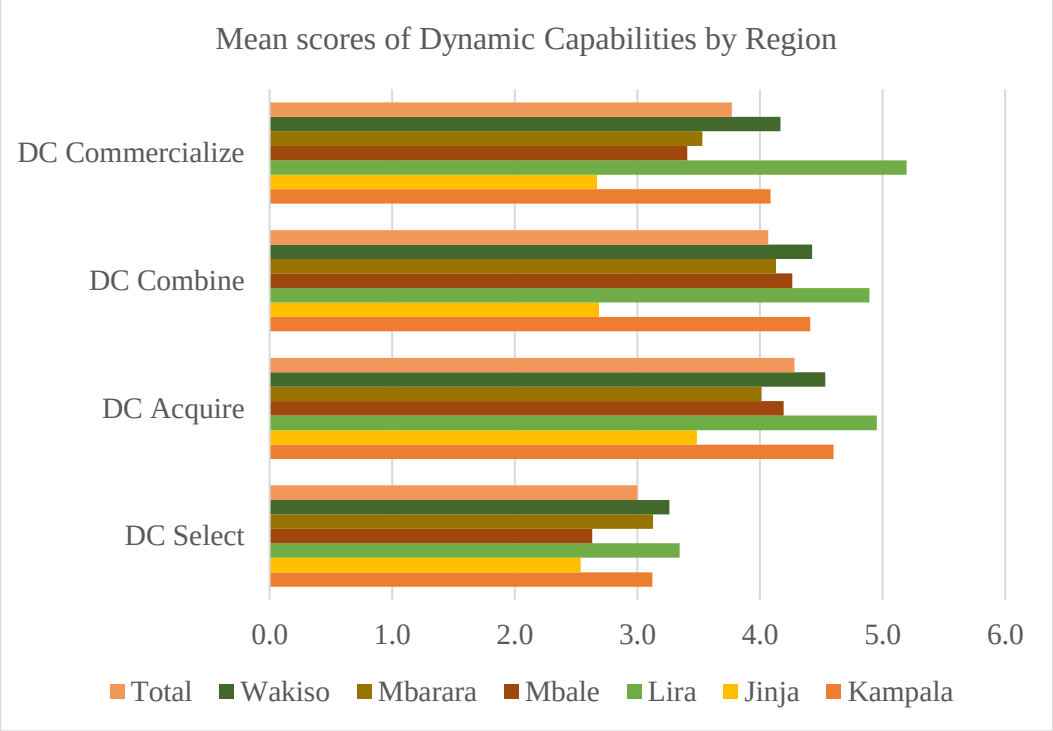


Figure 9. Dynamic capabilities

Illustration of Cases

In this section a brief highlight of cases is given to illustrate the dynamic capabilities as discerned. We look at capabilities in terms of education, skills, facilities and process. This analysis is based on the IFS data.

Stone veneer company

We found that the capabilities at the firm level were generally above average. At the Stone veneer, the owner manager was educated in economics and business administration but had ventured and mastered the science of stone ware and design. The firm uses diverse knowledge to manage both processes and technical decisions. The founder has also set up formal company structures to ensure smooth transformation and sustenance of operations. He has learnt the physical attributes of stones that define their hidden value.

Management system that involves delegation, health care system among others was akin to the process improvements. Thus the innovation activities discerned from this company were among others included stone cutting and designs, process setting to ensure standardization and efficiency measures through the operations

Furniture Company

Expansion and Transformation into a large company; improved board set up and composition skilled enough to steer the strategic direction of the company; sustainability through the family membership on the board and in management; the company has obtained an ISO certification. Management has also separated manufacturing which is now done about twenty kilometres out of the city and the show room and sales department which are in the central business district.

The company has noted the need for a strategic positioning in the entire value chain. They have bought a large piece of land and ventured into tree growing to ensure sustain future supplies of soft and hard wood. Various by products are also used in the same vain, like pulp for making soft cushions, husks are also utilized into manure.

They have also acquired a plot in the government designated industrial park which is foreseen to be the main business hub in the coming years. To meet future needs of the changing market, the company is shifting from manual to computerized systems in the whole operations. This has required new skills and a program to retool the staff is going on with a slogan *for innovation.* The owner manager travels a lot to see and get inspired with new ideas from around the world. In his knowledge management model he is preparing for succession in the next three years.

Energy saving company

The innovation in stove making has taken root in the Ugandan market. The company that was involved in this study was key testimony of how much local entrepreneurs have managed to move this skill to a higher level. Driven by the world advocacy for energy systems that conserve the environment, this has become not only a lucrative business but also a policy friendly venturesome. The country is running out of forest cover at a very fast pace. The key domestic source of energy is firewood and charcoal. The current domestic technologies do not conserve energy thus use of large quantities of firewood. The other innovations in faecal sludge and briquettes are still in nascent technological breakthrough; it is shrouded in cultural and technological limitations. So an innovation in stones that conserve energy is timely as it will not save the environment but also saves domestic users from high energy expenses.

The company has grown from 5 to 30 employees in less than ten years of operation, and combined knowledge in ceramic fabrication to improved stoves. These are shaped in square, rectangle, oval and round. They are curved of old iron sheets, with attractive colour patterns and use a combination of marketing channel innovations. They have partnered with environmental protection focused NGOs who have large orders to supply to their beneficiary communities. In this vain, the company has benefitted from trainings by the development partners. The company is lately studying a modification possibility to diversify into solar energy systems. Resources that have enabled them develop the innovations are machinery, technology, grant networks, professional engineers, and sector networks and collaborations under an umbrella association.

2.6 Trust

In this section we report the level of trust of the firms to their partners in business dealings. Results are given in Table 13. Four items measured on a 7-point-likert scale ranging from completely disagree to completely agree used 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. Mbale and Lira reported the highest mean value on trust. On the other hand, Jinja reported the lowest mean value on trust. We carefully note that the mean values for five of the six regions were above average. The mean for Jinja was below the grand mean. Over all, the results imply a relatively high level of trust.

Table 13. Trust

Sampling region from final progress report	Min	Max	Mean	SD	N
Kampala	2.50	6.00	4.1639	.89429	61
Jinja	.00	5.50	3.3143	1.71535	35
Lira	2.50	6.00	4.6429	.86444	14
Mbale	3.25	6.00	4.7500	.80795	19
Mbarara	2.50	5.25	4.2800	.60519	25
Wakiso	2.75	5.25	4.2667	.72497	30
Total	.00	6.00	4.1318	1.11862	184

We compare mean values of trust in partners, and other organizations in their business dealings with mean values of political trust. This was to establish whether there is a general attitude of trust or distrust in government. 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. Items were 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. The results reveal that the mean values for political trust above average for all the regions, save for the case of Jinja. While this may imply better functioning government institutions, it may also have a historical dimension. As already noted earlier in this report, Uganda's current business landscape is mirrored in the political past the country suffered. In the old regimes government and its agencies were direct perpetrators of insecurity and harassment to the business community. This image has vividly changed in the minds of the people in the recent past. Jinja was once the country' industrial town but this progress was stunted. A most likely reason is based on government agencies. Jinja on the other hand reported the only mean below average in the trust of partners. It equally had the lowest trust in government and its agencies. This is summarized in table14.

Table14. Comparison of firm Trust in Partners and Government

Sampling region from final progress report	Trust in partners	Trust in Government and agencies	N
Kampala	4.1639	5.3934	61
Jinja	3.3143	1.7714	35
Lira	4.6429	6.7857	14
Mbale	4.7500	6.3158	19
Mbarara	4.2800	5.2000	25
Wakiso	4.2667	5.8333	30
Total	4.1318	5.8937	184

2.7 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 15 shows that Lira reported the highest mean value on this indicator. We conclude that firms in the northern region have relatively close relations with external actors than the others. The lowest mean was recorded in Mbarara which was also below the grand mean. The implication is lowest relationship of firms with external actors in the western part of Uganda.

The values suggest that a divergence in agreement on having well established relations with external actors. This implies a somewhat moderate degree of integration signifying that only some firms are likely to benefit from information and opportunities in their local networks of economic activity and others likely not.

Table 15. Relationship with external actors

Sampling region from final progress report	Minimum	Maximum	Mean	Std. Deviation	N
Kampala	1.75	6.00	3.9877	.82339	61
Jinja	1.00	5.00	3.2357	.81110	35
Lira	4.50	6.00	5.1429	.49725	14
Mbale	3.75	5.50	4.6711	.44917	19
Mbarara	1.75	4.50	3.0700	.90289	25
Wakiso	2.50	5.75	4.0833	.84163	30
Total	1.00	6.00	3.8940	.98363	184

3 DFID Research Questions

This part of the report answers several questions relating to firm-level and regional-level factors that drive innovation in Uganda. We use 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. This analysis and the statistics in the tables are based on the Uganda ES2013 data set. This data covered firm level and market factors including age, ownership and education; access to credit, innovation, location and regulatory quality. There were 762 cases on which the analysis is based.

3.1 Firm characteristics, regional factors and innovation activities

In this section the following research question is addressed: "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?"

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. Table 16 reports the results of our estimation. For the firm-level factors we observe that the coefficient for size is positive and significant across all model except internal R&D. This indicates that larger firms have a generally higher likelihood of engaging in innovation activities.

Table 16. Logistic regression coefficients (n =762)

Variable	Internal R&D		External R&D		Formal training		New equipment	
Firm-level factors								
Age	0.015**	(.000)	-0.0031	(0.000)	0.024	(0.000)	0.025	(.1364)
Size	0.011	(.000)	0.078**	(0.000)	0.117***	(0.001)	0.104**	(.2197)
Foreign ownership	.0015**	(.000)	0.059*	(0.000)	-0.001	(0.000)	-0.019	(.2009)
Education	-0.008	(0.000)	0.080**	(0.000)	0.175***	(0.000)	0.085	(.1738)
Access to credit	0.017**	(0.009)	0.083**	(0.036)	0.032	(0.043)	0.073	(.1612)
Regional-level factors								
Location	0.152***	(0.007)	0.048	(0.028)	-0.025	(0.043)	0.049	(.1337)
Knowledge creation	1.020**	(0.000)	0.499***	(0.001)	-0.185**	(0.001)	0.030	(.3344)
RIQ	0.001	(0.001)	0.020	(0.003)	-0.012	(0.003)	0.016	((.1398)
Constant	-0.348	(0.022)	-0.107	(0.083)	0.194**	(0.097)	-0.4819	(.41417)

Clustered robust standard errors in parentheses

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

On the firm level factors, the coefficients were widely positive and significant for external R&D, save for age. Age was positive and significant for internal R&D only and negative and not significant for external R&D. For the rest it was positive but not significant. This implied that older firms were more likely to engage in internal R&D. The coefficient for education is negative for internal R&D, positive and significant for external R&D and not significant for new equipment. Hence, firms with a large proportion of employees with high school education have a higher likelihood of engaging in external R&eD. The coefficient for foreign ownership is positive and significant for internal R&D, external R&D, but negative for formal training and new equipment. This may be a result of foreign direct investment where foreign owners attempt to focus on R&D and less on formal training as they come in

with experts. Access to credit is positive and significant to internal and external R&D. It remains positive but not significant in the rest of the models. This means that firms access credit to engage in R&D but do not seek credit to finance formal training and purchase of new equipment.

On the regional level factors, knowledge creation has more spread positive and significant coefficients across the models. It is negative with formal training. This inverse relationship may mean that with more knowledge created within the firm, there is less attraction to formal education. Also it is likely that there are several knowledge sharing channels. Location is positive and significant only for internal R&D, hence firms located in the urban center may seek to increase their internal R&D. Thus urbanization may not encourage investment in external R&D. We also observe that the coefficient for RIQ are not significant across all models. A probable explanation for this is may be that firms do mind risks associated with entering into contracts for the production of innovations.

Hence, from this analysis we conclude that firm level factors and regional level factors are diversely significant in the various models. We infer that in Uganda, the prediction of innovation has to be assessed across factors on both scales.

3.2 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 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 17 reports the results of our estimation. We observe that none of the firm level factors had a significant effect on commercialization. There are negative coefficients for size, education and age. Probably this, means that firms to commercialize their innovations is not given due attention as firms grow in age and size. However, location had a very strong effect on commercialization. This is important and means that urban location with big concentrates of population attracts more commercialization than rural areas where people are sparse.

Table 17. OLS regression coefficients (n = 184)

Variable	Commercialization	
Firm level factors		
age of firm	-.121	(0.001)
Size	-.060	(0.001)
Foreign Ownership	.012	(0.010)
Education	-.032	(0.009)
Access Credit	.003	(0.759)
Regional level factors		
Location	.252**	(0.738)
RIQ	-.063	(0.068)
Knowledge Creation	.128	(0.017)
(Constant)	9.150***	(2.318)
Robust standard errors in parentheses * p<0.10, ** p<0.05, *** p<0.01		

Among the regional level factors, location was most significant. RIQ was negative and not significant whereas knowledge creation was not significant. This counterintuitive as one would expect that firms have higher ability to commercialize. We could also note 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 firm-level factors, the size of the firm is not important for commercializing innovative output. Furthermore, knowledge creation and RIQ are not crucial regional-level factors for successful commercialization of innovative products and services. Notwithstanding, urbanization seems to hinder the extent to which firms can successfully commercialize innovative output.

3.3 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 18 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 Uganda benefit from incorporating foreign technology in their production processes.

Table 18. OLS regression coefficients (n = 184)

Variable	Innovation output	
Firm-level factors		
Age	0.101	(0.001)
Size	-0.011	(0.000)
Foreign ownership	-0.057	(0.008)
Education	-0.079	(0.007)
Access to credit	0.062	(0.010)
Regional-level factors		
Location	0.085	(0.595)
Knowledge creation	-0.187*	(0.014)
RIQ	0.067	(0.054)
Innovation activities (Reference: Foreign technology acquisition)		
In-house activities	-0.054	(2.522)
Collaborative activities	-0.009	(2.508)
Constant	7.805	(2.192)

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.

3.4 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 19 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 19. Logistic regression coefficients (n =184)

Variable	Innovation	
Firm-level factors		
Age (log)	0.129	(.000)
Size (log)	0.076	(.000)
Foreign ownership	0.087	(.000)
Education	0.009	(0.001)
Access to credit	0.012	(0.091)
Regional-level factors		
Location	-0.025	(0.092)
Knowledge creation	0.341***	(0.002)
RIQ	-0.019**	(0.008)
Cooperative relationships		
Customer	0.200**	(0.206)
Supplier	0.054	(0.571)
Cooperation for innovation		
Firms	0.186**	(0.170)
Private consulting company/individuals	0.086	(0.129)
Universities/research institutions	-0.087	(0.164)
Constant	0.699	(0.521)

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 for knowledge creation and R&D are positive and significant. Coefficients for collaborating with customers are significant. This implies that spillovers arising from collaborating for innovation between firms is important for Uganda. Additionally firms benefit more from customer ideas as they are likely to give feedback.

Based on our estimation, we conclude that horizontal spillovers arising from firms are more critical for innovation performance relative to vertical spillovers from customers and suppliers. In particular,

innovation ideas from other firms and customers have significant effects on innovation performance for manufacturing firms in Uganda.

3.5 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 20 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 knowledge creation and market dominated by established firms. Notwithstanding, the most critical barrier to technology diffusion is size, foreign ownership and knowledge creation.

Table 20. OLS/ Logistic regression coefficients (n =762)

	Innovative Output		Technology Diffusion	
age of firm	.113	(.001)	-.078	(.000)
Size	.002	(.001)	.269***	(.000)
Foreign Ownership	-.027	(.008)	.332***	(.001)
Education	-.032	(.007)	.042	(.001)
Access Credit	.109	(.631)	-.016	(.099)
Location	.010	(.595)	.166	(.104)
Knowledge creation	-.215**	(.014)	.199*	(.002)
RIQ	.046	(.055)	.087	(.009)
Lack of finance?	.037	(.351)	.041	(.057)
High cost innovation?	-.033	(.415)	-.067	(.064)
Lack of qualified personnel?	.029	(.387)	-.091	(.070)
Lack of information on technology?	-.123	(.411)	.035	(.075)
Lack of information on markets?	.068	(.432)	.075	(.064)
Difficulty finding co-operating partners?	-.005	(.371)	.113	(.062)
Market dominated by established enterprises?	-.191*	(.407)	-.024	(.069)
Uncertain demand for innovative goods or services?	.153	(.406)	-.018	(.072)
No need in innovation due to prior innovations?	-.016	(.4100	-.064	(.070)
(Constant)	8.919***	(2.009)	-.440	(.348)

We therefore conclude that the most critical barrier to process of innovation is knowledge creation. This implies that without creating new knowledge firms cannot have innovations developed. Furthermore, difficulty in finding co-operating partners implies weak linkages between firms, and universities and research institutes.

3.6 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 21 reports the results of our estimation of the relation between the highlighted linkages and innovative activity in the firms.

Table 21 Logistic regression coefficients (762)

Variable	Internal R&D		External R&D		Formal training		New equipment	
Firm-level factors								
Age (log)	-.024	(.000)	-.061	(.000)	-051	(.000)	.010	(.1951)
Size (log)	.012	(.000)	.112	(.000)	.126	(.000)	-.058	(.1466)
Foreign ownership	-.009	(.000)	-132*	(.000)	-.102	(.001)	.113	(.2032)
Education	.006	(.000)	.092	(.001)	.083	(.001)	-.205*	(.1785)
Access to credit	.013	(.000)	.009	(.083)	.056	(.645)	-.034	(.1513)
Regional-level factors								
Location	.238***	(.021)	.046	(.085)	-.006	(.093)	.017	(.1766)
Knowledge creation	1.077***	(.000)	.547***	(.002)	.292**	(.002)	.101	(.3796)
RIQ	-.001	(.002)	.010	(.007)	.076	(.008)	-.057	(.1358)
Academic/research institutions	-.005	(.037)	-182**	(.154)	.033	(.167)	-.155	(.2897)
Firms	.007	(.038)	-.014	(.158)	-.009	(.172)	.036	(.3389)
Private consultants	-.018	(.029)	.168**	(.120)	.109	(.130)	.014	(.2217)
Constant	-.638	(.113)	.133	(.466)	-.333	(.506)	.8158	(.9015)

Standard errors in parentheses

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

We observe that firms collaborating with private consultants are more likely to engage in external R&D than those collaborating with Academic institutions.

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 external R&D. Linkages with other firms was not 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 Uganda. Furthermore, linkages do not affect formal training and purchase of new equipment for innovation.

3.7 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 22 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 negative and not significant. Notwithstanding, the coefficients for female participation in top management is positive but not significant.

Table 22. Logistic regression coefficients (n=184)

Variable	Innovation	
Firm-level factors		
Age (log)	.141**	(.000)
Size (log)	.063	(.000)
Foreign ownership	-.058	(.001)
Education	.096*	(.001)
Access to credit	.034	(.073)
Regional-level factors		
Location	.046	(.049)
Knowledge creation	.409***	(.001)
RIQ	.093*	(.005)
Gender diversity		
Female ownership	-076	(.015)
Female top manager	.119	(.059)
Female workforce participation	-.115*	(.006)
Constant	.032	(.183)

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 do not necessarily introduce a new product or service. Essentially, female owned firms have no likelihood of introducing innovations in the context of Uganda. The coefficients for female ownership was negative and not significant; those for female workforce participation were negative but statistically significant.

Considering these coefficients, we attribute to the general social structure in which women may be attributed to low participation rates. Furthermore, the negative but non-significant relation between female participation in the top management could be explained by the general social status in which women managerial capability is not highly considered.

4 Conclusions

4.1 Distribution of firms

The report presents data from three samples, the Innovations Capability survey (ICS) with 184 firms, a qualitative follow up in 2017 with 13 companies and the Enterprise Survey data of 2013 with 762 cases. The report covers firms from all regions of the country namely Kampala, Lira, Mbale, Jinja, Mbarara and Wakiso. These major towns represent the major regions. The firms were from manufacturing in terms of furniture, fabrication, equipment, craft making, construction and printing. Thus there was generally a balance in regional and sector distribution.

4.2 Exports and Imports

We also looked at exports and important. It was said that Uganda is mainly import oriented. The Ugandan economy is still predominantly import based. Being a land locked country, Uganda relies mainly on the sea route through Mombasa in Kenya. The recent focus is a diversification to Dar es Salaam. The country has gone through a turbulent past that seems to define her SMS status. This notwithstanding the country has consolidated a recovery road map. With oil and gas discovery in the

Albertine region alongside. All the countries in the sub region were cited as export destinations. Kenya is the major on for both exports and imports. Other countries were US, UK and European countries

4.3 Supplies and imports

We analysed the proportionality of exports and imports, especially for raw materials. We noted that most of the raw materials and intermediate goods are of mainly domestic origin. There were very few from foreign markets origins. In regional distribution Mbale and Jinja have the highest of both. It is also possible the firms may also be purchasing some of their inputs from local importers. This means sources are local but of foreign origin.

4.4 Innovations

This report widely covers findings on innovation among the surveyed firms. It enlists the source of innovation information, measures of innovation, innovation activities and barriers.

4.4.1 Innovation activities

There were various innovation activities reported in the survey. They included production innovations in the processing and packaging, internship, new product development, training and new equipment. The highest score was on new product developments across the various sectors and regions. This confirms that firms in Uganda are involved in various forms of innovation. The objectives of innovations can be summarized as increasing sales, improvements in process, help communities, regulations, competition and new markets.

4.4.2 Sources of information for innovation

The survey was also interested in summarizing the source of information for the innovations. This was mainly from customer feedback. It scored highest while others were university and research institutions. This implies that SMEs in Uganda who are involved in various innovative activities have close linkage with their customers and interestingly with academic institutions either through direct study programs or internship opportunities with students. After all internship was also mentioned among the innovative activities. Other sources of information which were important and reaffirm the innovations activities of the firms were benchmarking, government sources, suppliers and study trips. These various sources of information imply that SMEs are clearly looking out for any possible information from multiple sources to drive their innovative ideas.

4.4.3 Barriers to Innovation

Several barriers to innovation were enlisted. They ranged from personal factors, firm level factors, industry and policy matters. These include innovations in costs; cost was very important a factor across the regions in terms of production and running businesses. The other key challenges to innovation were taxation regimes, poor or lack of machinery, knowledge base was low and prices are unstable. They also reported lack of customers and clear market, seasonality of demand, technological flows and cost of electricity, among others.

4.5 Dynamic capabilities

Dynamic capabilities were measured using that included the firm's ability for identifying and selecting knowledge, ability for acquiring knowledge, transforming knowledge and commercializing products. There were generally balanced across the regions with Lira scoring highly on most of the variables. It was closely followed by Wakiso on identification & selection of knowledge, acquisition and transformation. Jinja posted the lowest scores on all the four dimensions. We conclude that overall, firms report a high ability of identifying and selection of knowledge, and transforming knowledge. They however reported a low level of acquiring knowledge. This challenges them on how to translate knowledge into innovations if its acquisition is very low.

4.6 Trust and relationships with external actors

The measurement of trust and relationship with partners were important to assess how much the firms worked with other players in the industry as well as government. In the report a comparison is made between the other partners and government. The level of trust a firm has with the government could widely influence the ability to innovate. Mbale and Lira reported the highest mean value on trust. On the other hand, Jinja reported the lowest. Over all, the results imply a relatively high level of trust by firms to external players. Interestingly, and important for the survey, the level of trust in government was very low across all the regions, save for Mbale. We attribute this to the political history the country went through were people who are of age and witnessed government machinery forcefully root merchandize could still be vivid in their minds or the stories retold over the years. Relationships with buyers, suppliers, competitors, and institutional actors indicate the degree to which firms interact and work with others. We know that firms are environmental serving and environmental dependent. We conclude that firms in the northern region have relatively close relations with external actors than the others.

4.6 Gender diversity

Gender diversity was observed to be a key factor in innovations. Across the regions, however, firms are characterised of patriarchal societies and female ownership was likely to be very low as well as female as top manager. The role of gender diversity in promotion of innovation cannot be ignored. Urbanization is likely to play a key role in fostering female participation.

4.7 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 knowledge creation 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.

In sum, there are salient features of manufacturing firms in Uganda that provide insightful contextual information that is crucial to understanding innovation.

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Appendix. Variable measurement

Variable	Measurement	Source
Innovation performance		
Innovative output	Number of innovative products or services introduced	IFS
Innovation	Firm introduced any new product or service: "1" Yes "0" No	IFS
Firm-level factors		
Age (log)	Year of survey (2013) less the year the establishment began its operations	WBES
Size (log)	Number of permanent full-time employees at the end of the last fiscal year	WBES
Foreign ownership	% owned by private foreign individuals, companies or organizations	WBES
Education	% of full-time workers completed high school	WBES
Access to credit	Establishment has a line of credit or loan from a financial institution: "1" Yes "0" No	WBES
Regional-level factors		
Location	City with population over 1 million: "1" Urban "0" Rural	WBES
RIQ	Composite measure of mean of standardized firm-level scores of corruption, rule of law and regulatory quality in each region	WBES
	Corruption	
	Corruption as an obstacle is measured: five-point scale (0 = not an obstacle, 4 = very severe obstacle).	WBES
	Rule of law	
	Courts as obstacle: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
	Political instability as obstacle: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES

	Crime, theft, disorder as obstacle: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
	Regulatory quality	
	Tax rates as obstacle: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
	Tax administration as obstacle: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
	Customs and trade regulations as obstacles: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
	Business permits and licensing as obstacles: five-point scale (0 = not an obstacle, 4 = very severe obstacle)	WBES
Knowledge creation (log)	% of firms conducting internal R&D within a region	IFS
Innovation activities		
Internal R&D	Dummy variable: "1" Yes "0" No	IFS
External R&D	Dummy variable: "1" Yes "0" No	IFS
Formal training	Dummy variable: "1" Yes "0" No	IFS
New equipment	Dummy variable: "1" Yes "0" No	IFS
Commercialization	Average value of items in commercialization construct	ICS
	Extent to which firm can successfully commercialize products: 7-point-likert scale (0= completely disagree, to 6=completely agree)	ICS
	Extent to which firm can commercialize completely new products: 7-point-likert scale (0= completely disagree, to 6=completely agree)	ICS
	Extent to which firm can commercialize new products in existing markets: 7-point-likert scale (0= completely disagree, to 6=completely agree)	ICS
	Extent to which firm can commercialize new products in new markets: 7-point-likert scale (0= completely disagree, to 6=completely agree)	ICS

Collaboration		
Collaborative activities	Innovation with firms, universities/research institutions, private consulting companies, individuals: "1" Yes "0" if otherwise	IFS
In-house activities	Innovation developed entirely by the firm: "1" Yes "0" if otherwise	IFS
Foreign technology	Technology licensed from a foreign-owned company: "1" Yes "0" No	WBES
Spillovers		
Other firms	Number of firms reporting most important source of information/knowledge to be from parent or another firm	IFS
Consultancy firms	Number of firms reporting most important source of information/knowledge to be from private consulting company/individuals	IFS
Universities/research institutes	Number of firms reporting most important source of information/knowledge to be from universities/research institutes	IFS
Barriers		
Lack of funds within enterprise	3-point-likert scale (0= not important, to 3=very important)	ICS
Lack of external financing	3-point-likert scale (0= not important, to 3=very important)	ICS
High costs of innovation	3-point-likert scale (0= not important, to 3=very important)	ICS
Lack of qualified personnel	3-point-likert scale (0= not important, to 3=very important)	ICS
Lack of information technology	3-point-likert scale (0= not important, to 3=very important)	ICS
Lack of information markets	3-point-likert scale (0= not important, to 3=very important)	ICS
Difficulty finding co-operating partners	3-point-likert scale (0= not important, to 3=very important)	ICS
Market dominated by established firms	3-point-likert scale (0= not important, to 3=very important)	ICS
Uncertain demand for innovative products	3-point-likert scale (0= not important, to 3=very important)	ICS

No need due to prior innovation	3-point-likert scale (0= not important, to 3=very important)	ICS
Technology diffusion	Adapted or reproduced a product or service already sold by another firm: "1" Yes "0" No	IFS
Linkages		
Academic/research institutions	Innovation developed with domestic or foreign academic/research institutions: "1" Yes "0" No	IFS
Firms	Innovation output developed with domestic/foreign firms or a domestic-owned parent firm: "1" Yes "0" No	IFS
Private consulting company/individual	Innovation output developed with private consulting company/individual: "1" Yes "0" No	IFS
Demand vs supply side policies		
Financial support	Government agencies or departments source of funds for innovation activities: "1" Yes "0" No	IFS
Non-financial support	Government agencies or departments source of non-financial support for innovation activities: "1" Yes "0" No	IFS
Gender diversity		
Female ownership	Ownership of firm: "1" if female, "0" if otherwise	WBES
Female top manager	Top manager of firm: "1" if female, "0" if otherwise	WBES
Female workforce participation (log)	Ratio of number of female full-time employees to the number of full-time employees both at the end of the last fiscal year	WBES