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INNOVATION AND GROWTH OF FIRMS IN EAST AFRICA

BY

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DECLARATION

I, the undersigned, hereby declare that this dissertation is a product of my own work and effort. I have, to the best of my knowledge and belief, acknowledged all the sources of information in line with normal academic conventions. I further certify that the dissertation is original, and has not been submitted before at this or any other university for the award of a degree.

Patricia Naluwooza

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Date……

APPROVAL

The undersigned certify that they have read this dissertation titled “Innovation and Growth of firms in East Africa” in the process of guiding the author and thereby recommend it for submission to the Directorate of Research and Graduate Training of Makerere University in the partial fulfillment of the award of the degree of Master of Arts in Economics of Makerere University.

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DEDICATION

This dissertation is dedicated to my parents, Eng Ivo Frederick Ssozi Muwangwe and Rosemary Nanyomo Ssozi; to my siblings: Angella Nakiyemba and Pauline Ssozi; and to my grandmother: Dr. Matilda Namatovu Ssozi.

ABSTRACT

Empirical evidence has shown that innovation is a major determinant of firm growth in developed and developing countries. However, little is known about the impact of innovation on firm growth in LICs like those in the East African region. This study attempts to fill this gap in the literature using a modified Crepon-Duguet-Mairesse (CDM) structure model to analyze data from the World Bank Enterprise Survey of 2754 firms in Burundi, Kenya, Rwanda, Tanzania and Uganda. The study examines the role of product and process innovation in explaining firm growth. Furthermore, it investigates how innovation interacts with firm-level resources to explain firm growth in East Africa. Proxies for firm growth used are sales, employment and productivity growth. We hypothesize that product and process innovation positively and independently affect firm growth and also exhibit complementarity effects. In addition, we hypothesize that innovation moderates the effect of firm-level resources on firm growth. The set hypotheses are tested using a Two Stage Least Squares estimation strategy.

Overall, the results suggest that product and process innovation positively and significantly affect the three proxies of firm growth. The results also reveal evidence of complementarity effects of product and process innovation on sales, employment and productivity growth. In addition, results show that product and process innovation positively moderate the effect of firm-level resources on firm growth.

Key words: *Product innovation; process innovation; firm growth; East Africa*

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LIST OF ACRONYMS

2SLS	Two Stage Least Squares
AFDB	African Development Bank
DRC	Democratic Republic of Congo
DWH	Durbin-Wu- Hausman
EAC	East African Community
FY	Financial Year
GDP	Gross Domestic Product
GoU	Government of Uganda
ICT	Information and Communication Technologies
IV	Instrumental Variable
KNBS	Kenya National Bureau of Statistics
MoFPED	Ministry of Finance Planning and Economic Development
OLS	Ordinary Least Squares
R&D	Research and Development
SSA	Sub-Saharan Africa
UNBS	Uganda National Bureau of Standards
UNCTAD	United Nations Conference on Trade and Development

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Firms play a key role in economic growth in almost all countries, but in low-income countries (LICs) they still play only a marginal role in terms of their contribution to development (Beck & Demirguc-Kunt, 2006; Nichter & Goldmark, 2009; UNCTAD, 2013). This is mainly attributed to the failure of most firms to grow as it is evident from their low sales, productivity and employment levels which in turn increases their odds of facing extinction from the economy (Cirera et al., 2016; Ronge et al., 2002; AFDB, 2014). According to MoFPED (2016), the growth of Ugandan firms particularly those in the manufacturing sector has continuously fluctuated. This is evident from a marginal growth rate of 0.4 percent which was reported in financial year (FY) 2015/2016 compared to 11 and 2.2 percent of growth registered in FY 2014/2015 and 2013/14 respectively. Furthermore, the Kenya National Bureau of Statistics-KNBS (2007) notes that three out of five firms fail to grow especially within their initial stages of operation. In addition, KNBS argues that approximately 80 percent of the firms collapsed along the way before making it to their fifth year of existence.

Noteworthy, the share of firms' contribution to GDP, particularly those in the manufacturing sector in East Africa has declined (AFDB, 2014). In Rwanda, this share declined from 7 percent to 5.9 percent over the period of 2000 to 2012 and in Kenya, the proportion of firms' contribution to GDP remained stagnant at 11 percent in the same period. Likewise, in Tanzania and Uganda, this share remained relatively small at 10 and 8 percent respectively compared to figures reported in the 1970s (that is; 12 and 9 percent for Rwanda and Uganda respectively).

The question of achieving firm growth remains central to public policy and has therefore attracted the attention of policy makers and researchers in the East African region. The ineludible policy concerns follow the vital purpose that firms play in boosting the economic performance of a country. Firms are recognized in literature as necessary for providing the potential for employment creation, especially for the growing share of the non- agricultural labor force in East Africa (Ayyagari et al., 2007; Calice et al., 2012; Artz et al., 2010; Nichter & Goldmark, 2009). Firms also contribute significantly to the gross domestic product (GDP) of their respective countries in form of economic output and are a source of revenue. The growth of firms in East Africa has also been targeted as one of the strategies intended to generate industrialization and reduce poverty in the region (Atieno, 2009; Mano et al., 2012). More individuals are able to get opportunities to engage in income generating activities that are empowering thereby solving the poverty issue.

Following the importance of firms, East African governments have recognized the need for their firms to grow as it is evident from major policy documents. In Kenya for example, the government has come up with the industrial development master plan including its vision 2030 drafted in 2008, the Medium Term plan II 2013-2017 and the national industrial policy framework (2012). These policy documents aim to achieve sustainable firm growth rate especially in the manufacturing sector of about 10% and also increase the sector's share to GDP from 10 percent to 15 percent. In Tanzania, the government through its development vision 2025 and the Sustainable Industrial Development policy intends to hasten growth in firms from 8 to 12 percent. The Tanzanian government has also implemented target projects which focus on industrial growth aimed at creating industrial clusters, for example; the Tanzania Energy Development and Expansion project (TEDAP); and the Integrated Industrial Development Strategy 2025.

For the case of Uganda, the government through its vision 2040 and the national industrial policy (2008) has come up with a number of initiatives to foster firm growth. Among them includes; a yearly budgetary allocation which enables Uganda National Bureau of Standards (UNBS) to support firms in acquiring quality marks and product certifications and an industrial cluster level program to help firms grow by providing technical training aimed at increasing productivity. In addition, the government of Uganda (GoU) plans to achieve productivity enhancement in firms by allocating a share of GDP towards research and development (henceforth R&D).

Furthermore, the East African Community (EAC) which is a regional inter-government organization comprising of six partner countries has also come up with major policy documents targeting firm growth. Among these include, the industrialization Policy and strategy of 2012 -2032 which aims at strengthening R&D, technology and innovation capabilities among firms. These policies are tailored to achieve optimal growth especially in the manufacturing sector as well as strengthening national and regional institutional capabilities to promote efficient industrial policy design (AFDB, 2014).

Despite effort from the respective East African governments, few of their firms are able to experience substantial growth (AFDB, 2014). The inability of most firms to grow is hampered by a number of reasons that range from firm characteristics to the environment within which firms operate. Nkurunziza (2010) highlights the challenge of access to finance which impedes firm growth especially during macroeconomic shocks. On the other hand, Beck & Demirguc-Kunt (2006) argue that it's the imperfections in markets and institutional weaknesses that deter firm growth. Other challenges that adversely impact on firm growth put forth include; inadequate and unreliable physical infrastructure like communication, energy and transport; inability to technologically be innovative; competition; and low technological diffusion (Fowowe, 2017; Dinh et at., 2010; Gonzalez & Lamanna, 2007).

In addition, the nature of human capital characterized by inadequate managerial skills and inadequate training for employees has also been noted in literature as an impediment to firm growth (Malaolu & Ogbuabor, 2013; Konings & Vanormelingen, 2015; Goedhuys & Sleuwaegen, 2010). Low human capital makes it almost impossible to permit adopting, adapting and the ability to diffuse innovative technologies; among others.

Amidst the obstacles of firm growth, existing empirical evidence points to innovation as one of the major potential enablers in empowering firm growth in East Africa (Cirera et al., 2016; Gebreeyesus, 2009; Fu et al., 2017; Goedhuys & Sleuwaegen, 2010). Fu et al. (2017) argue that firm growth is actually a learning process with only firms able to either adapt or create technologies and knowledge through innovation being able to grow and survive. Innovation refers to the generation, combination, and diffusion of new and economically valuable knowledge that may be in form of unique products, processes, management and organizations (Sangwon et al., 2015).

In reference to firms, innovation activities may be divided into two types; technological and non-technological innovation. Technological innovation comprises of product and process innovation which are a result of the development or application of new technologies. The new products are characterized by new technical features which offer new functionalities and improved product quality. Process innovation entails new technologies to increase the firm's efficiency or its quality of production. On the other hand, non-technological innovation refers to the introduction of new organizational or marketing procedures in a firm (Schmidt & Christian, 2007). Noteworthy, innovation in most of the LICs like those in the East African Region is a result of absorption, adaptation, and mastery of technologies that have been developed elsewhere especially from developed countries (Goedhuys & Veugelers, 2011).

1.2 Innovation and firm growth

Firms need to engage in innovative activities if they are to maintain or boost their competitiveness which is necessary for their long term survival and growth (Skerlavaj et al., 2010; Goedhuys, 2007; Mansury & Love, 2008). Evidence shows that firms engaging in product and process innovation are more likely to realize growth in sales, employment or productivity.

Product innovation, in particular is expected to result in an increase of a firm's output which is essential for sales growth (Goedhuys & Veugelers, 2012). However, this is on condition that the new product introduced is not a substitute of the already existing products of the firm (Benavente & Lauterbach, 2008). In addition, firms that engage in product innovation are expected to exploit new markets or expand the existing ones by putting new products into the market thus achieve sales growth. However, this depends on the nature of competition that the firm faces and the delay with which the firms' rivals react to the introduction of the new product (Harrison et al., 2014; Artz et al., 2010). Furthermore, based on the fact that innovation is a risky activity, there is no guarantee that individuals may consume more just because they have a variety of products to choose from. In addition, sales of the new products of a firm may cannibalize a given proportion of its existing sales and thus minimizing the chances of a firm to achieve sales growth (Harrison et al., 2014).

Regarding employment growth, the new products or processes introduced by a firm may involve a change in the production technique and a mix in the factor inputs which could either imply a reduction or an increase in the labor requirement. Specifically, product innovation which relates more to the demand-creation of a firm's new product is expected to positively impact on employment growth (Capasso et al., 2015). On the other hand, process innovation may negatively impact on employment growth especially if it is labor saving in

nature. This is because process innovation often entails a reduction in the unit cost of the factors of production, including the labor requirement necessary in achieving a unit output of a firm. Based on the nature of competition that a firm faces, a reduction in the unit cost of production is likely to result in a decline in the firm's price, which will eventually stimulate demand and hence employment growth. However, this effect is largely determined by the elasticity of demand for the new product introduced (Harrison et al., 2014).

With reference to productivity growth, product innovation which ascribes to firm-specific demand variations may result in increased productivity growth especially if it's mainly directed towards higher quality products or product differentiation (Cirera et al., 2016; Hall et al., 2009). Similarly, process innovation is expected to improve firm level efficiency which is essential in promoting productivity growth among firms. Process innovation is expected to reduce defects, wastes, lead time and the cost of production thereby improving efficiency (Lee & Kang, 2007). Contrary, product and process innovation may instead negatively impact on productivity growth based on the fact that innovation implies firms making adjustments or changes in their production processes. These changes may instead deteriorate the firm's efficiency or productivity growth. For example, radical product innovations may negatively affect firm productivity growth, especially in the short run. This is because, the product introduced is completely new or strange to the firm and as such, the firm may require a longer period to adjust in terms of its production (Lee & Kang, 2007).

It is important to note that existing empirical evidence on the role of innovation on firm growth in Sub-Saharan Africa is not conclusive. One strand of empirical literature argues that innovation boosts firm growth while the other finds no evidence with some studies finding a weaker relationship between innovation and firm growth. Pertaining to innovation and productivity, similar studies have been done in East Africa for example; Cirera et al. (2016) who found that firms engaging in product, process and organization innovation experience

higher productivity compared to their counterparts. However, they only consider the impact of innovation on productivity rather than productivity growth and also fail to show the possible complementarity effect that may arise from a firm's ability to engage in both product and process innovation on productivity growth.

Contrastingly, Goedhuys et al. (2008) found that product and process innovation had no impact on firm productivity but instead the business environment within which firms operate negatively impacted on productivity. Similar to Cirera et al. (2016), they also fail to evaluate the impact of innovation on the relative change in productivity over time (productivity growth). In regards to innovation and employment growth, Goedhuys and Sleuwaegen (2010) found that product but not process innovation positively impacts on employment growth. However, they only consider the impact of product and process innovation on high growth firms and neither test the possible complementarity effect from engaging in both product and process innovation on employment growth. The non-convergence in findings may be as a result of the complexities in measuring innovation where some studies use an input measure for innovation such as expenditure on R&D which does not necessarily entail the innovation outcome of such an investment.

Therefore, while using World Bank Enterprise Survey (WBES) data from a sample of firms in the East African region, this study intends to contribute to the existing literature on innovation and firm growth. In particular, attention is put on the interplay between product and process innovation and their subsequent effect on the growth of firms from five East African countries, that is; Uganda, Kenya, Tanzania, Burundi and Rwanda with the exception of South Sudan because of the inexistent data. Furthermore, to provide more insight, the study investigates in detail the effect of these two types of innovation across three firm growth indicators (sales, employment and productivity growth) and also considers the interaction of innovation and firm level resources in form of the quality of human capital and

finance on firm growth. The study also incorporates other influences in terms of firm and business environment characteristics to ascertain other impediments or drivers of firm growth.

1.3 Problem statement

Despite the fact that firms in East Africa play a basic role in catalyzing economic development, their growth has lagged behind the competitive global level as it is characterized by their low sales, productivity and employability growth rates. This stunted growth has particularly been strong in the manufacturing sector as it is evident from the decline in its share of both employment and GDP. For instance in Uganda; between the period of 2008 and 2012, chemicals and textile; clothing and footwear dropped by 3 and 11 percent respectively while in Tanzania; the textile and leather sector decreased by 10 percent in the same period (Balchin et al., 2016). Many firms in different sectors still suffer from low growth rates resulting from a set of challenges mentioned hitherto. Unless revived actions are taken by the owners of firms and respective governments of the East African countries to dramatically increase the growth of their firms, there is a likelihood of continued sluggishness and deterioration.

Given the importance of firms, there is need to identify factors necessary in harnessing firm growth. Among the factors highlighted in the literature, innovation has been singled out as a pivotal determinant of positive firm growth. Nonetheless, some studies find a negligible or negative role of innovation on firm growth. The non-convergence in the results has been attributed to the use of different measures on innovation where some studies use input indicators like patent rights or expenditure on R&D. On the other hand, others researchers use the actual innovation output measures like product and process innovation which have been highly appraised in major theoretical studies (like Crepon et al.(1998) . Therefore, there is a compelling need to delve into the role played by innovation in explaining sales,

employment and productivity growth in the East African region. This is fundamental in the design of appropriate policies intended to put firms on a sustainable growth trajectory which is a necessary condition for economic growth.

1.4 Objective of the study

This study explains the relationship between innovation and firm growth in East Africa.

1.4.1 Specific objectives

1) To investigate the roles of product and process innovation in explaining firm growth.
2) To explore the complementarity effect of product and process innovation on firm growth.
3) To examine the interaction effect of firm level resources (formal training and finance) and innovation on firm growth.
4) To guide in the design and implementation of micro-level policies geared towards firm growth.

1.4.2 Study Hypotheses

The following are the hypotheses to be tested empirically;

H1: Both product and process innovation independently and positively affect firm growth.

H2: The combination of product and process innovation results in significantly faster growth of the firm and thus product and process innovation are complements.

H3: Product and process innovation enhance the firms' ability to gain more from their resources.

1.5 Justification of the study

Knowledge on how product and process innovation affects the growth of firms in Sub-Saharan Africa particularly in East African countries is still limited, albeit the existing body

of growing literature on innovation and firm growth. With most of the existing literature mainly focusing on developed countries, it is almost impossible to generalize research findings from these studies especially in the context of low developed countries. This is because of the prevailing differences in these countries, for example in terms of institutional arrangements and peculiarities in resources. Some of the scholars that have pursued this line of research in East Africa have paid much attention to the factors that explain the evolution of innovation (Goedhuys, 2007; Danquah & Amankwah, 2017; Barassa et al., 2016).

This research is related to studies done by Goedhuys and Sleuwaegen (2010); Gebreeyesus (2009) and Agyapong et al. (2017). However, the study diverges from Goedhuys and Sleuwaegen's study by considering high and low growth firms since they both have the potential to create employment opportunities in East Africa. Furthermore, this study differs from that of Gebreeyesus (2009) by considering the effect of both product and process innovation on employment growth. In addition, this research diverts from Agyapong's study by incorporating the possible complementarity effect that could arise from the firm's ability to combine product and process innovation. Overall, using WBES data, this research contributes to the existing literature on innovation and firm growth by giving a clear insight of the effect of product and process innovation on firm growth in five East African countries thereby deviating from single country studies. In addition, the study assess the effect of product and process innovation on sales, employment and productivity growth to give a deep understanding of the role played by innovation on firm growth.

1.6 Organization of the Study

This dissertation consists of five chapters. Chapter one provides an overview of the entire research study. Chapter two presents the relevant firm growth theories and also gives an account of the empirical literature behind innovation and firm growth. Chapter three

discusses the methodology and data used. Chapter four provides descriptive statistics, presents and discusses the econometric results obtained from the model estimation. Chapter five succinctly gives the conclusion and recommendations based on the empirical findings.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter gives a review of the relevant theoretical and empirical literature that explains firm growth and innovation. It consists of three sections; that is section 2.1 which contains six sub-sections consisting of different theories of firm growth and innovation. Section 2.2 discusses empirical literature on firm growth and innovation. Section 2.2 is divided into three sub-sections which allow discussion of literature from Sub-Saharan Africa, other developing countries and developed countries respectively. Section 2.3 gives a summary of the empirical literature and also identifies the existing research gap.

2.1 Theoretical review on firm growth

There exist different theoretical strands explaining how the growth of firms evolves.

2.1.1 Classical theories

Initially, traditional neoclassical economists (Leon Walras, Alfred Marshall and Vilfredo Pareto) focused on the factors affecting both the demand and supply for the products produced to explain growth in firms. They argue that firm growth is a result of firms adding workers until a point where the value of the marginal product of the last worker is equal to the wage paid to that worker. However, they contend that this can only occur as a reaction to changes in technology, the wage rate or the price of the product (McPherson, 1996).

2.1.2 Stochastic theories of firm growth

Stochastic theories extend the traditional neoclassical static theory by making it dynamic through introducing firm specific costs to account for the evolution of firm growth overtime. These theories argue that each year firms grow randomly with a proportion of ‘lucky’ firm repeatedly drawing high growth rates and growing overtime (McPherson, 1996).The most

prominent stochastic theory is that by Robert Gibrat (1931) who initiated the Gibrat Law which is sometimes known as the Gibrat's rule of proportionate growth or the Law of Proportionate Effect (LPE). Gibrat's law is a proposition which states that the probability of a given proportionate change in size for a given period is the same for all firms in a given industry regardless of their size at a beginning of the period. In other words, the law posits that firms grow every year randomly implying that growth of firms is independent of the size thus small or large firms have equal growth chances. However, empirical literature testing stochastic theories criticize their assumptions and in particular found that Gibrat's law fails to hold.

2.1.3 The learning model

The learning model by Jovanovic (1982) succeeded Gibrat's stochastic model. This model basically relates to firm-specific efficiency differences to account for firm growth thereby diverting from the stochastic theories which argue that firms grow randomly. According to this model, potential firm entrants know the costs of all firms but do not know their own. However, upon entering the market, firms are able to renew their prior expectations through experience and ultimately become certain about their true type. The model further asserts that those encountering high costs (low efficiency) choose to exit while those experiencing low costs (high efficiency) choose to grow. This model relies on the notion that annual firm growth rate depends on the accuracy of the firm manager's predictions regarding a firm's efficiency and also the price of the product.

Jovanovic's model has further implications regarding the relationship between firm growth rate, size and age. Jovanovic argues that as a firm grows older, the manager's ability to estimate a firm's efficiency increasingly becomes accurate which reduces the probability of a firm's next period's output to differ from the current year's output. As a result older firms on average grow more slowly than young ones. Considering firm size, the model concludes that

bigger firms grow more slowly since such firms are more efficient and have less room for further increases. Jovanovic's main assumption is that firm managers are born with an efficiency level which cannot be changed even after learning about this efficiency level over time. This assumption is however criticized by Pakes and Erickson (1987) who argue that the firm manager's efficiency level can be altered by human capital formation.

2.1.4 Schumpeter's firm growth theory

Specifically, models relating innovation and firm growth are highly indebted to endogenous growth models led by Schumpeter (1934). Schumpeter's theory differs from the proceeding models by explicitly highlighting the role of innovation on firm growth. Schumpeter describes innovation as a process of 'creative destruction' by referring to it as a way in which firms can merge different types of knowledge or adapt to the existing stocks of knowledge. According to Schumpeter, the new stock of knowledge is necessary in developing new products, processes and organization structures deemed necessary in over taking the market share from the non-innovators. In addition, Schumpeter argues that the new stock of knowledge is fundamental in lowering costs as well as increasing quality thus enabling innovative firms to grow at the expense of non-innovators. Schumpeter further affirms that innovators are able to enjoy monopoly rents which help them grow faster and efficiently until such a time when their new products or processes are imitated.

2.1.5 Grossman and Helpman theory

According to this theory, upcoming innovators are assumed to invest in research and R&D in order to improve the quality of their products or establish new ones. In this theory, R&D is regarded as the major determinant of long term growth in firms. Grossman and Helpman argue that innovating firms are able to earn monopoly profits which boost their growth. Similar to the Schumpeterian theory, they further affirm that the monopoly rents for innovating firms persist up to the point where rival firms discover and improve the better

version of the same product. In contrast to Schumpeter's theory, they assert that innovation can only be rewarding if firms are granted property rights for their new products or processes given that a country's patent system is effective.

2.1.6 Crepon-Duguet-Mairesse (CDM) theory

Similar to Schumpeter theory (1982) and Grossman & Helpman theory, the Crepon-Duguet-Mairesse (CDM) structural model established by Crepon et al. (1998) also clearly describes the relationship between innovation and firm growth. However, unlike the aforementioned theories, the CDM theory describes the performance of firms as a function of process and product innovation which are determined by R&D efforts of the firm. The CDM model is constructed in three steps where the first step relates to firms deciding on investing in R&D; the second step comprises of knowledge production function (that is; product and process innovation) and the third step corresponds to the firm performance function with product and process innovation as explaining factors. While using this model, Crepon et al. (1998) find that firm performance correlates positively with a higher innovation output using productivity as a proxy for performance. The CDM model is adapted in this research in an attempt to achieve the set study objectives since it properly articulates how innovation transmits into firm performance.

2.2 Empirical Literature review

The empirical literature presented below is sub-divided into three parts, that is; literature from Sub-Saharan Africa, that from other developing countries and lastly that from developed countries.

2.2.1 Empirical literature from Sub-Sahara Africa

From Sub-Saharan African (SSA) countries, there are studies that found a positive impact of product and process innovation on firm growth using sales, productivity and employment

growth as indicator variables for firm growth. For instance; Goedhuys and Sleuwaegen (2010) in their analysis of the growth performance of entrepreneurial firms from eleven SSA countries while using least squares estimation found that product but not process innovation positively impacted on employment growth. In contrast, Fu et al. (2017) while using the CDM structural model to analyze innovation survey data for firms in Ghana also found both product and process innovation positively impact on productivity of firms. In addition, Cirera et al. (2016) while using firm-level data for a sample of six SSA countries also found that product and process innovation positively affect productivity growth in DRC, Ghana, Tanzania, Uganda and Zambia but not in Kenya. In the same spirit, Gebreeyesus (2009) while using micro survey data from Ethiopia argues that innovative firms grow faster in terms of employment than non-innovators particularly those engaging in product innovation and that training has a strong effect on the innovation activity there by resulting in high firm growth.

In contrast, Mahemba et al. (2003) in their study of small and medium enterprises (SMEs) in the Tanzanian manufacturing sector using in-depth case studies found a weak positive relationship between innovation (measured through technological change) and growth performance of firms. On the other hand, Goedhuys et al. (2008, 2015) argue that in Tanzania, productivity growth is not enhanced by product and process innovation but rather it's the business environment that plays a relevant role. In addition, Robson et al. (2009) while using data from 492 entrepreneurs in Ghana assert that innovation (that is; product and service) is not positively associated with employment growth.

2.2.2 Empirical literature from other developing countries

Empirical evidence from other developing countries shows the importance of product and process innovation in explaining firm growth. For example Goedhuys and Veugelers (2012) in their study for Brazilian manufacturing firms argue that product and process innovation

each positively affects sales growth of firms. They also affirm that it's only firms that combine successful product innovation with process innovation who generate significantly higher sales growth thus supporting complementarity of product and process innovation. In addition to innovation, Goedhuys and Veugelers (2012) also found access to finance and skills relevant in explaining growth. On the contrary, Benavente and Lauterbach (2008) while using firm-level micro-data found that product innovation affects employment growth positively and significantly. On the other hand, Benavente and Lauterbach (2008) find no evidence suggesting that process innovation significantly affects employment growth possibly due to lack of additional efficiency in the production of old goods. Chudnovsky et al. (2006) in their study using panel data from innovation surveys in Argentina also justify that firms that introduce new products and/or processes attain higher productivity levels than non-innovators.

2.2.3 Empirical literature from developed countries

Regarding developed countries, there is no consensus in the literature on the impact of innovation on growth of firms. On one hand, some studies stress the relevance of innovation in firm growth. For example; Bishop et al. (2009) found that more product innovative firms in the United Kingdom do indeed grow twice as faster both in sales and employment compared to firms that fail to innovate. In addition, Artz et al. (2010) using data from COMPUSTAT comprising of a sample of 272 firms in the US found that firms that introduce new products experience higher growth of sales. However, while using patents counts as a measure of innovation, they found a negative relationship between innovation and sales growth. Furthermore, Cucculelli and Ermini (2012) while investigating the effect of product introduction on sales growth using a sample of Italian firms found that the release of a new product (product innovation) enhances growth opportunities among firms and that product innovation promotes growth especially in those firms with a stronger commitment to R&D.

Similarly, Cassiman et al. (2010) using a panel of Spanish manufacturing firms found strong evidence that product innovation and not process innovation affects productivity.

Additionally, Junge and Sorensen (2016) also concluded that product innovation in skill intensive firms results into significantly faster productivity growth which according to them implies that skill-intensive firms that engaged in product innovation grew faster than skilled intensive firms that do not engage in product innovation implying that innovation only fosters growth in skill intensive firms. In contrast, Stam and Wennberg (2009) while using a dataset of start-up firms in the Netherlands failed to find evidence for the positive impact of product innovation on growth of firms. There results were consistent with those of Freel and Robson (2004) who carried out a similar study in Scotland and Northern England.

2.3 Conclusion

Empirical literature previously summarized suggests that the effect of innovation- that is product and process innovation is mixed. Some studies find a positive effect of innovation on firm growth, while some argue against such a finding due to evidence of either a negative or insignificant impact. In addition, innovation and firm growth literature focusing on East Africa is limited as noted in the review. Majority of similar studies mainly focus on developed and developing countries. For a few studies focusing on East African countries, there are still issues that have not been entirely addressed. For instance, most of these studies take the impact of innovation on productivity, sales or employment without considering the actual impact of innovation on the growth measures of these metrics. Furthermore, among the studies done in East African countries, there is no single study that focuses on the differences in firm growth across innovative and resource equipped firms (that is; in terms of labor quality and finance) this compared to their counterparts. Therefore, the analysis of these issues is vital due to their implication for policy and attainment of the development set goals in each of the five East African countries considered in this study.

CHAPTER THREE

METHODOLOGY AND DATA

3.0 Introduction

This chapter presents a discussion about the theoretical framework adapted for the research. It also gives the econometric models and empirical strategies that are used in the model estimation in chapter 5. The source of data and the variable description are also presented in this chapter.

3.1 Theoretical Framework

The theoretical framework is based on the Crepon-Duguet-Mairesse (CDM) model which provides a benchmark in describing how both product and process innovation impact on firm growth. This model was developed by Crepon et al. (1998) and it is formalized in three stages. The first stage relates to firms making a decision on whether and how much to invest in R&D activities. The second stage is then concerned with how firms use R&D as an input to produce knowledge which is in form of product and process innovation. The final stage relates to how knowledge output which takes the form of product and process innovation produced using R&D and other inputs affects the performance of firms. Firm performance in this regard is measured through a number of indicators ranging from productivity growth, profitability, sales growth, employment growth, value added per employee, among others.

In summary, the CDM model explains a process where firms invest in R&D conducive to establish process and product innovations, which then contributes to the performance of firms. This model also incorporates additional information on firms' employment number; market share diversification as well as demand-pull and technology push indicators of a firm. This framework is desirable because it encompasses econometric methods essential for dealing with selectivity and simultaneity biases in the data. This is because, it's based on an

assumption that studies mainly restrict on firms that engage in R&D activities and innovation therefore leading to selectivity biases. Additionally, it is based on an assumption that disturbances in the equations considered in the model reflect a correlation between unobserved variables and firm effects resulting in endogeneity problem which is dealt with using a two stage estimation procedure. The CDM model is conceptually laid out as follows in the diagram below;

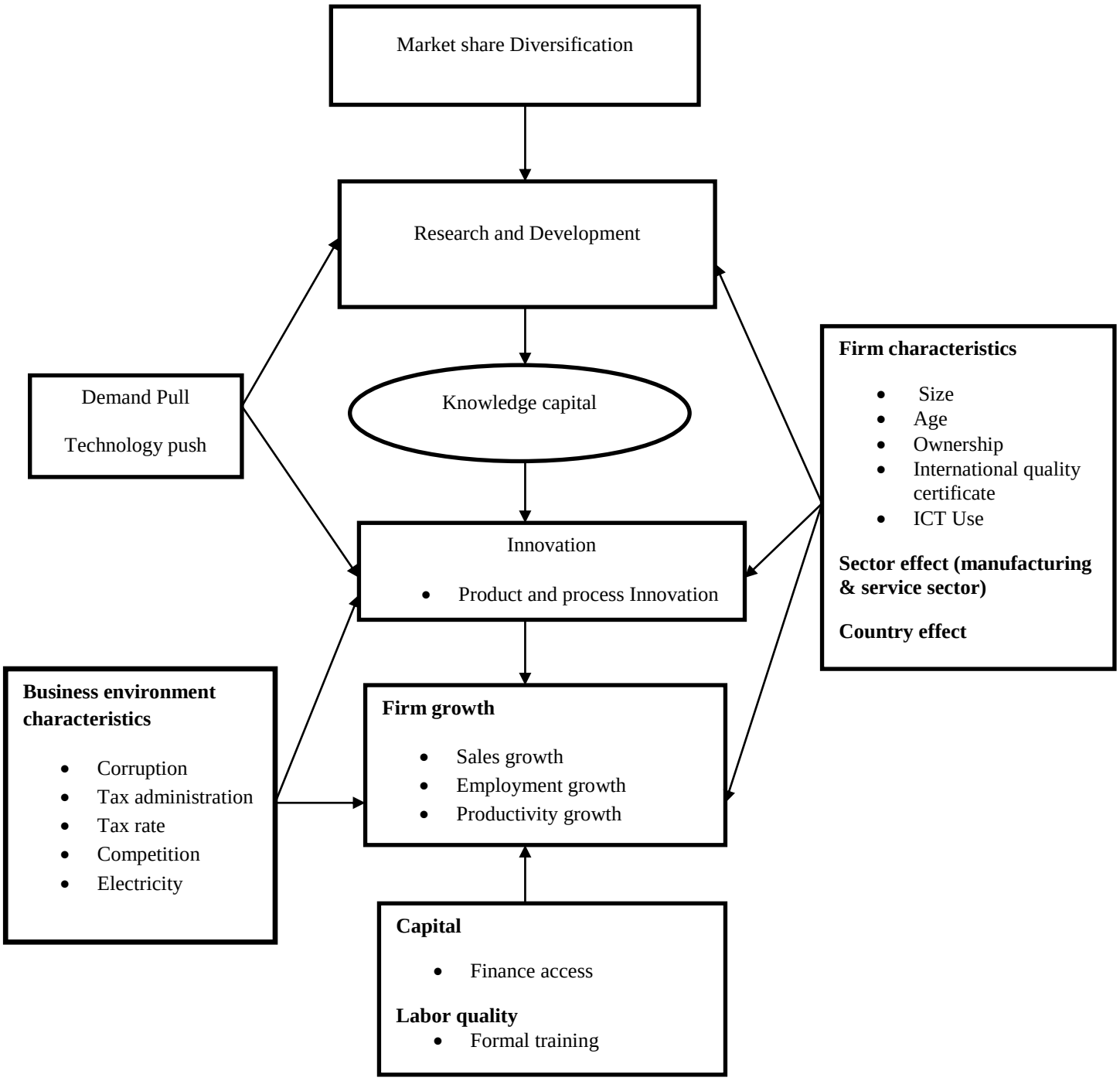

Figure 3. 1: Schematic diagram showing a modified structure of the CDM model

Figure 3.1 demonstrates a schematic diagram showing the modified structure of the CDM model. This model summarizes a process that goes from firms deciding to engage in R&D activities to the use of innovation in boosting its growth (Crepon et al., 1998). The CDM model is basically made up of three main relationships: first, the research component where firms that seek to diversify their market share decide to engage in R&D. This research component links R&D to its determinants, including; demand pull and technology push indicators; firm size & sector effects. However, based on literature review other firm characteristics such as firm age, ownership, possession of an international quality certificate and ICT use have been extended in the CDM model as additional determinants of R&D.

Second, the innovation output relation from knowledge capital created from R&D activities. In additional to R&D, this component relates innovation output in form of product and process innovation to a set of other explanatory variables including, demand pull and technology push indicators; firm size and sector effects. From the reviewed literature, other firm characteristic variables like firm age, ownership, possession of an international quality certificate and ICT use as well as business characteristic variables such as corruption, tax rate and administration, competition, and electricity have also been adapted as determinants of the innovation output in the CDM model (see figure 3.1).

Lastly, we have the firm growth component composed of three growth metrics. In the original CDM model, only productivity was considered. However, two additional growth metrics have been extended (that is; employment and sales growth) in the CDM model. This component links firm growth to its determinants with product and process innovation being the main explanatory variables. Other determinants for firm growth include firm level resources in terms of finance access and formal training; firm and business characteristics (See figure 3.1).

3.2 Empirical model

Formally, the model adopted in this research is laid out as follows;

Let $j = 1,2,\ldots,N$ be the index for country, $i = 1,2,\ldots,K$ the index for a firm and $k = 1,2,\ldots,T$ be the index for sector. The first step of the model identifies an equation that explains how firms decide on whether or not engage in R&D activities. This equation is given as follows;

$$rd^{*}_{ijk} = x'_{ijk}\beta + \varepsilon_{ijk} \quad (1)$$

x'_{ijk} = (firm characteristics: *firm size, age, ownership, Int quality cert, ICT use*)

Where rd^{*}_{ijk} is the research effort by a firm i in country j belonging to sector k and is unobserved latent variable, x_{ijk} is a vector of determinants of research effort, β is a vector of parameters of interest and ε_{ijk} is the error term.

Equation (1) is estimated using a probit model which describes whether or not a firm invests in R&D. The probit model is given as;

$$rd_{ijk} = \begin{cases} 1 \; if \; rd^{*}_{ijk} = x'_{ijk}\beta + \varepsilon_{ijk} > 0 \\ 0 \quad otherwise \end{cases} \quad (2)$$

Where rd_{ijk} is the observed dummy variable equal to 1 if a firm invests in R&D and 0 if a firm does not invest in R&D.

The second step of this model deals with the innovation production functions where three equations are estimated. The first equation combines both product and process innovation (3a) while the other two equations separately capture the estimation of the two types of innovation (3b & 3c). This is required to achieve the set objectives. The three equations are therefore expressed as;

$$I^{*}_{ijk} = rd^{*}_{ijk}\alpha + w'_{ijk}\theta + u_{ijk} \quad (3a)$$

$$prod^{*}_{ijk} = rd^{*}_{ijk1}\alpha_1 + w'_{ijk}\theta_1 + u_{ijk1} \quad (3b)$$

$$proc^{*}_{ijk} = rd^{*}_{ijk2}\alpha_2 + w'_{ijk}\theta_2 + u_{ijk2} \quad (3c)$$

w'_{ijk} = *(firm characteristics; business environmental characteristics)*

Where $I^{*}_{ijk}, prod^{*}_{ijk}$ and $proc^{*}_{ijk}$ are the unobserved latent variables representing combined innovation output, product and process innovation respectively. rd^{*}_{ijk} is the R&D effort which now enters the innovation functions as an explanatory variable; w'_{ijk} represents a vector of other determinants (including firm characteristics; age, size, ownership, Int quality cert, ICT use, and business environmental characteristics- corruption, tax rate and administration, competition, and electricity) of the combined innovation effort and also product and process innovation separately; $\theta \; and \; \alpha$ are the parameters of interest while u_{ijk} is the error term.

Probit models were used to estimate equations (3a), (3b) and (3c). The models are as shown below;

$$I_{ijk} = \begin{cases} 1 \;\; if \quad I^{*}_{ijk} = rd^{*}_{ijk}\alpha + w'_{ijk}\theta + u_{ijk} > 0 \\ 0 \qquad otherwise \end{cases} \quad (4a)$$

$$prod_{ijk} = \begin{cases} 1 \; if \; prod^{*}_{ijk} = rd^{*}_{ijk1}\alpha_1 + w'_{ijk1}\theta_1 + u_{ijk1} > 0 \\ 0 \qquad\qquad otherwise \end{cases} \quad (4b)$$

$$proc_{ijk} = \begin{cases} 1 \qquad if \quad proc^{*}_{ijk} = rd^{*}_{ijk2}\alpha_2 + w'_{ijk2}\theta_2 + u_{ijk2} > 0 \\ 0 \qquad\qquad\qquad otherwise \end{cases} \quad (4c)$$

$where \; I_{ijk}$, $prod_{ijk}$ and $proc_{ijk}$ are the observed binary variables for the combined innovation effort and product and process innovation separately taking on a value of 1 if a firm introduced a new product in the last three years for product innovation and 0 for a firm that did not introduce any new product. Similarly, the dummy variable for process innovation takes on a value of 1 if a firm established a new process in the last three years and 0

otherwise. With regards to I_{ijk}, a value of 1 implies a firm established both a new product and process in the last three years and 0 if a firm did not do both.

It should however be noted that in all equations (4a) , (4b) and (4c) to be estimated, predicted values of the research effort obtained from the probit model in equation (2) will be used. The predicted values will act as an instrument for R&D in these equations. This is intended to take care of any possible endogeneity problems and selection bias in the research effort variable (Crepon et al., 1998).

The final stage is then concerned with expressions that will be used in examining the effect of product and process innovation on the growth of a firm. Sales growth, productivity growth and employment growth will be used as proxies for firm growth. The firm growth equations are given as;

$$y_{ijk} = \gamma + I^*_{ijk}\beta_1 + z'_{ijk}\delta + v_{ijk} \quad (5a)$$

$$y_{ijk} = \mu + prod^*_{ijk}\beta_2 + z'_{ijk}\delta_1 + v_{ijk1} \quad (5b)$$

$$y_{ijk} = \pi + proc^*_{ijk}\beta_3 + z'_{ijk}\delta_2 + v_{ijk2} \quad (5c)$$

Where y_{ijk} represents growth of a firm i in country j and sector k (that is; sales growth, productivity growth and employment growth) expressed in log form, $prod^*_{ijk}$ and $proc^*_{ijk}$ stand for product and process innovation variables separately while I^*_{ijk} is the combined innovation effort; $\mu, \gamma, \pi, \beta_1, \beta_2, \beta_3$ and $\delta's$ are parameters of interest; v_{ijk} is the error term while z'_{ijk} is a vector of control variables that can also explain firm growth. These will include; firm characteristics, firm level resources and business environment indicators.

In order to test for the third hypothesis, equation (5a), (5b) and (5c) are expanded to capture the moderation effect of innovation on firm resources while explaining firm growth. Equation (6a), (6b) and (6c) below are be estimated to illustrate this effect;

$$y_{ijk} = \gamma_1 + I^*_{ijk}\beta_4 + (I^*_{ijk} * fr'_{ijk})\beta_5 + z'_{ijk}\delta_3 + v_{ijk3} \quad (6a)$$

$$y_{ijk} = \mu_1 + prod^*_{ijk}\beta_6 + (prod^*_{ijk} * fr'_{ijk})\beta_7 + z'_{ijk}\delta_4 + v_{ijk4} \quad (6b)$$

$$y_{ijk} = \pi_1 + proc^*_{ijk}\beta_8 + (proc^*_{ijk} * fr'_{ijk})\beta_9 + z'_{ijk}\delta_5 + v_{ijk5} \quad (6c)$$

Where fr'_{ijk} is a vector of firm level resources which include; formal training and finance access. β_4,β_5,β_6,β_7,β_8 and β_9 are the parameters of interest. The CDM approach is in line with studies done by Fu et al. (2017); Griffith et al. (2004); Hall et al. (2009) among others who use it to analyze the role of innovation on fostering firm growth.

3.3 Estimation Strategy

In the estimation of equation (5a) to (6c) above, a two stage least square regression procedure (2SLS) was used. This method is deemed appropriate because of the cross-sectional nature of the data used in the study. There is need to consider that innovation and firm growth are both endogenous. This arises because of the possibility that firms experiencing growth are more likely to engage in innovation activities (Fu et al., 2017). Likewise, innovation may also result in firm growth thus causing a challenge of reverse causality. For this study, while innovation may increase sales, employment and productivity growth, it is also possible that firms experiencing higher sales, employment and productivity growth adopt innovation activities. An endogeneity test for the innovation variables is done using an augmented regression test (that is; the Durbin-Wu-Hausman test) and should the endogeneity problem be confirmed, then an appropriate instrument for the innovation variables is obtained whose validity is confirmed using the over-identifying restrictions test – the Sargan statistic. It should also be noted that from the CDM model extended in this study, predicted values of innovation and firm level resources were used during the estimation of the firm growth equations in models (6a) to (6c). This was intended to minimize any firm selection bias.

3.4 Data source and variables

3.4.1 Data

The study uses data from the World Bank Enterprise survey (WBES) for five East African countries that is; Uganda, Kenya, Tanzania, Rwanda and Burundi. The data employed covers a period of 2013 for Uganda, Tanzania and Kenya; 2011 for Rwanda and 2014 for Burundi. The reason for the difference in years for the countries considered is due to the fact that data collection was carried out at varying time intervals in the respective countries. Data for the countries considered was merged to form one dataset that was used in the analysis. The WBES data covers information on various aspects of business environment and investment climate of economies with topics ranging from innovation, sales and supplies performance, finance, infrastructure and business-government relations. This information is provided by a representative sample of top managers and firm owners that are engaged in non-agricultural formal sector. A total sample of 2754 firms is considered in this study with 157, 781, 241,813 and 762 firms from Burundi, Kenya, Rwanda, Tanzania and Uganda respectively.

3.4.2 Variables

The choice of variables considered in this research is guided by existing literature on firm growth and innovation.

***Dependent variable*:** Firm growth is the key variable of interest whose measurement constitutes three different categories. That is; employment growth, sales growth and productivity growth. All the three growth metrics are computed from the data taking by the difference between the values given by the firm in the last fiscal year at the time the survey was taken in each country and three years ago divided by the value reported three years ago and then multiplied by 100 to convert it into percentages (that is, relative growth measures are taken).

Independent variables: Firm growth is related to a set of explanatory variables with innovation as the main independent variable. This study distinguishes between two categories of innovation; *product and process innovation*. From these two types of innovation, a combined variable for firms having both product and process innovation was generated to facilitate testing of the second hypothesis.

Firm-level resources in particular; formal training and finance are considered among independent variables. These are necessary in achieving the third objective of the study. For example; Junge and Sorensen (2016) assert that innovation especially in skill intensive firms results in significantly faster firm growth. Also, past literature confirms that firms that are financially constrained encounter slow growth while those that have financial access easily allocate resources and have reduced cash flow problems thereby increasing their growth potential (Atieno, 2009; Nkurunziza, 2008; Demirguc-Kunt et al ., 2015; and Goedhuys & Veugelers, 2012).

Other control variables: Although innovation and firm level resources are the main explanatory variables considered in this research, it is also relevant to point out control variables that studies in the literature have found to be significant in explaining firm growth. These include firm characteristics and the business characteristics under which the firms operate.

Firm characteristics

Age: A number of studies argue that young firms (especially those less than 15 years) grow considerably more rapidly on average than their counterparts that have been in existence for longer periods (Nichter & Goldmark, 2009; Liedholm, 2002; Coad et al, 2008; Coad et al., 2016; Sharma and Mitra, 2015; among others).

Ownership: There is evidence that foreign owned firms grow faster than domestically owned firms possibly because of their greater accessibility to international markets (Sharma & Mitra, 2015; Svejnar & Commander, 2007).

International quality certificate: Empirical evidence shows that firms with internationally recognized certificates may benefit more in terms of improved quality and performance (Corbett et al., 2005).

R&D: This has been regarded as a critical variable in explaining firm growth with preceding studies illustrating that only those firms investing in R&D are able to experience substantial growth higher than their counterparts (Robson & Obeng, 2009; Stam & Wennberg, 2009). However, the positive effects from R&D on firm growth are much realized when R&D results into successful innovation.

Business characteristics

Corruption: Empirical literature shows that corruption impedes the growth potential of firms (Kimuyu, 2007; Fisman & Svensson, 2007; Sharma & Mitra, 2015; Asiedu & Freeman, 2009). Kimuyu asserts that corruption creates entry barriers that make markets less contestable and also adds to the cost of production among firms.

Competition*:* Scholars argue that firms (especially the inefficient ones) which face competition often find it hard to growth into optimal sizes and sometimes end up exiting the market (Boone, 2008; Fowowe, 2017; Dinh et al., 2010; Schumpeter, 1934).

Tax rate and tax administration: Previous studies indicate that firms that encounter a higher tax rate or report tax administration as an obstacle face growth challenges (Fisman and Svensson, 2007; Gelb et al., 2011).

Electricity: empirical evidence from past studies shows that unreliable electricity or constant power outages constrain the firm's ability to growth (Aterido et al., 2011).

Other control variables

Country dummy: It is particularly necessary because the East African countries considered in this research differ in terms of their economic conditions such as per-capita output and are also characterized by political cultural and historical differences.

Sector dummy: This variable is important in controlling for sector heterogeneity among firms since firm growth may vary depending on the sector within which the firm belongs.

Noteworthy, the description of these variables is detailed in appendix A1

CHAPTER FOUR

PRESENTATION, INTERPRETATION AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter is divided into two sections. First, it presents descriptive statistics of the variables to be used in the study. The preliminary examination of the data makes it important to have knowledge on the basic properties of the data. Secondly, the regression results obtained from running the models 5a to 6c in chapter 3are then presented in this chapter. Result interpretation and discussion are done concurrently.

4.1 Descriptive statistics

Descriptive statistics for the variables used in the study are provided in table 4.1. These are necessary to understand the basic characteristics of the data to be used in the empirical econometric analysis. Note that details on the correlation between the variables can be found in appendix B.

From the sample of 2754 firms, the overall average sales growth is 13.3 percent where firms in Burundi report the highest average sales growth of 15.18 percent while firms in Tanzania have the lowest sales growth of 11.5 percent. On average, firms in Uganda, Kenya and Rwanda experience sales growth of 14.5 percent, 13.3 percent, and 14.8 percent respectively. Permanent employees grow on average by 9 percent in all countries. Average employment growth is highest in Tanzania at 17 percent and lowest in Kenya at 3.2 percent. Employment growth in Rwanda, Burundi and Uganda is at 10.7 percent, 7.8 percent and, 6.7 percent respectively. The average productivity growth for firms in all countries is 11.3 percent with Kenya reporting the highest percentage of 18.4 while Uganda has the lowest productivity

growth of 0.2 percent. Majority of the firms were actively engaged in either product innovation (61 percent) or process innovation (71percent).

Table 4. 1: Descriptive statistics

Variable	N	Mean	SD	Min	Max
Dependent variables					
Sales growth	2754	0.133	0.186	-0.375	7.325
Employment growth	2684	0.090	0.388	-1	5.209
Productivity growth	2728	0.113	2.525	-131.244	2.927
Independent variables					
Combined prod&proc (1=yes)	2689	0.548	0.498	0	1
Product innovation (1=yes)	2741	0.605	0.489	0	1
Process innovation (1=yes)	2694	0.711	0.453	0	1
Firm resources					
Formal training (1=yes)	2721	0.366	0.482	0	1
Access finance (1=yes)	2565	0.331	0.460	0	1
Control variables					
Firm characteristics					
Firm Age (in years)	2754	16.87	2.959	1	107
Firm size (medium=2)	2754	0.308	0.462	0	1
(Large=3)	2754	0.129	0.335	0	1
Formality (1=yes)	2660	0.766	0.423	0	1
ownership status (1=foreign)	2622	0.125	0.330	0	1
Quality certificate (1=yes)	2585	0.216	0.412	0	1
R&D (1=yes)	2721	0.254	0.435	0	1
Business environment					
Corruption	2642	0.753	0.431	0	1
Tax Admin (1=obstacle)	2689	0.760	0.427	0	1
Tax rate (1=obstacle)	2754	0.660	0.474	0	1
Competition (1=yes)	2579	0.679	0.468	0	1
Electricity (1=obstacle)	2734	0.822	0.383	0	1
Sector (1=service)	2754	0.583	0.493	0	1
Country (0=Uganda)	2754	0.277	0.447	0	1

Source: Author's own calculation

However, a proportion of 55 percent of firms were engaged in both product and process innovation. With regards to product innovation, Kenya has the largest share of firms introducing new products at 68 percent while in Uganda, Tanzania, Rwanda and Burundi the proportion of firms introducing new products is at 65 percent, 52 percent, 61.4 percent and 47 percent respectively. Furthermore, proportion of process innovators is highest among firms in Rwanda at 82 percent and lowest for firms in Tanzania at 60 percent. For Uganda,

Kenya, and Burundi, the share of firms engaged in process innovation is at 73 percent, 77 percent and 68 percent respectively. Considering the combination of product and process innovation, Kenya at 62 percent) and Uganda at 61 percent report the highest proportions of firms to have engaged in both product and process innovation whereas Tanzania, Rwanda and Burundi account for 45 percent, 56 percent and 41 percent respectively.

Overall, only 37 percent of the firms offer formal training to their permanent or full time employees with majority of these firms from Rwanda at 88.3 percent while in Uganda, Tanzania, Kenya, Burundi, and Tanzania this proportion stands at 32, 43.4, 83.4 and 30 percent respectively. In addition, the proportion of firms having access to finance is 33 percent. In Uganda, only 29 percent of the firms have access to finance while in Kenya, Tanzania, Rwanda and Burundi, the proportion of firms having access to finance is at, 38 percent, 21 percent, 7 percent, and 4 percent respectively.

With reference to firm characteristics, firms in Uganda, Tanzania and Burundi have been in existence for relatively the same average period which is 15 years while firms in Kenya and Rwanda on average have been in existence for 23 and 11 years respectively. In addition, majority of the firms are small in size (56 percent) with the highest proportion of such small firms from Tanzania at 33 percent while Uganda, Kenya, Rwanda, and Burundi account for 31, 23, 7, and 5 percent respectively.

Pertaining to the environment within which firms operate majority of firms report tax rate to be an obstacle in their operations. Most of these firms are from Kenya, Uganda and Tanzania at 33 percent, 30 percent, and 25 percent respectively. Likewise, using corruption to proxy for the quality of institution, an overall fraction of 75 percent of firms reported to have spent a percentage of their sales in bribing public officials. Tanzania, Uganda, and Kenya account

for the highest percentage at 31, 30, and 27 percent respectively of firms to have encountered corrupt public officials.

4.2 Econometric Results

The main objective of this research was to understand the role of innovation as an enabler for firm growth. The study hypotheses are tested by estimating equations (5a) to (6c). However, before presentation of the results it is worthy to comment on the endogeneity problem that has been addressed in the analysis. As highlighted in Sec 3.3 of chapter 3, there is a possibility that innovation and firm growth are endogenous. Therefore, a test for endogeneity of the innovation variables was performed using the Durbin-Wu- Hausman test (DWH). From the results across the three firm growth indicators, it is confirmed that the innovation variables are correlated with the error terms thus violating the exogeneity condition of the OLS estimation which makes OLS results inconsistent (See the DWH results at the bottom of tables 4.2, 4.3 and 4.4).

In order to correct for the endogeneity problem, an instrument variable (IV) approach, specifically the 2SLS method is used. The IV method requires a proper instrument that should be related to innovation variables and at the same time uncorrelated with the error term. While relying on literature specifically the CDM model and statistical tests, R&D is found to satisfy the condition of a relevant instrument. In particular, the first stage F-statistic results reported in table 4.2, 4.3 and 4.4 all exceed the threshold values of 10 provided by Stock and Yogo (2002) which imply that the R&D variable satisfies the relevance condition. The next step was to test for the exogeneity condition of the instrument; that is checking whether the R&D instrument is not correlated with the error terms in the various equations estimated. Using the over identifying restriction test, specifically the Sargan test, the statistical results show that the R&D instrument is considered exogenous given that the null

hypothesis is not rejected at all conventional confidence interval levels (refer to results at the bottom of tables 4.2, 4.3 and 4.4).

The OLS results have been included in Appendix C for comparison purposes. With regard to the innovation indicators, the OLS results are slightly different from those of the 2SLS in terms of the magnitudes of the coefficients. In particular, the coefficients of the innovation variables in tables 4.2, 4.3 and 4.4 for all the models considered in the 2SLS estimation method are higher compared to those presented in the OLS tables.

The 2SLS results are summarized in tables 4.2, 4.3 and 4.4 with each containing 6 models. Models 1 to 3 separately report results of the effect of combined innovation effort, product innovation and process innovation respectively on firm growth. Model (4) provides results of the interaction effect between combined innovation effort and firm resources on firm growth. Model (5) captures results for the interaction effect between product innovation and firm resources on firm growth while Model (6) reports results for the interaction effect between process innovation and firm resources on firm growth. The three tables follow the three metrics for firm growth, that is; sales, employment and productivity growth.

4.2.1 Innovation and sales growth

Table 4. 2: 2SLS results for the effect of innovation on sales growth

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	1.627***			1.577***		
	(0.594)			(0.603)		
Product innovation (1=yes)		1.278***			0.679	
		(0.458)			(0.506)	
Process innovation (1=yes)			1.369***			0.828
			(0.496)			(0.578)
Interaction variables						
Innov X formal training				0.108*		
				(0.058)		
Innov X finance				0.049		
				(0.037)		
Prodinnov X formal training					0.997***	
					(0.375)	
Prodinnov X finance					0.116*	
					(0.063)	
Procinnov X formal training						0.987**
						(0.436)
Procinnov X finance						0.086
						(0.054)
Firm resources						
Formal training (1=yes)	0.064**	0.047	0.051	0.018	0.583**	0.667**
	(0.032)	(0.032)	(0.031)	(0.052)	(0.225)	(0.301)
Finance (1=yes)	0.116**	0.106*	0.090*	0.033	0.083	0.122
	(0.059)	(0.057)	(0.051)	(0.014)	(0.064)	(0.059)
Firm characteristics						
Firm age (in years)	0.047	0.034	0.062*	(0.064)	0.029	0.060
	(0.038)	(0.039)	(0.036)	0.043	(0.039)	(0.037)
Firm Ownership (1= foreign)	0.062	0.077	0.075	(0.039)	0.076	0.071
	(0.079)	(0.079)	(0.075)	0.064	(0.078)	(0.075)
Int.qualitycert (1=yes)	0.169***	0.153***	0.148***	(0.081)	0.147***	0.145***
	(0.048)	(0.050)	(0.049)	0.162***	(0.050)	(0.048)
ICT use (1=yes)	0.331**	0.016	0.023	(0.049)	0.017	0.026
	(0.135)	(0.039)	(0.040)	0.329**	(0.039)	(0.040)
Business environment constraints						
Corruption	-0.001	-0.001	-0.001	-0.001	-0.000	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tax admin (1=Yes)	-0.023	-0.088*	0.020	-0.022	-0.081*	0.017
	(0.040)	(0.046)	(0.042)	(0.040)	(0.046)	(0.042)
Tax rate (1=Yes)	-0.042	-0.028	-0.037	-0.039	-0.033	-0.043
	(0.034)	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)
Competition (1=Yes)	0.015	-0.111*	-0.057	0.017	-0.080	-0.036
	(0.032)	(0.059)	(0.042)	(0.033)	(0.061)	(0.045)
Electricity (1=Yes)	-0.053*	-0.064**	-0.058**	-0.058**	-0.062**	-0.059**
	(0.028)	(0.027)	(0.027)	(0.028)	(0.027)	(0.027)
Constant	12.260***	12.928***	12.476***	12.281***	13.229***	12.803***
	(0.462)	(0.272)	(0.386)	(0.465)	(0.290)	(0.425)
Country	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,032	2,002	2,050	1,998	2,002	2,050
R-squared	0.047	0.059	0.049	0.051	0.068	0.060
Durbin-Wu-Hausman test (DWH)	0.0072	0.0066	0.0067	0.0080	0.0071	0.0075
First stage F-statistic	22.85	20.98	17.64	16.15	18.03	15.82
Sargan Statistic (P-values)	0.6452	0.4996	0.1678	0.5673	0.7575	0.2919

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

Source: Author's own calculation

Table 4.2 presents the empirical findings for the impact of innovation on sales growth. The results show that the effect of all innovation specifications considered on sales growth is positive and statistically significant. Specifically, product and process innovation independently have a positive significant effect on a firm's sales growth (Model (2) and Model (3) respectively). This may imply that firms that engage in product innovation besides having the ability to increase their output are able to exploit new markets or even expand the existing markets with their new products hence realizing growth in their sales. Similarly, process innovation may be crucial in improving the quality of the existing products thereby allowing firms to distinguish their products from competitors thus attaining growth in their sales. However, the results reveal that engaging in both product and process innovation is strongly positive and significantly associated with increased growth of sales. This finding implies the presence of complementarity among product and process innovation regarding their impact on sales growth. In other words, firms that engage in both product and process innovation realize higher growth in their sales as compared to those firms that engage in only one type of innovation. These findings are consistent with previous studies of Goedhuys and Veugelers (2012) and Agyapong et al. (2017) who also confirm the positive and significant relationship between product and process innovation and sales growth together with the complementarity effect between product and process on sales growth.

With regard to firm resource indicators of the quality of human capital and finance, the results show that formal training is positively and significantly associated with sales growth. This result is in line with previous findings of Goedhuys and Veugelers (2012); Goedhuys and Sleuwaegen (2010); Uhlaner et al. (2013) and it means that firms that offer formal training to their permanent or full time employees experience more growth in sales as compared to those that do not offer formal training to their employees. The positive effect of formal training on sales growth might be due to accumulated business experience and market

knowledge among formally trained employees hence resulting in sales growth. In addition, the results in table 4.2 show that the coefficients of the interaction terms between all the innovation variables considered and formal training are positive and statistically significant. The interpretation of these results is that firms that offer formal training to their employees and engage in either the product, process or the combined innovation effort of both product and process innovation do indeed grow faster in terms of their sales as compared to those firms that are skill intensive without engaging in any type of innovation. One potential explanation for these results is that employees who obtain formal training are able to acquire skills and knowledge which are necessary in the adoption and absorption or diffusion of different innovation types then later translate the knowledge and the skills gained into innovation outputs that can be in form of new products or processes hence the positive impact on the growth of firms.

Furthermore, the results show that access to finance is positively and significantly associated with sales growth. This result suggests that firms that have access to finance experience faster growth in sales as compared to those firms that cannot access finance. This finding is consistent with Demirguc-Kunt et al. (2015); Fowowe (2017); Nkurunziza (2008) and it might imply that firms with access to finance are adequately equipped with the necessary financial capital to aid them in funding expansionary investment opportunities and thus being able to meet future increase in sales demand of their products or services. Additionally, the results in the table 4.2 show that the coefficients of the interaction terms between product innovation and access to finance as well as process innovation and finance are positive and significant. These results imply that firms that have access to finance and also engage in product or process innovation experience faster growth in terms of their sales compared to their counterparts that have access to finance and do not engage in either product or process innovation.

There are other firm and business environment control variables that also have a significant effect on sales growth of a firm. In regard to firm characteristics, the results in table 4.2 confirm that age of the firm is statistically significant and negatively associated with sales growth. In line with the existing literature on firm age and sales growth, that is; Mansury & Love (2008); Coad et al. (2016) and Papageorgiou et al. (2017), this finding suggests that younger firms realize higher growth of sales compared to older firms. This finding is also in support of the learning model developed by Jovanovic (1982) who argues that firms grow very quickly at first, and then reduce in growth as they approach their optimal sizes. A plausible explanation for the negative relationship between firm age and sales growth could possibly be that older firms are characterized by rigidities or conservativeness which makes them unresponsive to economic changes and as such they tend to lose their competitive edge which translates into a reduced market share. On the other hand, young firms tend to be more flexible and proactive, thus engage more in strategic growth activities like innovation and risk taking with an aim of increasing the market share their products or services and they are also competitively aggressive with the way they respond to competitive trends and demands that exist in the market.

The results also show that the coefficient on international quality certificate is positive and statistically significant. Such a representation is in line with previous studies of Goedhuys and Sleuwaegen (2013); Starke et al. (2012) and it suggests that firms that have an international quality certificate experience higher sales growth as compared to their counter parts. This finding may reflect the fact that international quality certificates enable firms to have open access to wider markets including international markets since they signify quality of the firms' products or services and thus such firms are able to experience higher growth in sales. Furthermore, the results reveal that the use of ICT (measured through website use) is positive and significantly associated with sales growth. This finding is similar to empirical

results of previous studies such as Lun and Quaddus (2011); Glavas and Mathews (2014) and might be explained by the fact that ICT use may enable firms to improve their ability to gather and exchange market related information. In addition, firms that use ICT may also be in position to take advantage of international market growth opportunities for their product and services which later results into growth in sales.

While controlling for business environment variables like corruption, tax rate, tax administration, competition and electricity outages, the results in table 4.2show that firms that reported tax administration as an obstacle experience a decline in their growth of sales as seen from the negative and statistically significant coefficient on tax administration (see Model 2). In line with the argument put forth by Gelb et al. (2011), this result may imply that tax administration in East Africa is characterized by high bureaucratic procedures and is weakly governed hence increasing transaction costs on firms which negatively impacts on sales growth. Additionally, the results reveal that firms that face competition from other informal or unregistered firms do realize a decline in their growth of sales. This adverse effect may be the case when informal or unregistered firms tend to ignore a number of business regulations or are able to escape higher regulatory burdens of being formal and thus competing profitably (Gonzalez & Lamanna, 2007). On the other hand the negative relationship may imply that informal or unregistered firms tend to undercut formal firms by lowering prices which translates into increased sales of their products or services and thus cannibalizing the market share of formal firms. Similarly, the results in table 4.2 confirm that firms which complained about the lack of electricity or unreliable power do indeed experience a decline in sales growth. This is potentially because power outages result into losses in sales especially for those firms that rely on energy intensive equipment or machinery for production.

4.2.2 Innovation and employment growth

Findings for the impact of innovation on employment growth are presented in table 4.3 below.

Table 4. 3: 2SLS results for the effect of innovation on employment growth

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	0.043*			0.042*		
	(0.023)			(0.023)		
Product innovation (1=yes)		0.035**			0.017	
		(0.017)			(0.022)	
Process innovation (1=yes)			0.037*			0.023
			(0.019)			(0.025)
Interaction variables						
Innov X formal training				0.002*		
				(0.001)		
Innov X finance				0.003**		
				(0.001)		
Prodinnov X formal training					0.029**	
					(0.014)	
Prodinnov X finance					0.004**	
					(0.002)	
Procinnov X formal training						0.026*
						(0.018)
Procinnov X finance						0.003*
						(0.002)
Firm resources						
Formal training (1=yes)	0.001	0.000	0.001	0.001	0.018**	0.018
	(0.001)	(0.001)	(0.001)	(0.001)	(0.008)	(0.012)
Finance (1=yes)	0.004	0.004	0.003	0.002*	0.002*	0.004
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)
Firm characteristics						
Firm age (in years)	-0.004**	-0.005**	-0.004**	-0.005**	-0.005***	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Firm Ownership (1= foreign)	0.002	0.002	0.002	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Int.qualitycert (1=yes)	0.003*	0.003	0.003	0.003	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ICT use (1=yes)	0.006	-0.003**	-0.003**	0.006	-0.003**	-0.002*
	(0.005)	(0.001)	(0.001)	(0.005)	(0.001)	(0.001)
Business environment constraints						
Corruption	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tax admin (1=Yes)	0.002*	-0.000	0.003**	0.002	0.000	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tax rate (1=Yes)	0.002*	0.002**	0.002*	0.002*	0.002*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Competition (1=Yes)	-0.000	-0.004*	-0.002	-0.000	-0.003	-0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
Electricity (1=Yes)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	7.590***	7.607***	7.596***	7.591***	7.615***	7.604***
	(0.014)	(0.007)	(0.011)	(0.015)	(0.010)	(0.016)
Country effects	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,030	2,000	2,048	1,996	2,000	2,048
R-squared	0.042	0.068	0.062	0.047	0.071	0.066
Durbin-Wu-Hausman test (DWH)	0.0559	0.0561	0.0530	0.0585	0.0543	0.0526
First stage F-statistic	22.75	20.88	17.60	19.11	17.94	15.77
Sargan Statistic (P-values)	0.4067	0.9829	0.8128	0.7831	0.6427	0.6743

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

Source: Author's own calculation

The results in table 4.3 reveal a positive and significant relationship between innovation and employment growth. Categorically, product and process innovation each have a positive and significant effect on a firm's employment growth. The positive effect on employment growth resulting from process innovation may imply that firms engage in new processes that do not destruct job creation (or are not labor saving) but instead entail an increase in the number of employees. On the other hand, the positive significant relationship between product innovation and employment growth may suggest an increase in the demand of a firm's new products where a firm may require an increase in the factor inputs with labor inclusive in order to meet the increasing demand. Furthermore, the results show that firms that engage in both product and process innovation realize slightly higher growth in employment as compared to firms that only engage in product or process innovation therefore confirming the complementarity effect of product and process innovation on employment growth. These findings are in line with existing literature particularly; Gebreeyesus (2009) for firms in Ethiopia and Bishop et al.(2009).In contrast, the results differ partly from Goedhuys and Sleuwaegen (2010) and Benavente & Lauterbach (2008)who only found product innovation to positively and significantly impact on employment growth.

In regard to firm resource indicators, the results in the table show that the relationship between formal training and employment growth is statistically insignificant. This result is similar for the relationship between access to finance and employment growth. Conversely, table 4.3 further reveals that the coefficients of all the interaction terms between the combined innovation effort, product and process innovation with formal training and access to finance are all positive and statistically significant. Consistent with Gebreeyesus (2009),firms that offer formal training to their employees and engage in either product or process innovation or a combination of both types of innovation do grow faster in terms of

employment as compared to those firms that offer formal training to their employees but do not engage in any of the two types of innovation. Likewise, firms that have access to finance and also engage in product and process innovation or either of the two types of innovation experience faster growth in employment in comparison to those firms with access to finance but are unable to engage in either of the two types of innovation considered.

Regarding other control firm characteristic variables like firm age, formality, ownership, international quality certificate and the use of ICT, the results reveal that firm age and employment growth are inversely related as indicated by the negative and statistically significant coefficient for firm age. In other words, younger firms experience significantly faster growth in employment as compared to older firms. This finding implies that young firms are critical for higher job creation rates than older firms and it's in support of earlier findings from Ayyagari et al. (2011); Calvo (2006) and Gebreeyesus (2009) who argue that young firms employ a large share of workers and create more jobs in developing countries than mature firms. Additionally, the results affirm that firms that have an international quality certificate experience faster employment growth compared to those without an international quality certificate. This finding may be attributed to the increased demand followed by the improved quality of a firm's products or services which may necessitate an increase in the employment shares as a unit input to meet the demand growth.

On the other hand, the results show that the use of ICT is negative and significantly associated with employment growth. Consistent with the findings for Zysman and Kenney (2018) and Autor and Salomons (2018), this result suggests that ICT use among firms results into labor saving effects. This may be the case if ICT use entails further improved transformations within the firm's production processes which although may positively impact on productivity growth inform of higher technical efficiency, negatively impacts on employment growth, for example in financial institutions where bank tellers are substituted

with Automated Teller Machines (ATMs) and also the various online marketing platforms like Jumia, Ebay, Amazon and Uber which have led to the exit of a number of retail outlets thus negatively impacting on employment growth. However, this finding is contrary to that of Biagiand Falk (2017) who found the relationship between ICT use and employment growth neutral as well as Bessen (2018) who found ICT use to have positive effects on employment growth with this relationship being driven by the rapid demand growth of the firms' product or services.

In reference to business environment control variables, the results show that firms which reported competition from the informal or unregistered firms as an obstacle do experience a decline in employment growth. This finding is parallel to that of Fowowe (2017) and Dinh et al. (2010) in their study for the binding constraints of firm growth in developing countries who also found a negative effect of competition on employment growth. In addition, firms that reported to have electricity outages or unreliable electricity realized a decline in employment growth. This finding is in line with that of Aterido et al. (2011) who also indicate that a weak business environment characterized by poor infrastructure (measured using electricity outages) tends to hurt employment growth of a firm.

4.2.3 Innovation and productivity growth

Table 4.4 below reports the regression results for the effect of innovation on productivity growth.

Table 4. 4: 2SLS results for the effect of innovation on productivity growth

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	0.195***			0.189**		
	(0.074)			(0.075)		
Product innovation (1=yes)		0.148***			0.085	
		(0.056)			(0.063)	
Process innovation (1=yes)			0.156**			0.100
			(0.061)			(0.073)
Interaction variables						
Innov X formal training				0.012		
				(0.007)		
Innov X finance				0.007		
				(0.005)		
Prodinnov X formal training					0.114**	
					(0.048)	
Prodinnov X finance					0.013*	
					(0.008)	
Procinnov X formal training						0.117**
						(0.055)
Procinnov X finance						0.009
						(0.007)
Firm resources						
Formal training (1=yes)	0.009**	0.007*	0.007*	0.009	0.065**	0.077**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.029)	(0.038)
Finance (1=yes)	0.013*	0.012	0.010	0.016	0.011*	0.014*
	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Firm characteristics						
Firm age (in logs)	0.006	0.005	0.008*	0.005	0.004	0.008
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Firm Ownership (1= foreign)	0.006	0.008	0.009	0.006	0.008	0.007
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Int.qualitycert (1=yes)	0.019***	0.017***	0.018***	0.018***	0.016**	0.016***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
ICT use (1=yes)	0.041**	0.001	0.001	0.041**	0.003	0.004
	(0.017)	(0.005)	(0.005)	(0.017)	(0.005)	(0.005)
Business environment constraints						
Corruption	-0.000	0.004	0.005	-0.000	0.000	0.000
	(0.000)	(0.005)	(0.005)	(0.000)	(0.000)	(0.000)
Tax admin (1=Yes)	0.001	-0.009*	0.004	0.001	-0.006	0.006
	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Tax rate (1=Yes)	-0.004	-0.003	-0.004	-0.004	-0.003	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Competition (1=Yes)	0.002	-0.013*	-0.007	0.002	-0.009	-0.004
	(0.004)	(0.008)	(0.006)	(0.004)	(0.008)	(0.006)
Electricity (1=Yes)	-0.007*	-0.008**	-0.007*	-0.008**	-0.008**	-0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Constant	1.625***	1.705***	1.651***	1.627***	1.740***	1.690***
	(0.058)	(0.035)	(0.049)	(0.059)	(0.037)	(0.054)
Country effects	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,030	2,000	2,048	1,996	2,000	2,048
R-squared	0.040	0.051	0.041	0.044	0.059	0.051
Durbin-Wu-Hausman test (DWH)	0.0096	0.0088	0.0087	0.0104	0.0116	0.0107
First stage F-statistic	22.75	20.88	17.60	19.11	17.94	15.77
Sargan Statistic (P-values)	0.6347	0.4535	0.1557	0.4261	0.6879	0.2933

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

Source: Author's own calculation

The results in table 4.4 show that product and process innovation are positively and significantly associated with firms' productivity growth. The positive effect of process innovation on productivity growth is comparatively higher than that of product innovation. The positive and significant effect of process innovation on productivity growth may imply a firm's ability of using process innovation to improve its efficiency by either reducing its lead time or cost of production. In contrast, the positive effect of product innovation on productivity growth may rather relate to firm specific demand variations where a firm experiences an outward shift in its demand curve with respect to its new product. The results also show that significantly higher productivity growth is exhibited by firms that engage in both product and process innovation. This implies the presence of complementarity effect of product and process innovation on productivity growth. These results are consistent with other studies in LICs for example; Fu et al. (2017) for firms in Ghana and Cirera et al. (2016) for firms in DRC, Tanzania, Uganda and Zambia but not in Kenya and Ghana.

With respect to firm level resource indicators of the quality of human capital and finance, the results confirm that formal training of employees is positively and significantly related to productivity growth. Consistent with previous findings from Malaolu and Ogbuabor (2013) and Konings and Vanormelingen (2015) on formal training and productivity growth, this result suggests that firms which offer formal training to their full time or permanent workers achieve higher productivity growth as compared to those firms that do not formally train their employees. This might be explained by the fact that formal training enables employees to acquire knowledge and skills necessary to adapt to technological changes and any other changes within the firms thus making employees more efficient. Furthermore, the coefficients of the interaction terms between formal training with product and process innovation are also positive and significant at 95 percent level of confidence. This finding suggests that firms that offer formal training to their employees and engage in either product

or process innovation realize high productivity growth compared to firms that only offer formal training to their employees without engaging in either product or process innovation. These results may imply that employees who obtain formal training are equipped with all the necessary skills and knowledge which enable them to perform better and easily cope with any existing changes in the firm regarding either product or process innovation. These results are however in contrast with those of Goedhuys et al. (2008) who found that training of employees had no impact on productivity growth for firms in Tanzania.

Also, the coefficient for access to finance is positive and significant at 90 percent level of confidence implying that firms that have access to finance or credit markets achieve higher productivity growth compared to their counterparts. This result is similar to that of Nichter and Goldmark (2009); Olawale and Garwe (2010) and Goedhuys et al. (2008) for their study in Tanzania and it implies that credit constrained firms may not be in position to make investments in improved technology or physical equipment which might be required to enhance efficiency. Similarly, the results show that the coefficient for the interaction term between product innovation and access to finance is positive and significant. This suggests that firms that engage in product innovation and have access to finance experience faster productivity growth as compared to firms that can access finance but without engaging in any innovative activities.

In relation to firm characteristics, the results in table 4.4 reveal that coefficient on international quality certificate is positive and statistically significant which suggests that firms that have an international quality certificate achieve higher productivity growth than their counterparts. This result is in support of findings from Goedhuys and Sleuwaegen., (2016, 2013); Fernandes (2008) and it may imply that international quality certificates are vital in improving a firm's operational efficiency since they ensure the use of internationally recognized technical standards and encourage firms to obtain improved technology in order

to secure competitive advantage on global markets. Goedhuys and Sleuwaegen (2016) note that firms in possession of international quality certificates are able to raise productivity and adhere to international standards, which enables them to reduce the uncertainty associated with entering foreign markets. Furthermore, the use of ICT is positive and significantly associated with productivity growth. Consistent with Cirera et al. (2016) who study the link between ICT use, innovation and productivity in Sub-Saharan Africa, this result suggests that firms that use ICT experience faster productivity growth compared to those firms that do not use ICT. The positive effect of ICT use on productivity growth may indicate that ICT enables firms to improve efficiency. This maybe inform of reduced operating costs and improved firms' ability to respond flexibly to new market opportunities.

In considering business environment control variables, the results in the table show that the coefficient on tax administration is negative and statistically significant at 90 percent level of confidence (see Model 2).This result highlights that firms which reported tax administration as an obstacle certainly face declining productivity growth. A possible explanation for the negative effect of tax administration on productivity growth could be because of the heavy bureaucratic custom practices that tend to increase time and the cost of trade (Gelb et al. 2011). Furthermore, firms that experience competition from informal or unregistered firms realize a decline in productivity growth as it is evident from the negative and statistically significant coefficient on competition in table 4.4 (Model 2).This result may reflect the fact that informal firms are able to escape from high transaction costs like taxes which are imposed by the government which eventually contributes to their high productivity and efficiency (Saunoris, 2018). In agreement with the findings of Fernandes (2008) while relating firm productivity and infrastructural bottlenecks, the results show that firms which reported to have experienced electricity outages or unreliable power face a decline in productivity growth. The reason for the declining productivity growth may be as a result of

most of the firms using energy intensive modes of production where even the possible alternatives like the use of generators tend to be costly.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.0 Introduction

This chapter summarizes the present research and gives policy recommendations based on the findings. The chapter contains three sections; section 5.1 presents the summary of the study; policy recommendations are given in section 5.2 while section 5.3 gives recommendations for future research.

5.1 Conclusion

The major aim of this research was to contribute to a limited body of literature on the effect of innovation on firm growth in East Africa and also guide in the effective design and implementation of micro policies targeting innovation and firm growth. Particularly, with innovation as the main variable of interest in the firm growth equation, this study sought to ascertain whether firms that introduced new products or processes reap higher growth in form of sales, employment and productivity. Three specific objectives were addressed in this research, that is; a) to show whether product and process innovation independently impacted on firm growth; b) to examine if there were any complementarity effects between product and process innovation on firm growth; and c) to test for the interaction effects between innovation and firm level resources of finance and quality of human capital on firm growth.

While using the WBES dataset merged for five East African countries, this research extended the CDM structural model to address the study objectives. The research findings highlight the role of innovation on firm growth. Specifically, the results reveal that product innovation and process innovation each have a positive and significant relationship across the three proxies for firm growth. Therefore, the first hypothesis, H1 of the study which suggests that product

and process innovation positively and independently impact on firm growth finds support. However, the results reveal that the impact of product and process innovation is much stronger on sales growth compared to employment and productivity growth. In addition, there is evidence of complementarity effect of product and process innovation across the three firm growth indicators considered in the study. This finding supports the second hypothesis, H2 of the study and implies that firms that combine product and process innovation realize faster growth compared to those firms that only engage in either of the two types of innovation. Furthermore, the findings indicate that the interaction of innovation and firm resources (quality of human capital measured through formal training and finance) has positive and significant effects on the three firm growth indicators of sales, employment and productivity growth. As a result, the third hypothesis of the study also finds support. Therefore product and process innovation enhance the firm's ability to gain more from their resources. This finding provides evidence that resources may be necessary but not sufficient for firms to experience substantial growth. Essentially, for firms to reap higher growth benefits, they need to combine their resources with innovation in order to achieve higher growth.

While controlling for firm characteristics, the results reveal that younger firms significantly grow faster than older firms and that firms in possession of an international quality certificate also experience growth in terms of sales, employment and productivity. The findings reveal that much as ICT use may enhances a firm's productivity and sales growth, it may result in job destruction as evidence from the research points to a negative relationship between ICT use and employment growth. Finally, when considering the impact of business environment control variables on the three indicators of firm growth, the findings of the study show that a poor business environment characterized by poor tax administration systems, competition

from the informal firms and regular electricity outages or unreliable power heavily costs firms by deterring sales, employment and productivity growth.

5.2 Policy Recommendations

The research findings provide new insights that are critical for appropriate policy formulation both at firm and government level to support growth of firms in East Africa. Based on the evidence from this research that innovation plays an important role in improving firm growth in East Africa, there is need for innovation support policies that mainly aim at fostering product and process innovation among firms. For example government policies which focus on R&D investments and also policies targeting the development and strengthening of linkages between different research institutions and firms. This is imperative in promoting knowledge spillovers from R&D thus enabling firms to benefit in terms of identifying, assimilation and exploitation of knowledge which can be transformed into new products and processes.

The results reveal that for firms to grow, they must overcome credit constraints. Therefore, this calls for policies aimed at overcoming obstacles in obtaining finance as well as making financial services accessible and affordable through viable credit mechanisms to support and strengthen the capacity of firms. In addition, policies promoting the quality of human capital especially through education and formal training are important to meet specific human capital needs of firms. Such policies may include; investment in improved educational systems that aim at upgrading skills of workers as per firms' needs; developing and strengthening training institutions. Furthermore, government policies should strongly focus on young firms since they exhibit more growth opportunities compared to older firms as suggested by the research findings. The results also justify the need for policies aimed at facilitating the adoption of ICT among firms. Such policies may be tailored to strengthen

technological infrastructure by the governments. These policies are vital because the use of ICT enables knowledge spillovers and boosts the absorptive capacity thus encouraging innovativeness among firms.

Government policy makers should also focus on improving the environment within which firms operate. Targeted policy actions to combat the poor tax administration system reported to be an obstacle for firm growth are critical. Such policies may entail reforming the current regulatory tax systems with an aim of promoting transparency and less bureaucratic procedures. Lastly, government policy is also required to improve the provision of reliable power since the study findings suggest that regular electricity outages constrain firm growth.

5.3 Further areas of research

This study mainly focuses on the impact of innovation on firm growth in East Africa using cross-sectional data. This brings about methodological limitations in terms of the inability to directly draw conclusions through a casual inference. Therefore, with the availability of longitudinal data, a similar study may be relevant to examine the causal effects of innovation on firm growth to guide in a more insightful design of policies for firm growth. In addition, future research studies may complement quantitative data on this study topic with qualitative methodological approach like in-depth firm case studies. This is necessary to generate a much deeper understanding on the relationship between different variables especially the subjective ones on the firm growth indicators. This is because present data on some constructs does not provide sufficient information.

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APPENDICES

Appendix A: Variable definition

Variable name	Unit	Description
Dependent variables		
Sales growth	Continuous	This is relative sales growth computed as a firm's sales in the last fiscal year (based on the period of the survey) minus sales 3 fiscal years ago divided by sales 3 fiscal years ago.
Employment growth	Continuous	Computed as the difference between the number of full time permanent workers in the last fiscal year (based on the period of the survey) and the number of full time permanent workers in the last 3 fiscal years.
Productivity growth	Continuous	This is a quotient (sales per employee) generated from sales and employment growth representing relative labor productivity growth.
Independent variables		
Product innovation	Dummy	Defined as the introduction of a new or significantly improved product or service in the last fiscal year; taking on a value of '1' if the firm introduced a new product and zero otherwise.
Process innovation	Dummy	Described as to whether the firm introduced a new process in production; taking on a value of '1' if the firm introduced a new process and zero otherwise.
Combined product & process	Dummy	Refers to whether a firm introduced both a new product and process in the last fiscal year; taking on a value of '1' if the firm introduced both a new product and process.
Firm resources		
Formal training	Dummy	Takes on the value of '1' if the firm had formal training programs for its full time employees in the last fiscal years.
Access to finance	Dummy	Defined as to whether a firm has access to finance inform of loans or credit taking on a value of '1' if the firm has access to finance and '0' otherwise.
Control variables		
Firm characteristics		
Age	Continuous	This calculated as the difference between the year the survey was taken in each country and the year when the firm began its operations.
Size	Dummy	This is generated from the number of full time permanent employees and is categorized into small (below 20 employees), medium (20-99 employees) and large (more than 99 employees).
Formality	Dummy	Described as whether the firm was formally registered when it started its operation and takes on the value of '1' for registered firms and '0' for those not registered.
Ownership	Dummy	Defined as to whether the firm is owned by a foreign individual taking on a value of '1' or domestically owned with a value of '0'.
Quality certificate:	Dummy	Refers to whether a firm has an internationally-recognized quality certificate with values of '1' for firms with a quality certificate and '0'

Appendix A: Variable definition

Variable name	Unit	Description
		for those firms without the quality certificate.
ICT use	Dummy	Takes on the value of '1' if the firm has its own website or zero otherwise
Research & development	Dummy	Defined as to whether the firm spent on R&D in the previous fiscal year taking on the value of '1' if the firm spent on R&D and '0' if the firm did not spend on R&D.
Business characteristics		
Corruption	Continuous	Defined as the percentage of total annual sales paid in informal payments to public officials
Tax admin	Dummy	Relates to whether tax administration is an obstacle to firms and takes on the value of '1' for those who reported tax administration as an obstacle and '0' otherwise
Tax rate	Dummy	This relates to whether tax rate is an obstacle to firms and takes on the value of '1' for those who reported tax rate as an obstacle and '0' otherwise
Competition	Dummy	Asks firms whether they face any competition from informal or unregistered firms. In the study, competition takes on a value of '1' if the firm faces any competition from the informal firms and zero otherwise.
Electricity	Dummy	Measures whether firms experienced any power outage in the last fiscal year prior to the survey, taking on the value of '1' is a firm experienced any obstacles and zero otherwise.
Other variables		
Sector	Dummy	Two sectors are considered in the study. That is; the manufacturing sector taking on the value of '1' and service sector which takes on the value of '0'.
Country	Dummy	Defined as the country dummy with Uganda taking on a value of '0' while Kenya, Tanzania, Rwanda and Burundi taking on a value of '1'.

Appendix B1: Descriptive disaggregated statistics for countries considered

Country	Variable	N	Mean	SD	Min	Max
	Sales growth	760	0.145	0.296	-0.375	7.325
	Employment growth	760	0.067	0.281	-1.000	2.079
	Productivity growth	761	0.002	4.770	-131.244	2.503
	Combined prod&proc	748	0.610	0.488	0	1
	Product innovation	760	0.645	0.479	0	1
	Process innovation	748	0.729	0.445	0	1
	Firm age	762	14.601	10.288	1	86
	R&D	748	0.279	0.449	0	1
	Formal training	755	0.317	0.465	0	1
	Access to finance	684	0.290	0.406	0	1
	ICT	751	0.221	0.415	0	1
	Formality	727	0.622	0.485	0	1
	ownership	741	0.143	0.350	0	1
	Int quality cert	697	0.189	0.392	0	1
	Corruption	755	0.784	0.412	0	1
	Tax administration	760	0.761	0.427	0	1
	Tax rate	762	0.706	0.456	0	1
	Competition	709	0.879	0.327	0	1
	Electricity	760	0.782	0.413	0	1
Uganda	Sector	762	0.580	0.494	0	1
Country	**Variable**	**N**	**Mean**	**SD**	**Min**	**Max**
	sales growth	157	0.152	0.085	-0.065	0.599
	employment growth	157	0.078	0.209	-0.406	1.465
	productivity growth	157	0.184	0.117	-0.099	0.829
	combined prod&proc	157	0.408	0.493	0	1
	product innovation	157	0.465	0.500	0	1
	process innovation	157	0.675	0.470	0	1
	firm age	157	15.083	13.729	1	87
	R&D	157	0.223	0.418	0	1
	Formal training	157	0.312	0.465	0	1
	Access to finance	156	0.040	0.487	0	1
	ICT	157	0.166	0.373	0	1
	Formality	157	0.834	0.373	0	1
	ownership	156	0.199	0.400	0	1
	Int quality cert	152	0.066	0.249	0	1
	corruption	154	0.818	0.387	0	1
	tax administration	157	0.841	0.367	0	1
	tax rate	157	0.274	0.447	0	1
	competition	141	0.582	0.495	0	1
	electricity	153	0.843	0.365	0	1
Burundi	Sector	157	0.624	0.486	0	1
Country	**Variable**	**N**	**Mean**	**SD**	**Min**	**Max**
	sales growth	781	0.133	0.129	-0.262	1.213
	employment growth	774	0.032	0.198	-0.633	1.335
	productivity growth	779	0.176	0.195	-0.347	2.043
	combined prod&proc	759	0.618	0.486	0	1
	product innovation	775	0.679	0.467	0	1
	process innovation	762	0.785	0.411	0	1
Kenya	firm age	781	22.762	17.785	1	107

	R&D	773	0.309	0.462	0	1
	Formal training	775	0.434	0.496	0	1
	Access to finance	742	0.380	0.488	0	1
	ICT	781	0.493	0.500	0	1
	formality	763	0.920	0.271	0	1
	ownership	715	0.113	0.317	0	1
	Int quality cert	734	0.292	0.455	0	1
	corruption	769	0.711	0.453	0	1
	tax administration	773	0.679	0.467	0	1
	tax rate	781	0.777	0.416	0	1
	competition	749	0.573	0.495	0	1
	electricity	778	0.895	0.307	0	1
	Sector	781	0.519	0.500	0	1
Country	**Variable**	**N**	**Mean**	**SD**	**Min**	**Max**
	Sales growth	241	0.148	0.127	-0.108	1.402
	Employment growth	238	0.107	0.356	-1.000	3.585
	Productivity growth	241	0.181	0.240	-0.130	2.927
	Combined prod&proc	241	0.556	0.498	0	1
	Product innovation	241	0.614	0.488	0	1
	Process innovation	241	0.817	0.387	0	1
	Firm age	241	11.228	9.881	1	52
	R&D	240	0.308	0.463	0	1
	Formal training	241	0.577	0.495	0	1
	Access to finance	231	0.071	0.501	0	1
	ICT	241	0.373	0.485	0	1
	Formality	240	0.883	0.322	0	1
	Ownership	239	0.213	0.411	0	1
	Int quality cert	226	0.137	0.345	0	1
	Corruption	235	0.421	0.495	0	1
	Tax administration	240	0.704	0.457	0	1
	Tax rate	241	0.743	0.438	0	1
	Competition	220	0.541	0.499	0	1
	Electricity	238	0.689	0.464	0	1
Rwanda	Sector	241	0.689	0.464	0	1
Country	**Variable**	**N**	**Mean**	**SD**	**Min**	**Max**
	Sales growth	813	0.115	0.110	-0.256	0.970
	Employment growth	755	0.170	0.598	-1.000	5.209
	Productivity growth	790	0.124	0.200	-0.528	2.406
	Combined prod&proc	784	0.448	0.498	0	1
	Product innovation	808	0.520	0.500	0	1
	Process innovation	786	0.598	0.491	0	1
	Firm age	813	15.346	10.784	1	96
	R&D	803	0.167	0.373	0	1
	Formal training	793	0.295	0.456	0	1
	Access to finance	752	0.210	0.390	0	1
	ICT	799	0.268	0.443	0	1
	Formality	773	0.700	0.459	0	1
	Ownership	771	0.075	0.264	0	1
	Int quality cert	776	0.222	0.416	0	1
	Corruption	729	0.859	0.349	0	1
Tanzania	Tax administration	759	0.843	0.364	0	1

	Tax rate	813	0.555	0.497	0	1
	Competition	760	0.645	0.479	0	1
	Electricity	805	0.825	0.380	0	1
	Sector	813	0.609	0.488	0	1

Appendix B2: Sales growth correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Sales growth	1																				
2. Combinedprod&proc	0.05*	1																			
3. Product innovation	0.04*	0.89*	1																		
4. Process innovation	0.05*	0.70*	0.53*	1																	
5.Formal training	0.09*	0.30*	0.27*	0.28*	1																
6.Access finance	0.06*	0.13*	-0.14*	-0.14*	-0.15*	1															
7.Firm age	0.05*	0.07*	0.07*	0.02	-0.02	0.03	1														
8.Formality	0.02	0.12*	0.10*	0.13*	0.17*	-0.11*	0.09*	1													
9.Ownership	0.11*	0.05*	0.03	0.05*	0.10*	-0.04	-0.08*	0.13*	1												
10.Fsize (2=medium)	0.04*	0.10*	0.09*	0.12*	0.06*	-0.12*	-0.01	0.15*	0.07*	1											
11.Fsize (3=large)	0.26*	0.12*	0.12*	0.11*	0.21*	-0.16*	0.08*	0.15*	0.17*	-0.26*	1										
12.Intqualitycert	0.15*	0.18*	0.17*	0.17*	0.25*	-0.13*	0.13*	0.15*	0.21*	0.06*	0.36*	1									
13.R&D	0.07	0.28*	0.27*	0.25*	0.30*	-0.19*	0.03	0.12*	0.12*	0.06*	0.23*	0.21*	1								
14.ICT use	0.11*	0.23*	0.21*	0.22*	0.27*	-0.14*	0.14*	0.25*	0.21*	0.17*	0.33*	0.44*	0.28*	1							
15. Corruption	0.02	0.05*	0.04*	0.002	-0.04	0.03	0.10*	-0.06*	-0.07*	-0.02	-0.03	-0.03	-0.01	-0.08*	1						
16.Tax admin	-0.01	0.03	0.05*	-0.01	-0.06*	0.04	-0.06*	-0.06*	-0.01	-0.03	-0.01	-0.01	-0.02	-0.05*	0.35*	1					
17.Tax rate	-0.02	-0.01	0.01	-0.015	0.01	-0.01	0.10*	-0.02	-0.04	0.002	-0.01	-0.01	0.02	0.02	-0.22*	-0.27*	1				
18.Competition	-0.02	0.08*	0.09*	0.044*	0.01	0.04*	-0.03	-0.07*	-0.07*	-0.06*	-0.10*	-0.08*	-0.01	-0.10*	0.079*	0.02	-0.03	1			
19.Electricity	0.003	0.08*	0.08*	0.06*	0.02	-0.04*	0.14*	0.13*	0.06*	0.03	0.07*	0.08*	0.04*	0.13*	0.03	0.06*	-0.02	0.12*	1		
20.Country	0.019	-0.08	-0.05	-0.024	0.06*	-0.13*	0.11*	0.21*	-0.03	0.05*	0.08*	0.04*	-0.04	0.14*	-0.05*	-0.001	-0.06*	-0.27*	0.07*	1	
21.Sector	0.06*	-0.05	-0.05	-0.07*	-0.04*	0.11*	-0.10*	0.04	-0.07*	-0.06*	-0.19*	-0.13*	-0.08*	-0.08*	-0.08*	-0.07*	0.07*	0.08*	-0.06*	0.004	1

Source: Author's own calculation

Appendix B3: Employment growth correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Employment growth	1.00																				
2. Combinedprod&proc	0.06*	1																			
3. Product innovation	0.05*	0.89*	1																		
4. Process innovation	0.05*	0.70*	0.53*	1																	
5.Formal training	0.08*	0.30*	0.27*	0.28*	1																
6.Access finance	-0.03	0.13*	-0.14*	-0.14*	-0.15*	1															
7.Firm age	-0.06*	0.07*	0.07*	0.02	-0.02	0.03	1														
8.Formality	0.05*	0.12*	0.10*	0.13*	0.17*	-0.11*	0.09*	1													
9.Ownership	0.09*	0.05*	0.03	0.05*	0.10*	-0.04	-0.08*	0.13*	1												
10.Fsize (2=medium)	-0.05*	0.10*	0.09*	0.12*	0.06*	-0.12*	-0.01	0.15*	0.07*	1											
11.Fsize (3=large)	0.33*	0.12*	0.12*	0.11*	0.21*	-0.16*	0.08*	0.15*	0.17*	-0.26*	1										
12.Intqualitycert	0.15*	0.18*	0.17*	0.17*	0.25*	-0.13*	0.13*	0.15*	0.21*	0.06*	0.36*	1									
13.R&D	0.06	0.28*	0.27*	0.25*	0.30*	-0.19*	0.03	0.12*	0.12*	0.06*	0.23*	0.21*	1								
14.ICT use	0.15*	0.23*	0.21*	0.22*	0.27*	-0.14*	0.14*	0.25*	0.21*	0.17*	0.33*	0.44*	0.28*	1							
15. Corruption	-0.05*	0.05*	0.04*	0.002	-0.04	0.03	0.10*	-0.06*	-0.07*	-0.02	-0.03	-0.03	-0.01	-0.08*	1						
16.Tax admin	-0.003	0.03	0.05*	-0.01	-0.06*	0.04	-0.06*	-0.06*	-0.01	-0.03	-0.01	-0.01	-0.02	-0.05*	0.35*	1					
17.Tax rate	0.03	-0.01	0.01	-0.015	0.01	-0.01	0.10*	-0.02	-0.04	0.002	-0.01	-0.01	0.02	0.02	-0.22*	-0.27*	1				
18.Competition	-0.03	0.08*	0.09*	0.044*	0.01	0.04*	-0.03	-0.07*	-0.07*	-0.06*	-0.10*	-0.08*	-0.01	-0.10*	0.079*	0.02	-0.03	1			
19.Electricity	0.02	0.08*	0.08*	0.06*	0.02	-0.04*	0.14*	0.13*	0.06*	0.03	0.07*	0.08*	0.04*	0.13*	0.03	0.06*	-0.02	0.12*	1		
20.Country	0.02	-0.08	-0.05	-0.024	0.06*	-0.13*	0.11*	0.21*	-0.03	0.05*	0.08*	0.04*	-0.04	0.14*	-0.05*	-0.001	-0.06*	-0.27*	0.07*	1	
21.Sector	-0.07*	-0.05	-0.05	-0.07*	-0.04*	0.11*	-0.10*	0.04	-0.07*	-0.06*	-0.19*	-0.13*	-0.08*	-0.08*	-0.08*	-0.07*	0.07*	0.08*	-0.06*	0.004	1

Source: Author's own calculation

Appendix B4: Productivity growth correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Productivity growth	1.00																				
2. Combinedprod&proc	0.05*	1																			
3. Product innovation	0.04*	0.89*	1																		
4. Process innovation	0.04*	0.70*	0.53*	1																	
5.Formal training	0.08*	0.30*	0.27*	0.28*	1																
6.Access finance	-0.05*	0.13*	-0.14*	-0.14*	-0.15*	1															
7.Firm age	0.05*	0.07*	0.07*	0.02	-0.02	0.03	1														
8.Formality	0.01	0.12*	0.10*	0.13*	0.17*	-0.11*	0.09*	1													
9.Ownership	0.10*	0.05*	0.03	0.05*	0.10*	-0.04	-0.08*	0.13*	1												
10.Fsize (2=medium)	-0.04	0.10*	0.09*	0.12*	0.06*	-0.12*	-0.01	0.15*	0.07*	1											
11.Fsize (3=large)	0.23*	0.12*	0.12*	0.11*	0.21*	-0.16*	0.08*	0.15*	0.17*	-0.26*	1										
12.Intqualitycert	0.13*	0.18*	0.17*	0.17*	0.25*	-0.13*	0.13*	0.15*	0.21*	0.06*	0.36*	1									
13.R&D	0.07	0.28*	0.27*	0.25*	0.30*	-0.19*	0.03	0.12*	0.12*	0.06*	0.23*	0.21*	1								
14.ICT use	0.10*	0.23*	0.21*	0.22*	0.27*	-0.14*	0.14*	0.25*	0.21*	0.17*	0.33*	0.44*	0.28*	1							
15. Corruption	0.02	0.05*	0.04*	0.002	-0.04	0.03	0.10*	-0.06*	-0.07*	-0.02	-0.03	-0.03	-0.01	-0.08*	1						
16.Tax admin	0.01	0.03	0.05*	-0.01	-0.06*	0.04	-0.06*	-0.06*	-0.01	-0.03	-0.01	-0.01	-0.02	-0.05*	0.35*	1					
17.Tax rate	-0.02	-0.01	0.01	-0.015	0.01	-0.01	0.10*	-0.02	-0.04	0.002	-0.01	-0.01	0.02	0.02	-0.22*	-0.27*	1				
18.Competition	-0.01	0.08*	0.09*	0.044*	0.01	0.04*	-0.03	-0.07*	-0.07*	-0.06*	-0.10*	-0.08*	-0.01	-0.10*	0.079*	0.02	-0.03	1			
19.Electricity	-0.002	0.08*	0.08*	0.06*	0.02	-0.04*	0.14*	0.13*	0.06*	0.03	0.07*	0.08*	0.04*	0.13*	0.03	0.06*	-0.02	0.12*	1		
20.Country	0.01	-0.08	-0.05	-0.024	0.06*	-0.13*	0.11*	0.21*	-0.03	0.05*	0.08*	0.04*	-0.04	0.14*	-0.05*	-0.001	-0.06*	-0.27*	0.07*	1	
21.Sector	-0.05*	-0.05	-0.05	-0.07*	-0.04*	0.11*	-0.10*	0.04	-0.07*	-0.06*	-0.19*	-0.13*	-0.08*	-0.08*	-0.08*	-0.07*	0.07*	0.08*	-0.06*	0.004	1

Source: Author's own calculation

Appendix C1: OLS estimation results for sales growth and Innovation

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	1.014**			1.000**		
	(0.420)			(0.431)		
Product innovation (1=yes)		1.179***			0.673**	
		(0.262)			(0.265)	
Process innovation (1=yes)			0.866***			0.300
			(0.240)			(0.261)
Interaction variables						
Innov X formal training				0.111*		
				(0.058)		
Innov X finance				0.048		
				(0.037)		
Prodinnov X formal training					0.999***	
					(0.380)	
Prodinnov X finance					0.116*	
					(0.060)	
Procinnov X formal training						1.299***
						(0.437)
Procinnov X finance						0.100*
						(0.052)
Firm resources						
Formal training (1=yes)	0.068**	0.049	0.059*			
	(0.033)	(0.032)	(0.032)			
Finance (1=yes)	0.059	0.094**	0.044			
	(0.053)	(0.047)	(0.043)			
Firm characteristics						
Firm age (in years)	0.063*	0.037	0.073**	0.058	0.029	0.067*
	(0.037)	(0.038)	(0.036)	(0.038)	(0.038)	(0.037)
Firm Ownership (1= foreign)	0.100	0.084	0.108	0.100	0.077	0.094
	(0.072)	(0.072)	(0.069)	(0.074)	(0.072)	(0.069)
Int.qualitycert (1=yes)	0.178***	0.156***	0.164***	0.170***	0.147***	0.156***
	(0.048)	(0.050)	(0.048)	(0.049)	(0.050)	(0.048)
ICT use (1=yes)	0.194*	0.013	0.003	0.199*	0.017	0.011
	(0.102)	(0.038)	(0.038)	(0.106)	(0.038)	(0.038)
Business environment constraints						
Corruption	-0.001	-0.001	-0.000	-0.000	-0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tax admin (1=Yes)	-0.015	-0.082*	0.012	-0.015	-0.081*	0.008
	(0.040)	(0.043)	(0.040)	(0.040)	(0.043)	(0.040)
Tax rate (1=Yes)	-0.041	-0.029	-0.038	-0.038	-0.033	-0.046
	(0.034)	(0.034)	(0.033)	(0.034)	(0.033)	(0.033)
Competition (1=Yes)	0.024	-0.099**	-0.022	0.025	-0.080*	-0.005
	(0.033)	(0.046)	(0.037)	(0.033)	(0.045)	(0.038)
Electricity (1=Yes)	-0.053*	-0.063**	-0.057**	-0.058**	-0.062**	-0.058**
	(0.028)	(0.027)	(0.027)	(0.028)	(0.028)	(0.027)
Constant	12.690***	12.968***	12.813***	12.684***	13.232***	13.152***
	(0.366)	(0.224)	(0.251)	(0.370)	(0.228)	(0.255)
Country	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,032	2,002	2,050	1,998	2,002	2,050
R-squared	0.048	0.059	0.052	0.052	0.068	0.062
Robust standard errors in parentheses			*** p<0.01, ** p<0.05, * p<0.1			

Source: Author's own calculation

Appendix C2: OLS estimation results for employment growth and Innovation

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	0.023			0.022		
	(0.016)			(0.017)		
Product innovation (1=yes)		0.049***			0.038***	
		(0.010)			(0.012)	
Process innovation (1=yes)			0.040***			0.030***
			(0.008)			(0.010)
Interaction variables						
Innov X formal training				0.002*		
				(0.001)		
Innov X finance				0.003**		
				(0.001)		
Prodinnov X formal training					0.019	
					(0.012)	
Prodinnov X finance					0.003	
					(0.002)	
Procinnov X formal training						0.021
						(0.013)
Procinnov X finance						0.003
						(0.002)
Firm resources						
Formal training (1=yes)	0.001	0.000	0.001	-0.001		
	(0.001)	(0.001)	(0.001)	(0.001)		
Finance (1=yes)	0.002	0.005***	0.003**	0.003		
	(0.002)	(0.002)	(0.001)	(0.002)		
Firm characteristics						
Firm age (in years)	-0.004**	-0.005***	-0.004***	-0.004**	-0.006***	-0.004***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Firm Ownership (1= foreign)	0.003	0.001	0.002	0.003	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Int.qualitycert (1=yes)	0.003*	0.002	0.002	0.003*	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
ICT use (1=yes)	0.001	-0.002*	-0.002**	0.001	-0.002*	-0.002*
	(0.004)	(0.001)	(0.001)	(0.004)	(0.001)	(0.001)
Business environment constraints						
Corruption	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tax admin (1=Yes)	0.002*	-0.001	0.003***	0.002*	-0.001	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tax rate (1=Yes)	0.002*	0.002**	0.002*	0.002*	0.002**	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Competition (1=Yes)	0.000	-0.005***	-0.002*	0.000	-0.005***	-0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Electricity (1=Yes)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	7.604***	7.601***	7.594***	7.604***	7.606***	7.599***
	(0.010)	(0.006)	(0.007)	(0.011)	(0.008)	(0.009)
Country	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,030	2,000	2,048	1,996	2,000	2,048
R-squared	0.044	0.071	0.062	0.049	0.075	0.066

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

Appendix C3: OLS estimation results for Productivity growth and Innovation

VARIABLES	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Innovation						
Combined inn effort (1=yes)	0.123**			0.122**		
	(0.054)			(0.056)		
Product innovation (1=yes)		0.138***			0.080**	
		(0.034)			(0.034)	
Process innovation (1=yes)			0.099***			0.032
			(0.031)			(0.033)
Interaction variables						
Innov X formal training				0.012		
				(0.008)		
Innov X finance				0.007		
				(0.005)		
Prodinnov X formal training					0.116**	
					(0.048)	
Prodinnov X finance					0.013*	
					(0.008)	
Procinnov X formal training						0.157***
						(0.052)
Procinnov X finance						0.011*
						(0.007)
Firm resources						
Formal training (1=yes)	0.009**	0.007*	0.008**	0.000		
	(0.004)	(0.004)	(0.004)	(0.007)		
Finance (1=yes)	0.007	0.011*	0.005	0.010		
	(0.007)	(0.006)	(0.005)	(0.008)		
Firm characteristics						
Firm age (in years)	0.008*	0.005	0.009**	0.007	0.004	0.008*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Firm Ownership (1= foreign)	0.010	0.009	0.012	0.010	0.008	0.010
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)
Int.qualitycert (1=yes)	0.020***	0.017***	0.018***	0.019***	0.016***	0.017***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
ICT use (1=yes)	0.025*	0.003	0.001	0.026*	0.003	0.002
	(0.013)	(0.005)	(0.005)	(0.014)	(0.005)	(0.005)
Business environment constraints						
Corruption	-0.000	-0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tax admin (1=Yes)	0.002	-0.006	0.005	0.002	-0.006	0.005
	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
Tax rate (1=Yes)	-0.004	-0.003	-0.004	-0.004	-0.003	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Competition (1=Yes)	0.003	-0.011*	-0.002	0.003	-0.009	-0.000
	(0.004)	(0.006)	(0.005)	(0.004)	(0.006)	(0.005)
Electricity (1=Yes)	-0.007**	-0.008**	-0.008**	-0.008**	-0.008**	-0.008**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	1.676***	1.711***	1.694***	1.674***	1.742***	1.735***
	(0.048)	(0.029)	(0.033)	(0.048)	(0.029)	(0.032)
Country	YES	YES	YES	YES	YES	YES
ISIC effects	YES	YES	YES	YES	YES	YES
Observations	2,030	2,000	2,048	1,996	2,000	2,048
R-squared	0.041	0.051	0.044	0.045	0.059	0.054

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