ADOPTION, RETURNS AND VARIATION OF INFORMATION AND COMMUNICATION TECHNOLOGY IN SUB-SAHARA AFRICA

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Abstract

Increased competition in the modern economy has driven firms to search for increased efficiency, as well as an increased access to information. This, in conjunction with the continual advancement in information and communication technologies (ICTs), and coupled with falling prices, has inspired firms to adopt different types of ICTs in order to be competitive. This has heightened and provoked research interest in the effectiveness of ICT at the firm level. However, most studies on the use and effectiveness of ICTs in firm development have focused on developed economies, with mainly anecdotal evidence on many developing countries.

Using data collected on 3,996 small and medium enterprises (SMEs) across 14 Sub-Saharan African countries, the thesis examines the factors that motivate the adoption, usage and the contribution of ICTs to turnover of firms. The thesis uses a seemingly unrelated Bivariate Probit model and meta-analysis technique to determine the factors that influence SMEs decision to adopt ICT. We also employ two different production function specifications to ascertain the effect of ICT adoption on turnover of SMEs, as well as on technical efficiency. The effect of ICT on turnover is thoroughly examined also employing quantile regression technique to ascertain the productivity effect of ICT along the entire distribution. The thesis assesses the contribution of ICT adoption to turnover differentials among various types of SMEs using a recently proposed decomposition technique by Fortin et al (2010).

The factors influencing adoption decisions of firm vary significantly across countries. Nonetheless, the meta-analysis identifies common determinants of ICT adoption among SMEs in these countries. The findings indicate that the ratio of users of computer and the Internet in an industry and perceived national competition influences adoption decisions of firms. Our findings also indicate that ICT capital has a positive and significant effect on firm's output, suggesting that there is no ICT productivity paradox among SMEs in Africa. We also find that ICT adoption positively influences technical efficiency of firms. Further, the results show that the contribution of ICT adoption to turnover differential varies considerable across income groupings of countries as well as various types of firms.

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Dedication

I dedicate this thesis to my wife – Eugenia, and my children – Maame, Nana and Nhyira

Also special dedication to my stepmother: Elizabeth Agyire-Tettey

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CHAPTER 1 - INTRODUCTION AND OVERVIEW OF THE DATA

1 Overview

Africa, compared to other less developed parts of the world, is estimated to have the highest penetration rate of mobile telephony, Internet and computer usage [International Telecommunication Union (ITU), 2013]. Notwithstanding this, the continent lags behind in its usage of ICT compared to Asia, Europe and the Americas. The high diffusion rate of ICT has given great optimism to African countries, leapfrogging the development process and reducing poverty amongst its population. Despite this, studies which assessed the impact of ICT on development have mainly been on advanced economies and East Asian countries. Little is known about the impact of ICT in Africa, as the available evidence is mainly anecdotal rather than based on empirical studies. In recent times, the few studies that have examined the effect of ICT in Africa have done so from a macro view point, and also looking at how it affects the livelihood of households (Duncombe, 2006). Other studies that assessing ICT usage in Africa at the micro level use small samples of firms obtained from private sources and mainly from the services sector (Matambalya and Wolf, 2001; Chowdhury, 2006). The paucity of ICT research on African countries is attributable to the absence of comprehensive micro data on African firms' ICT usage. Furthermore, differences between developed and SSA countries in terms of culture, income, education, economic, political and legal structures may render findings from studies on the usage of ICT in developed countries not directly applicable in the context of Africa.

Thus the vast difference between developed economies and African countries does not automatically imply that ICT would have the same success in Africa as in the developed world. In fact some sceptics (Alzouma, 2005) argue that the success of ICT is dependent on education, adequate language skills, and also some level of infrastructure, which are lacking in many African countries. Dedrick, et al (2003) argue that the low cost of labour relative to the high cost of capital in developing countries reduce the possibility of labour – technology substitution in comparison to the situation in developed countries. Chowdhury (2006) finds that ICT investment has a negative effect on productivity in Tanzania and Kenya. Bankole et al. (2011) indicate that the impact of ICT on high income economies may differ from that of

LIC economies. ICT induced productivity growth is relatively high in the United States compared to other advanced nations such Japan, the United Kingdom and France (IMF, 2001). It is therefore imperative to examine ICT adoption, it effects and contribution to firms in Africa in order to design relevant policies for countries on the continent rather than adopting policies that are designed for more advanced economies. The failure to properly understand the factors behind ICT adoption, its effect on firm output and also its contribution to firms' turnover will imply the pursuance of over-ambitious and unrealistic goals, thereby wasting resources which are already scarce in Africa.

Furthermore, the role of ICTs for development studies on Africa has mainly concentrated on the impact it has in reducing poverty, especially its effect on core developmental objectives; improving education, empowerments, bringing health closer to the population, improving agricultural extension services and providing farmers with a livelihood. Empirical research on ICT in Africa has so far failed to assess the adoption, effects and contribution of ICT to SMEs. Given the importance of SMEs to the development of African countries there is a need for research to ascertain the factors that determine the adoption of ICT and the effect of ICT on the turnover of SMEs. One may expect variations in the usage of ICT across different types of firm as well as different countries. It therefore becomes important to determine the contribution of ICT across these different types of firm and how this varies across income levels of the country where they are located. The contribution and potential of SMEs to the development of African countries cannot be overemphasised as they are a major source of employment and contribute to income generation in the populace. They are also major foreign exchange earners and a channel for innovative ideas. The micro impact of ICT on SMEs in Africa has largely been ignored in the development literature. Finally, all studies on ICT and development have failed to differentiate between formal sector, semi-formal and informal sector firms. This distinction is necessary for Africa as it has a large and striving informal sector. It is imperative that the formality of the firm is controlled for in order to provide unbiased analysis of adoption and impact of ICT on SMEs in SSA.

In the light of the limitation of the current literature in this area this thesis seeks to address the following key research questions in relation to the factors that motivate SMEs in sub-Saharan African countries to adopt ICT (measured by computer and Internet usage) and ascertain the effect of ICT capital on the turnover of SMEs in SSA. The thesis also addresses the question of whether the adoption of ICT improves the technical efficiency of SMEs in SSA countries. The heterogeneity of firms may cause the effect of ICT to differ along with turnover distribution making Ordinary Least Squares (OLS) an inappropriate estimator. This study therefore examines the effect of ICT at different points of the distribution of turnover besides the mean. The study further examines the variations of ICT contribution to turnover across various categories of SMEs in fourteen SSA countries. We also address the question relating to whether ICT contribution to turnover varies across low income, lower-middle income and upper-middle income countries in SSA.

2 Why small and medium enterprises

The role of Small to Medium Enterprises (SMEs) in economic development around the globe and Sub-Sahara Africa (SSA) has assumed greater significance. They are viewed around the world as impetus for growth and job creation, and an effective channel for poverty reduction especially among Less Developing Countries (LDCs). In many advanced economies the success of SMEs is seen as a major driving force for economic growth, employment and sustainable development. Evidence suggests that about 60 percent of GDP in high income countries is attributable to activities of SMEs, and employing about 65–70 percent of the total workforce, emphasising their dominant role. The development of SMEs in these economies has deepened the manufacturing sector and raises the competitiveness of firms, leading to innovation and declining prices. The success stories of many leading Asian economies have been on the backbone of SMEs in these countries. Increasingly, Asia has positioned itself as a manufacturing and information technology hub of the world economy propelling it to higher growth. The Asia-Pacific cooperation estimates that over 97 percent of all enterprises in the region are SMEs and employ over 50 percent of the workforce with their contribution to GDP ranging from 20-50 percent in most APEC countries. This is in spite of several challenges that SMEs face in this region. SMEs have the potential to promote rapid domestic-led economic growth in emerging economies, in Africa and around the world.

One major characteristic of African economies and LDCs is the existence and importance of a large informal sector, generally made up of SMEs. Lately, governments in LDCs and SSA have recognised the importance of SMEs as a productive tool for rapid economic growth and development as well as a channel to reduce high unemployment among the teeming youth. Empirical evidence concludes that SMEs have high labour absorptive capacity and the average cost of capital per employment generated is below that of large firms. It is estimated that about 70 percent of the rural poor in Africa are actively engaged in either formal or informal SME sectors. They are viewed as more export-oriented mainly due to their structure and size in comparison to larger firms, hence making them major earners of foreign exchange; a critical resource needed for developmental projects in many LDCs. In addition, SMEs in many developing countries have evolved to become key suppliers of goods and services for larger corporations and multinationals in their domestic economies. In South Africa over 91 percent of all formal business enterprises are estimated to be SMEs while in Ghana they form about 92 percent of businesses and yet contribute about 49 percent to GDP. About 70 percent of manufacturing businesses in Nigeria are categorised as SMEs, accounting for over 50 percent of GDP. There is abundance of empirical evidence showing the importance of SMEs to economic growth and development which is labour-intensive, competitive and entrepreneurially driven. This type of growth and development has the ability to alleviate poverty among the African rural poor as in the case of East Asian countries. A consensus has emerged around the globe of the potential of SMEs in putting LDCs onto the path of economic growth and sustainable development.

An important contributing factor to the success story of SMEs in East Asian Countries has been as a result of the high cooperative inter-firm relationships making them less vulnerable to risk, fostering mutual exchanges of information and know-how between firms and creating a rich pool of collective knowledge (UNCTAD, 2001). The provision of technological extension services to SMEs, such as research and development support as well as information relating to the sources of technology, have also been critical for their rapid development. Thus, various governments have played a major role in facilitating the development of SMEs in East Asian countries by strengthening their competitiveness. However, SMEs in African countries are yet to experience the level of success attained by those in East

Asian countries. Despite the high number of SMEs in Africa, their expected growth remains low and the failure rate high in some countries compared to other parts of the world. Though SMEs contribute to between 50 and 80 percent of total employment, youth unemployment in SSA is relatively high, which the International Labour Organisation (ILO) estimate to be between 20 to 25 percent in 2013. Several factors accounts for the poor growth of SMEs in Africa. Unlike SMEs in APEC region, there is a lack of necessary and appropriate resources, such as requisite skills, collectively shared knowledge and technical know-how, and more importantly lack of government support, needed to enable SMEs in Africa to grow. SMEs in Africa are not competitive compared to SMEs in Europe and other regions of the world. Increased globalisation and the lack of technology may also hinder the growth and development of SMEs in Africa.

Sustained high income and employment levels can be realised if the competitiveness of the country is high and this is lacking in many LDC, and for that matter SSA. The competitiveness of a country depends on its ability to sustain continuously the growth rate of productivity of its enterprises. Increasing the productivity of enterprises to improve the competitiveness of the country requires the shift from comparative advantage to competitive advantage, which is the ability to compete on cost, quality, delivery and flexibility (UNCTAD, 2005). These are factors that reduce the cost for all domestic firms in various sectors of the economy. If SSA countries are to increase their competitiveness in the global market then they would have to build and strengthen the production capacity of firms, especially SMEs. Increasing competitiveness will also imply increasing the export competitiveness of SMEs in SSA. It is estimated that SMEs in SSA have the potential to increase their total output substantially, increasing employment levels, improving local technology, output diversification and the development of local entrepreneurship in the process. In fact SMEs are more resilient to economic downturns than larger firms and offer relatively more stable levels of employment as their activities are more diverse.

In spite of SMEs potential to put SSA on the path of sustained economic growth and development and assist in poverty alleviation directly through the generation of stable employment for African poor, they face a new form of challenge. With increased globalisation of production and the shift in importance of various

determinants of competitiveness, the global economy is heavily reliant on Information and Communication Technology (ICT). The development and proliferation of ICT has been made possible by rapid innovations in ICT technology reducing the cost of production, making ICTs less costly and affordable to a wider group of consumers and firms.

3 Why ICT is important

Access to reliable information is critical to the development of countries and enterprises alike and this is both a costly and valuable good. African countries and other LDCs lack greater access to information and where present it is costly and unaffordable for many firms and individuals (Stiglitz et al., 1988; Duncombe and Heeks, 1999; Altenburg and von Drachenfels, 2008). The high cost of reliable information is attributed to both poor institutional frameworks and the absence of technological infrastructure in developing countries. The paucity of reliable information in developing countries thwarts the development efforts of enterprises and governments as it leads to inefficiencies in production and the developmental process. This leads to sub-optimal allocation of resources at both firm and national levels. Firms reduce uncertainty associated with the market and other activity to enhance their productivity when they have access to reliable information.

However, in recent years the price of information has declined, and continues to, making it more accessible to many individuals and firms. In spite of the high rate of diffusion of ICT around the world, its usage is mainly concentrated in developed countries creating a digital gap between the developed economies and the developing world. The continuous decline in the cost of ICT around the globe has the potential to bridge this informational gap. The advent of ICT has ushered a knowledge-based economy which over the years has become increasing important in the global economy. It has altered the approach of both countries and enterprises when transacting business around the globe. It has made markets relatively accessible from any part of the world. Businesses are linked in real-time to both suppliers and customers, allowing all parties to access information and data. This enables firms, suppliers and customers to make informed decisions in real-time, increasing firm efficiency and competitiveness. Brynjolfsson and Hitt (2003) assert that ICT reduces the cost of information, communication and also coordination which reduces the

operation costs of users. It has therefore been argued that ICT reduces the transaction costs of firms related to trade by lowering both information and search costs (Cordella, 2006; De Silva, et al., 2008).

There is an overwhelming recognition that access to ICT has the potential to thrust developing countries to high economic growth and a sustained level of development (Avgerou, 2003; Timmer and Van Ark, 2005; Audretsch and Keilbach, 2008). ICT-lead development is multidimensional as it cuts across both economic and social development worldwide, doing so at a rapid pace. The use of ICT has created new opportunities in the areas of health, climate change, expansion of knowledge, stimulating economic growth and empowering people and communities. It is no longer debated whether ICT has increased productivity in developed countries, enabling firms to increase wages without necessarily increasing the price of their products. Higher productivity driven by ICT is a more sustainable way of development as it does not result in inflationary pressures which are a major challenge facing many developing economies.

4 Definition of ICT

There are many definitions of ICT. It frequently encompasses more than just computers or Internet usage though there has been a tendency to focus on Internet and computer usage. According to Barba-Sánchez et al (2007), ICTs in today's world must be broadly conceived to encompass the information that businesses create and use, as well as the wide spectrum of increasingly convergent and linked technologies that process that information. They further opined that ICTs in this regard can be viewed as a collective term for a wide range of software, hardware, telecommunications and information management techniques, applications and devices, and are used to create, produce, analyse, process, package, distribute, receive, retrieve, store and transform information.

Similarly, Rao (2004) defined ICT as technologies devoted to the storage of information, processing and communication. Barba-Sanchez et al (2007) also define ICTs as a range of software, hardware, telecommunication and information management technologies, applications and devices that are used to create, produce, analyse, process, package, distribute, retrieve, store and transform information.

Furthermore, Unwin (2009) defines ICT as "any communication device or application encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems; and so on as well as the various services and applications associated with them such as videoconferencing and distance learning".

However, recently ICT generally encompasses equipment and services that facilitate the electronic capture, processing, display and transmission of information (Torero and Von Braun [Eds.], 2006). They provide a broader definition of ICT as "all equipment and services, which include the computing industry (software, hardware, networks, the Internet, and related services), electronic data processing and display (such as photocopiers, cash registers, calculators, and scanners, as well as a myriad of lesser known machines specifically tailored to production and manufacturing), telecommunications and related services (such as fixed and cellular telephones, facsimile machines, instant messaging, teleconferencing, and so on) and audio-visual equipment and services (including television, radio, video, DVDs, digital cameras, compact discs, MP3 players, and so on". On the other hand Duncombe and Heeks (1999) simply define ICT as "electronic means of capturing, processing, storing and disseminating information". In this respect, Seyal et al (2000) and Sharma and Bhagwat (2006) have all asserted that ICTs are organized communication networks and data resource that collect, transform and disseminate information within and among organizations.

5 Definition of SMEs

The definition of SME is a concern in the development literature. Various studies have offered different definitions largely due to varying definitions by regulatory authorities in various countries. In fact the use of a single definition for different countries at different levels of economic development can create distortions. Though the precise definition of SMEs varies from country to country, similar criteria are used to categorise firms. The number of employees, the firm's turnover and value of the firm's assets are frequently used to classify firms as SMEs. Although SMEs definition may differ, such firms have common attributes:

- Contribution of individual SME to total industry output is relatively low.
- There is low specialisation among workers.

- They have high capacity to innovation making market adaptability easier, thus there is the lack of formal strategic plans on the part of SMEs.
- Management of SMEs centre on the owner/manager.
- SMEs tend to use simple information systems which are based on direct and personal contacts.

The United Nations Industrial Development Organisation (UNIDO) defines and classifies SMEs on the basis of the number of employees and gives different classifications for industrialised and developing countries.

Table 1. 1: UNIDO classification of firms

Company category	Industrialised countries	Developing countries
Large sized firms	more 500 employees	more than 100
Medium sized firms	between 100 and 499 employees	between 20 and 99 employees
Small sized firms	less than 99 employees	between 5 and 19 employees
Micro sized firms	-	less than 5 employees

The European Commission classifies firms that employ less than 10 persons as micro-level enterprises, those that employ between 10 and 50 persons as small scale enterprises, and those that employ above 50 persons are classified as medium scale enterprises. In this study we adopt the definition of SME as provided by the UNIDO, which classifies all firms with less than 100 employees as SMEs. The use of the definition provided by UNIDO is informed by the fact that an inappropriate definition of SME which does not meet the developmental level of the specific country may generate biased results. It is therefore important for the study to adopt a definition of SME appropriate in the context of SSA countries.

7 Overview of data

This thesis uses data from the SME e-Access and Usage survey carried out by Research ICT Africa (RIA)[1] between the last quarter of 2005 and the first quarter of 2006. The dataset is a firm-level cross-section survey conducted in 14 sub-Saharan African countries. It is a comprehensive cross-country dataset designed to capture ICT usage among private sector SMEs. The aim of the data is to provide an

[1] The Research ICT Africa Network conducts research on ICT policy and regulation that facilitates evidence-based and informed policy making for improved access, use and application of ICT for social development and economic growth. The network consists of researchers/institutions from 20 African countries.

understanding of ICT usage among SMEs across SSA. The survey uses a standard definition and measurement for ICT variables across all the countries and these standards are based on internationally accepted definitions designed by the International Telecommunication Union (ITU). The survey therefore provides internationally comparable data on the usage of ICT by African firms. The dataset provides a unique collection of information on ICT usage and the context in which this usage occurs. The survey targets an average of 280 SMEs in the sampled countries with the sampling based on target lists of SMEs in the capital city of the countries and at least two economically significant urban areas. The firms are selected based on a simple random sampling technique and also based on the profile of the SME. The survey collects data on 3,966 SMEs located in Botswana, Cameroon, Ethiopia, Ghana, Kenya, Mozambique, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Uganda, Zambia and Zimbabwe.

Table 1. 2: Distribution of SMEs by country

Country	Number of SMEs	Percent
Botswana	255	6.43
Cameroon	280	7.06
Ethiopia	282	7.11
Ghana	280	7.06
Kenya	277	6.98
Mozambique	280	7.06
Namibia	307	7.74
Nigeria	265	6.68
Rwanda	279	7.03
South Africa	290	7.31
Tanzania	263	6.63
Uganda	351	8.85
Zambia	276	6.96
Zimbabwe	281	7.09
Total	**3966**	**100**

The SME e-Access and Usage dataset is unique, it is the only dataset that uses the same measures of ICT across different countries besides the European Union data on ICT. Various studies on ICT and firm analysis at the micro level have mostly been on individual countries, this is largely due to differences in measuring and defining ICT across countries. The data thus allows for a comparison of the relationship between acquisition and access of ICT, and performance indicators of firms across various SSA countries. Secondly, the data is the most comprehensive dataset on ICT usage in SSA countries as there is virtually no other data that provides detailed information on firms' usage of ICT in the region. Although this dataset has been in

existence since 2007 little research has been carried out using this data to explore access to ICT, the effect of ICT on firms and also the contribution of ICT to various types of firm.

The dataset provides information on individual firm characteristics, modes of communication, financial records and the nature of bank transactions. Other information captured includes usage of ICT equipment, public access to ICT gadgets and e-commerce. The firms surveyed consist of those operating in the formal, semi-formal and informal sectors of their respective economies and they are all small to medium scale enterprises (SMEs). Table 1.2 shows that the firms are roughly evenly distributed across the countries. The firms are also distributed across the three regions of sub Saharan Africa, with 20.8 percent located in West Africa, 36.6 percent in East Africa and the remaining 42.6 percent located in Southern Africa.

7.1 SME e-access and usage survey sample design

In each of the countries the sample design is stratified in two stages. In the first stage the cities to be surveyed are selected and this is based on the level of economic activity in the city. In the each country the capital city is selected along with two other cities with the highest level of economic activity besides the capital city. In the second stage all SMEs registered with their respective national associations in these three economically active cities are then surveyed. Some firms registered with the national association of SMEs in the catchment areas were excluded as they were not operational at the time of the survey. The excluded SMES comprised of less than 5 percent of the total target.

The survey uses the same questionnaire for all countries, thus variables have the same definitions across all the countries. This allows for consistency of variables and for comparative analysis across the countries. The survey is divided into eight separate sections. The first section collects background information on the SMES. This information includes form of ownership, number of owners, the enterprise's main activity, year of establishment of the firm, who manages the business and the educational level of the owner(s). Information gathered also includes: financial record keeping, Internet access, emails and website access.

The second section gathers information on the mode of communication used by the enterprise and its expenditure on communication. The third aspect of the questionnaire deals with the financial statements of the firm, and includes information such as turnover, annual average cost of utilities (water and electricity), value of assets, annual average direct cost, the annual average wage bill, annual profit, value of ICT capital and the value of ICT investment made over the past year. The fourth and fifth sections of the questionnaire look at the nature and mode of banking used by the SMEs, assessing the firm's use of Internet and telephony banking, and public access to ICT respectively. Issues concerning the usage of short message services (SMS), Internet usage and e-commerce are captured in sections six and seven of the questionnaire with section eight soliciting information on the business climate the firm operates under. A copy of the questionnaire is included in Appendix A-1.

7.2 Firm characteristics

Table 1.3 and Table 1.4 show the distribution of SMEs by age and size, captured in the survey for all the countries. The data shows that 43.8 percent of the SMEs surveyed are micro-level enterprises, with an average workforce of 3, while small scale enterprises, with a mean of 9 employees, form 46.1 percent of total number of firms. Medium sized firms form 10.1 percent of the sample and have a mean of 32 employees. Overall the firms employ 33,943 persons, with small scale firms employing about 57.6 percent, while the micro level and medium scale enterprises employ about 38.6 percent and 3.8 percent respectively.

Table 1. 3: Summary statistics of firm size

	number of firms	% of total number of firms	number of employees	% of total employees	mean (employees)	Std. dev.
Micro (employee<5)	1735	43.75	4,569	13.45	2.63	1.04
Small (5<employee≤19)	1830	46.14	16,535	48.67	9.04	3.75
Medium (employee>20)	401	10.11	12,868	37.88	32.09	12.06
All firms	3,966	100.00	33,972	100.00	8.57	9.65

We distinguish between three categories of firm based on age (Table 1.4). Firms that have been in existence for less than 5 years are termed infant firms, while those aged between five and twenty years are referred to as mature firms, and finally, firms

above 20 years are classified as old firms. Infant firms form the 56.7 percent of the sample, with firms classified as mature and old representing 36 percent and 6.8 percent respectively. The average age of all firms is about 7 years and that of infant firms is equivalent to about 3 years with mature firms' age averaging about 10 years. Older firms have an average age of 31 years.

Table 1. 4: Summary statistics of firm age

	observations	% of total number firms	mean age of firm	std. dev.
Infant (age < 5)	2,252	56.78	2.70	1.63
Mature (age < 20)	1,443	36.38	9.99	3.87
Old (age > 21)	271	6.83	31.25	18.72
All firms	3,966	100	6.91	8.41

Table 1.5 presents the distribution the sample by sector, formality, ownership and managerial structures. The firms are grouped into seven broad industries based on their main economic activity using the international standard of industrial classification (ISIC). From this we further group the enterprises into three broad industrial classifications of manufacturing, construction and services. Firms operating in the services sector dominate the dataset, representing 76 percent of the sample, with enterprises in the manufacturing sector consisting of 18 percent of the total number of firms. The construction sector is the smallest sector, with about 6 percent of SMEs.

Table 1. 5: Distribution of firms by sector, formality, ownership and management structure

Variable	Observation	Percentage
Industrial Sector		
manufacturing	728	18.36
construction	232	5.85
services	3,006	75.79
Formality		
informal	1,606	40.49
semi-formal	1,234	31.11
formal	1,126	28.39
Ownership structure		
sole proprietorship	2,615	66.15
partnership	697	17.63
close corporation	207	5.24
business	422	10.68
other business form	12	0.3
Management structure		
owner	2,663	67.95
full time manager	1,061	27.07
family member	183	4.67
other	12	0.31

The survey also categorises SMEs into three business sectors – formal, semi-formal and informal. The categorisation is based on the computation of a formality index which is dependent on the responses of the SME to questions relating to form of ownership, registration with the receiver of taxes, registration for value added tax (VAT), the number of employees that have written contracts and financial management and record keeping. The possible maximum index is 4.5 after assigning a score to each response as shown in Table 1.6. A score of 1.5 or below puts the SME into the informal sector categories and from 2.0 to 3.5 classifies the firm as a semi-formal sector SME and finally, a score greater than 3.5 implies the SME operates in the formal sector.

Table 1. 6: Computation of the formality index

Question	Response	Value
Form of ownership?	sole proprietor, partnership Close Corporations	0 0.5
Is your business registered with the receiver of taxes?	no yes	0 0.5
Is your business registered for value added tax (VAT)?	no yes	0 1
How the number of employees that have written contracts?	none one or more	0 1
Does business strictly separate business finance from that of personal?	no yes	0 0.5
Does your business keep financial records?	No simple bookkeeping double entry bookkeeping audit annual financial statements	0 0.5 1 1
maximum total		4.5

Source: Adopted from Towards an African e-Index – SME e-Access and Usage, 2006

Based on this index the majority of firms operate in the informal sectors in the various countries. Table 1.5 shows that 41 percent of the sample is drawn from the informal sector, with 31 percent operating in the semi-formal sector. The remaining 28 percent operate in the formal sector. Table 1.7 shows the formality level of firms disaggregated by firm size. About 49 percent of micro-level firms operate in the informal sector, 31 percent are in the semi-formal sector while the remaining 20 percent operate in the formal sector. The majority of small-scale firms operate as formal sector firms (53 percent), with 31 percent and 16 percent operating in the semi-formal and formal sectors, respectively. The situation is similar in the case of medium scale enterprises, in which about 70 percent are in the formal sector and 30

percent are semi-formal (see Table 1.7). There was no medium-scale firm operating as an informal sector firm.

Table 1.5 also shows that firms owned by sole proprietors dominate, representing 66 percent of those sampled, while 18 percent are partnerships. An additional 11 percent of firms are corporate businesses, and 5 percent specify that their enterprises are close corporations[2]. The majority indicated that the owner of the firm manages (68 percent of the sample) the daily operations, while the about 27 percent of enterprises are managed by full-time managers. About 4.7 percent of firms are managed by family members and about 0.3 percent of SMEs indicated other forms of management structure.

Table 1. 7: Firm size by formality

Firm size	formality			
	informal	semi-formal	formal	Total
Micro scale (%)	62.02	26.05	11.93	100
observations	1076	452	207	1735
Small scale (%)	27.05	36.34	36.61	100
observations	495	665	670	1830
Medium scale (%)	8.73	29.18	62.59	100
observations	35	117	251	401
Total (%)	40.49	31.11	28.39	100
observations	1606	1234	1126	3966

7.3 Financial indicators of SMEs

The survey also collected information on the financial status (see Table 1.8) of the firms in the local currency of the country in question. To enable a comparison of all monetary values of the firms across the various countries we convert values in local currency into United States Dollars (US$) using the Implied 2005 Purchasing Power Parity (PPP).The conversion also enables the pooling of the individual country dataset into one dataset for cross-country studies. The data shows that the mean turnover of the firms are about US$1.1 million and the average profit of the firms stand at US$470,485. The average total fixed cost of the enterprises is US$1.8million. Compared to the fixed cost of the firms, the data show that expenditure on ICT is low, with an average expenditure of US$11,129, while the average investment in ICT over the previous 12 months is US$29,674. This

[2] This form of business uses a corporate business structure, but all shares are held by a small number of individual who are usually closely associated with the activities of the business. This form of business enables partners to benefit from liability protection without the mode of operation of the business changing.

investment in ICT forms about 15 percent of the previous year's total investment excluding investments in ICT. The average value of ICT equipment is US$14,869, forming 8 percent of average total fixed cost.

Table 1. 8: Descriptive statistics of financial indicators of firms

Variable	Mean	Median	St. Dev.
Average turnover	1,136,156	80,640	14,200,000
ICT expenditure	11,129	2,162	56,573
Average wage	92,521	11,599	890,527
Average direct cost	255,628	15,341	2,120,240
Average profit	470,485	15,341	9,432,551
Total fix cost	1,780,441	11,850	78,600,000
Value of ICT equipment	140,869	1,060	4,485,311
Total investment	192,390	353	6,635,402
ICT investment	29,674	0	1,402,833

All monetary values are in United States Dollars (US$) implied 2005 Purchasing Power Parity (PPP) conversion. Total number of observation is 3966.

An analysis of the correlation matrix shows that most of the financial indicators are lowly correlated, with a few exceptions. For instance the correlation between the average wage and average turnover is high, likewise the correlation between average profit and turnover of firms. Average direct cost and the average wage bill are highly correlated.

Table 1. 9: Correlation matrix of financial indicators of SMEs

Variable		1	2	3	4	5	6	7	8	9
1	Average turnover	1								
2	ICT expenditure	0.303	1							
3	Average wage	0.665	0.344	1						
4	Average direct cost	0.539	0.205	0.771	1					
5	Average profit	0.912	0.258	0.444	0.281	1				
6	Total fix cost	0.029	0.008	0.012	0.016	0.022	1			
7	Value of ICT equipment	0.036	0.041	0.048	0.034	0.028	0.002	1		
8	Total investment	0.029	0.026	0.049	0.037	0.021	0.006	0.035	1	
9	ICT investment	0.039	0.032	0.075	0.042	0.024	0.0004	0.314	0.108	1

7.4 Access to ICT

The data shows that usage of ICT is low among SMEs in the various countries. In all, 39.7 percent of SMEs have access to computers[3], with 18.7 percent indicating they have access to Internet connections. Furthermore, 52.1 percent of firms who indicated that they have access to computers also indicated that the computers are

[3] Access to computer and Internet are used as three different dependent variables in our regression estimation

connected to the Internet. Out of the firms using the Internet, 30 percent indicated that they have used the medium to purchase goods and services, and 36.5 percent indicated receiving orders via the Internet[4]. Mobile telephony usage is common among the firms; 83.3 percent have access to mobile phones in working condition, while 51.2 percent report having access to fixed line telephony. The data also show that 26.1 percent of SME establishments have access to a fax machine in workable condition.

Website operation is not common among SMEs as only about 7.2 percent have an established website, with just 0.8 percent having fully functioning websites. In addition a few firms, although not having a fully functioning website, have some basic form of web presence and they constitute 5.2 percent of the sample. A further 1 percent has a web portal. Furthermore, a total of about 37 percent indicated that either the owner or at least one employee has an e-mail account, whereas the remaining 63 percent indicated that neither the owner nor any employee holds an e-mail account of any form.

Table 1. 10: Access to ICT equipment by firms

Variable	% of Positive responses
Access to computer	39.71
Access to internet	18.66
Access to mobile phone	83.26
Access to fixed line telephone	51.19
Access to fax machine	26.07
Does firm has a website	7.16
E-mail account holders	37.12
Electronic Data Interchange	6.33
Purchases via internet	8.19
Receives orders via internet	9.88

Total number of observation is 3966

Table 1.11 shows that Internet usage among enterprises increased over the last six months, as about 50 percent of firms indicated that their usage of the Internet rose over the period. A further 39.9 percent indicated that their usage has not changed during the same period, with the remaining 10.1 percent indicating a decline in Internet usage. SMEs indicated that there are obstacles to the usage of e-commerce to transact business and attributed this to various reasons. The data shows that 35.4 percent of respondent firms saw the lack of readiness on the part of other firms and

[4] Firms purchasing goods and services, and those receiving orders via the Internet form about 8.2 percent and 9.9 percent of the total number of sampled firms respectively.

customers to embrace e-commerce as a major obstacle for not adopting e-commerce. Other firms, around 20 percent, also indicated that the lack of secure payment is an obstacle to the adoption of e-commerce, whereas about 17.4 percent of respondent firms said that their products or services cannot be transacted via Internet.

Table 1. 11: Internet usage by firms

Variable	Observations	Percentage
usage of Internet for business		
yes, from office	675	17.02
yes, from home	46	1.16
yes, from Internet cafe	361	9.1
no	2,884	72.72
total respondents	3,966	100
Internet usage over the past six months		
increased	528	50.05
stayed the same	421	39.91
decreased	106	10.05
total respondents	1,055	26.60
obstacle to e-commerce		
product/service not suitable for sales via internet	160	17.41
customers and other firms not ready for e-commerce	325	35.36
security problem related to payment	181	19.7
uncertainty of delivery	91	9.9
logistical problems	162	17.63
total respondents	919	23.17

Table 1. 12: Correlation Matrix of ICT variables

Variable		1	2	3	4	5	6	7	8	9	10	11	12
1	Computers	1.00											
2	Internet connections	0.59	1.00										
3	Fax Machine	0.37	0.35	1.00									
4	Mobile phones	0.30	0.30	0.42	1.00								
5	Fix line telephony	0.34	0.32	0.57	0.36	1.00							
6	E-mail account holders	0.44	0.37	0.49	0.54	0.37	1.00						
7	E-mail account holders/employee	0.40	0.33	0.29	0.21	0.13	0.55	1.00					
8	Computers/ employee	0.60	0.41	0.11	0.00	0.04	0.02	0.43	1.00				
9	Internet Conn./ employee	0.39	0.71	0.10	0.02	0.04	0.02	0.30	0.64	1.00			
10	Fix line telephony / employee	0.15	0.22	0.25	0.01	0.35	0.00	0.25	0.31	0.33	1.00		
11	Mobile phones /employee	0.02	0.06	0.00	0.27	0.01	-0.08	0.18	0.30	0.31	0.37	1.00	
12	Fax machines /employee	0.08	0.15	0.32	-0.04	0.06	-0.02	0.40	0.43	0.40	0.62	0.30	1.00

A look at the correlation matrix in Table 1.12 shows that the correlation between the various ICT variables is quite low. With the exception of the correlations between Internet connections and computers; fixed line telephony and fax machine, and e-

mail account holders and mobile telephony which are high, the rest of the variables exhibited a low correlation. The high correlation between Internet connection and computer is expected as the prerequisite for Internet usage in the organisation is access to a computer. Also use of a fax machine and fix line telephony are highly correlated since there is the need for a fixed line telephone to have access to fax.

8 Thesis structure

The remainder of this thesis is organised as follows. Chapter 2 examines in detail the determinants of ICT adoption, measured by the adoption of computer and Internet across twelve sub-Saharan Africa (SSA) countries. To obtain consistent determinants of ICT adoption in SSA we use the Meta-Regression Analysis (MRA) technique to combine all the individual country results, controlling for the likely presence of heterogeneity across the countries, to obtain the average weighted determinants of adoption of ICT across SSA. Thus we are able to determine factors that are significant in determining ICT adoption across a set of countries. This chapter contributes to the debate of ICT usage among SMEs in developing countries, specifically countries in SSA of which little is known.

The third chapter assesses the effect of ICT on firm's turnover and also examines the effect of ICT on technical efficiency among SMEs across the sampled countries. First, we employ Cobb-Douglas and Translog production functions to estimate the effect of ICT capital on turnover at the mean of the distribution across the various countries. Second, we again apply Meta-analysis techniques to determine consistent effect of ICT capital on the firms' turnovers. Third, to deal with possible heterogeneity and to deal with possible outliers that may influence OLS estimation we employ quantile regression techniques to determine the effect ICT capital has on firms' turnovers at various points along the turnover distribution. Finally, using a stochastic frontier within both Cobb-Douglas and Translog production frameworks we examine the effect of ICT usage on technical efficiency in selected SSA countries. Chapter four examines the variations in contribution of ICT capital to turnover differentials using a decomposition analysis across various groups of firms in SSA. First, using the decomposition we examine variations across seven groups of firm at the mean of the turnover distribution. We then determine the variations in contribution of ICT capital at various points along the distribution. To analyse the

variations of ICT capital at different points we apply an unconditional quantile decomposition technique proposed in Fortin et al (2010) and apply a reweighting technique. Finally, the fifth chapter provides the contribution of the thesis, outlines it's limitations as well as an agenda for future studies on the usage of ICT among SMEs in sub-Sahara Africa.

CHAPTER 2 – DETERMINANTS OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) ADOPTION IN SUB-SAHARAN AFRICA

1 Introduction

Several African countries are rapidly adopting and implementing Information and Communication Technology (ICT) policies and strategies, with the expectation that it can lead to rapid development of Small-Medium Enterprises (SMEs) and hence higher levels of economic growth. This expectation is fuelled by the success stories of advanced countries that have adopted and used ICT, which has aided in rapid economic growth. Within Africa, according to the International Telecommunication Union (ITU, 2013) mobile telephony is growing at a fast rate. In 1996, for instance, only five African countries had access to Internet facilities, but today there is an Internet connection in virtually every urban centre in Africa, yet the continent has the lowest percentage of the population who have access to ICT in the world (ITU, 2013). Thus, in spite of the rapid adoption of ICT on the continent, Africa lags behind the rest of the world in its adoption and use of ICT.

ICT is increasingly becoming an important element for economic growth and development and poverty reduction strategies in both developed and developing economies. It is expected that if developing economies are to catch up with developed economies, it is imperative that they adopt and make use of ICT (Heeks and Kenny, 2002). It is widely accepted that ICT has a significant and positive impact on the productivity of firms and economic growth in the developed countries (Sein and Harindranath, 2004). ICT plays a significant role in the development of small-medium scale enterprises (SMEs) in developed economies by increasing their access to markets and profit margins (Saeed and Bampton, 2013).

Several studies have examined the role that ICT plays in developed economies, and in recent times there has been a surge of research into the role it plays in developing economies (Gallego et al., 2014; Commander et al., 2011; Bankole et al., 2011; Chowdhury, 2006; Matambalya and Wolf, 2001; Dasgupta et al., 1999; Duncombe and Heeks, 1999). In spite of this development, not much is known about the driving factors of ICT adoption and usage among SMEs in Africa. This chapter arises out of

the lack of studies examining the determinants and impacts of ICT on SMEs in Africa. Much of the research on ICT has focused on developed economies, especially US and Western European countries (Tam, 1998), whilst developments in developing countries remain largely unexplored, especially in Africa, despite the rapid diffusion[5] of ICT in these countries. Altenburg et al. (2002) for instance, asserts that ICT and development is yet to be adequately examined and the complex role of ICT understood. The failure of existing research to concentrate on the developing world has largely been due to the availability of data, which is non-existent in these countries. Where data is available, it has mainly been at the macro level, with a complete lack of data at the micro level. Thus, the extent to which these African countries have adopted these technologies, the factors that determine their adoption and their economy-wide impact remain poorly understood.

Furthermore, many developing countries have as part of their development agenda ICT policies, even though there are uncertain factors that determine the adoption of these technologies. Ghana for instance, has ICT policies outlined both in the Ghana Poverty Reduction Strategy (GPRS I) and the Growth and Poverty Reduction Strategy (GPRS II) papers, an indication of the important role ICT plays in the development of the country.

Given the importance of ICT and SMEs to the development of SSA countries it is critical to ascertain and understand the factors that influence adoption decisions among SMEs if they are to exploit the ICT productivity gains. In this regard, the chapter examines the driving factors of ICT adoption among SMEs in Africa. The study broadly proposes to explore the determinants of ICT adoption among twelve Sub-Saharan African countries, by examining the determinants of Internet and computer adoption among SMEs in SSA countries.

2 Literature review

The study of technology diffusion dates back to the published work of Gabriel Tarde in the early parts of the twentieth century. Several studies (Ryan and Gross, 1943; Mansfield, 1961; Rogers, 1962; Fudenberg and Tirole, 1985; Geroski, 2000;

[5] The rapid diffusion of some components of ICT has been made possible largely by the availability and the declining price of ICT devices, resulting from competition in the market.

Stoneman, 2002; Metcalfe, 2005) have made significant contributions to the study of diffusion and adoption of technology since the publication of Gabriel Tarde's book "The Law of Imitation". However, it was not until Ryan and Gross (1943) published "The Diffusion of Hybrid Seed Corn in Iowa Communities" that research into diffusion was stimulated and adoption of technology in North America and Europe was studied. Research into technology adoption or diffusion became more prominent in the 1960s with various studies analysing technology adoption or diffusion at the aggregate with a handful examining diffusion at firm and industry levels (Everett Rogers, 1962). However, these studies have mainly focused on developed countries with few studies focusing on developing ones.

Studies on adoption and diffusion have taken different approaches, with some studies (Hargittai, 1999; Giunta and Trivieri, 2007) focusing on motivating factors for the spread of technology adoption, while others (Galliano et al., 2001; Billon et al., 2009; Andrés et al., 2010) have examined the unique features which increase the adoption and diffusion rate of technologies. Others researchers have also concentrated on characteristic agents which are viewed as early adopters of technology (Hollenstein, 2004; Arduini et al., 2010; Haller and Siedschlag, 2011; Kyobe, 2011). In this respect, there is considerable difference in the scope, approach, and methods used in technology adoption studies. Despite the conflicting results in many of the studies on technology adoption, there is a common trend that has emerged across them. They all find that the determinants of adoption vary widely across firms, industries and countries. These conflicting results make it challenging to outline clear policy targets.

2.1 Theoretical literature

A wide range of theoretical models have been developed to explain diffusion or adoption of technology and these have been drawn from a broad spectrum of disciplines including sociology, management, marketing and psychology. This review of the theoretical literature will focus mainly on models that are related to the discipline of economic development. Among these models are Epidemic, Rank or Probit, Stock and Ordered effect models of technology adoption. There is also the diffusion of innovation theory developed by Rogers (1962).

The epidemic model proposed by Mansfield (1961), asserts that the diffusion or adoption of innovation is determined by three main factors/variables. First, the profitability of adoption is directly proportional to the decision of adoption. That is expected high returns on technology adoption are an incentive for potential users to adopt the technology. Second, Mansfield points out that the required initial outlay is inversely related to the level of technology diffusion, stressing that a high initial investment is a disincentive for potential users of the new technology as well as small firms. Lastly, the number of users of the technology influences the rate of adoption positively as a larger number of existing users increases the rate of diffusion. The attributes and characteristics of the technology tend to spread rapidly with a large number of users. Thus, the rapid diffusion and adoption of new technology is dependent on the spread of information relating to its attributes. The model therefore, postulates the presence of late adopters due to the lack of adequate information and knowledge about the new technology.

Mansfield's epidemic theory indicates that at the inception of a new technology, potential users or adopters are unwilling to adopt the technology as they lack adequate information about its effectiveness and efficiency. However, over time as initial users outline the potential effectiveness through interaction with non-users, adoption increases as existing users dispel fears and uncertainty that non-users may have concerning the new technology. The dissemination of information has the potential to increase the rate of adoption and diffusion of the new technologies. Though the model indicates that diffusion is reliant on the number of adopters or users, it points out that as the number of users surpasses non-users, the rate of diffusion decreases. This is due to learning effects, which are assumed to be exogenous and the diffusion path is driven by the reduction in the cost or improvement in the quality of the new technology (Stoneman, 2002). However, Mansfield (1961) was quick to point out that the probability of an adopter influencing a non-adopter varies with different technologies. This probability is dependent on the characteristics and attributes of the technology, such as risk associated with adoption, profit or return from adoption and initial investment required for adoption. Mansfield (1961) further argues the presence of other factors such the market growth rates, which measures the purchasing capacity of the firm tend to affect technology adoption or diffusion.

The epidemic model assumes homogeneity across potential users and this is a major limitation, which has been highlighted by several studies (for example Davies, 1979; Brown, 1981; Karshenas and Stoneman, 1983). Mansfield ignored the fact that potential adopters are heterogeneous and the population of potential adopters tend to change over time. The model also failed to recognise the changing nature of technology. Firms are assumed to have equal opportunity of becoming infected[6], an unrealistic assumption underlying the epidemic model. It is natural for financially endowed firms (those with higher capital replacement ratio and relatively high-skilled management), to be more likely to adopt than those who are less endowed (Blackman, 1999). Profit from adoption tends to decline along the diffusion path, as more firms adopt the technology profitability tends to fall. This is because initial adopters' competitive advantage declines as more firms adopt the new technology, the model fails to account for this scenario. Mansfield asserts the spread of information increases the rate of adoption; however firms have several sources of information other than interaction with users. In spite of these developments, some researchers (Antonelli, 1995; Geroski, 2000; Metcalfe, 2005) are of the view that potential adopters of technology in the epidemic models remain homogeneous in nature. In summary, they believe that the lack of knowledge of the existence of a new technology in general can be a fundamental barrier to its adoption (Huang, 2008).

The drawbacks associated with epidemic models have led to the development of models that focus on factors that determine the potential benefits of technology adoption and the heterogeneity of firms. The rank models [7] account for the heterogeneity in firms as a fundamental determinant of the patterns of technology diffusion. The models presume that firms have different returns from the use of the previous technology which then influences their adoption of the new technology. Hence it is essential that firms identify a critical net return for adopting the new technology. Thus, according to Geroski (2000) the benefits from adopting a new technology depend on the characteristics of the firms and the markets. The rank models stipulate that firms form different expectations about the adoption of a new

[6] The process under which potential adopters interact with existing users of the new technology, and are influenced to adopt the new technology.
[7] The rank models are also referred to as the probit models of technology adoption.

technology as its effectiveness is not known with certainty, this makes firms have different adoption periods. Early adopters of the technology are firms with high expectations, while late adopters are those who are pessimistic in their expectations.

The rank model recognises differences in a firm's characteristics as a major reason why adoption varies across firms. This is an important digression from the epidemic models, as heterogeneity of firms is introduced into the rank models. The model suggests that the human capital of a firm requires a certain level of basic skills to use a new technology effectively and this hugely influences the firm's adoption decision, thus the variation in adoption. Like the epidemic model, the rank model recognises the importance of initial investment, financial and technical, required for adoption and this is a determining factor in the firm's adoption decision, as huge initial cost will deter potential adopters. The models specify that firms differ in relation to capital stocks, firm size, production costs, and expected profit resulting from innovation and these differences are fundamental to the rate of technology diffusion.

Other characteristics of firms have been cited, with the rank model as the cause of variation in adoption of new technology. Larger firms are more receptive to technology diffusion or adoption (Hall and Khan, 2003; Feder and O'Mara, 1981; Davies, 1979 and David, 1966). These streams of literature theorised that large firms have greater capacity to adopt new technologies because they are able to spread risk, access credit, and to take advantage of economies of scale associated with new technologies. Also larger firms have large financial resources which give them leverage to manage the challenges [8] associated with the adoption of the new technology and they are better able to deal with high switching cost compared to smaller firms. However, Wozniak (1987), McWilliams and Zilberman (1996) and Geroski (2000), have asserted that firms are discouraged to adopt new technology when high switching costs are expected to be incurred. Switching costs vary from firm to firm as they may differ in the skills required to deal with the new technology and they may also have different absorptive capacity. Firms find adoption less profitable if the cost of training employee and also switching to the new technology

[8] According to Blackman (1999) firms are likely to lose efficiency when they adopt new old technology.

is high. Bresnahan et al. (2002), thus argues that the human capital and capabilities are two important factors in firm's decision to adopt innovation or new technology.

Rogers (1995) analyses the adoption of innovations at the individual level in the theory of Diffusion of Innovations (DOI)[9]. Rogers (2003) defined diffusion of an innovation as "the process through which an innovation is communicated through certain channels over time among the members of a social system". Specifically, DOI identifies the factors of adoption of new technology at individual levels within the firm or organisation, it further analyses the diffusion processes of the innovation within society through a communication process. He points out that the introduction of an innovation does not lead to instantaneous adoption, but rather a gradual process of adoption by potential users. These stages of the adoption process, according to Rogers, lead to some firms adopting innovation earlier than others. Therefore, Rogers advances the argument that potential adopters of innovation go through several stages before finally making the adoption decision.

The first stage of innovation adoption starts with knowledge of the existence of the innovation (Rogers, 2003) which occurs when potential users or adopters are informed of the innovation and receive an understanding of its usefulness. Awareness of the existence of the innovation and its usefulness is largely determined by the attributes[10] of a particular potential adopter. This awareness of innovation takes place in two main ways – passive form and active form. Passive form occurs when one becomes aware of the innovation through an external message, while active form is when the individual searches for the existence of innovative solutions which meet a requirement.

With the awareness of the innovation the individual then appraises the innovation to determine whether it meets their specific needs so as to form an opinion. The evaluation of the innovation according to Rogers is based on the relative advantage, compatibility, complexity, trialability and observability. If the individual or potential adopter is satisfied with the attributes of the innovation at this stage of the process

[9] The Diffusion of Innovation was first published in 1962.
[10] Personal, social and economic attributes and other characteristics of the individual or firm can affect the initial awareness.

then the decision to adopt is made, however if the potential adopter is not satisfied with the attributes of the innovation then the individual rejects the innovation. This is the decision stage of the innovation process. When the decision to adopt is made, the innovation is then implemented and installed by the potential adopter. Rogers asserts that the potential adopter can opt to adopt the innovation in its original form or will ask for modifications which serve specific needs. The last stage of the innovation process is confirmation by the adopter that the actual advantages derived from the innovation compares to the expected benefits.

Fudenberg and Tirole (1985) introduced a more game-theoretic or strategic approach in determining the path of adoption or diffusion of new technology known as the stock effect model. The model is founded on the presumption that the net return on adoption is dependent on the total stock of firms (total number of firms that have previously adopted) that have adopted. The net return is negatively correlated with the stock of firms using the technology implying that increases in stock of firm tend to decrease the net return on adoption. A fall in average cost of production in a particular industry due to adoption of a new technology may result in output prices declining; according to Fudenberg and Tirole (1985) the stock effect of technology adoption has taken place. The stock effect thus stipulates that increases in adoption reduce output prices which in turn lower the net return on adoption. Intuitively, the stock effect model indicates that adoption is relatively more profitable for a certain number of firms at the early stages of the inception of new technology. The stock effect is not dependent on heterogeneity across firms and the order of adoption. The conclusion of the stock effect model is contrary to that of rank and order models, which indicates that the net return on adoption increases over time acting as an incentive for the non-user to adopt. The adoption periods for firms differ largely because the net return declines as the number of adopters increase over time. The strength of the stock determines the rapidity of technology diffusion; stronger stock effect will lead to rapid diffusion of the technology and vice versa.

2.2 Empirical literature

Several of the empirical studies on ICT adoption/diffusion have followed recent developments in the theoretical literature. Some studies in the past have examined the determinants of technology adoption, in general, among firms (Karshenas and

Stoneman, 1995; Battisti et al., 2007, 2009; Hollenstein and Woerter, 2008), while other studies have been more specific by examining the key elements which explain differences in ICT adoption across firms and industries (Hall and Khan, 2003; Hollenstein, 2004; Erumban and De Jong, 2006;). Earlier empirical studies have been focused generally on the epidemic learning models (Mansfield 1963a, 1963b, 1968), while later works take into account the rank, stock and order effects models (Karshenas and Stoneman 1993; Blackwell, 1999). While some empirical studies are based on at least one of the theoretical models, other studies have combined two or more of these models when assessing the determinants of technology adoption. Haller and Siedschlag (2011) observe that the bulk of the existing empirical literature has placed an emphasis on inter-firm diffusion while intra-firm adoption has been relegated to the background, a view also held by Battisti and Stoneman (2003).

Lefebvre and Lefebvre (1996) show that there are two groups of factors influencing the decision to adopt ICT: internal factors and external factors. The internal factors include among others, the firm's characteristics, and its past experience relating to technology usage, the firm's attitude towards technology usage, and the pursued strategy of the firm. External determinants include the characteristics of local industrial structures such as network externalities, information and knowledge spill over, and competitive pressure (local, regional and international competitiveness).

2.2.1 Firm characteristics

The technology adoption decisions of firms are restricted by their characteristics, which impact among other things, their capacity to adopt and use new technologies in order to derive the maximum possible benefits and to also bear the costs involved. Firm characteristics have been extensively used in the literature to ascertain their influence on the decision by firms to adopt technology. These characteristics include firm size, age and ownership structure. Davies (1979) shows that a firm's decision to adopt a new technology at a particular time is largely dependent on its expected returns exceeding a certain threshold which are unobservable. The expected return and threshold are both dependent on the firm's size, as at a critical size the firm equates the expected return to the threshold.

The adoption of the technology according to Davies (1979) is directly related to the critical expected size and delay in adoption is attributable to the firm not attaining the expected size or it anticipates a fall in size below the expected critical level. Thus, Davies (1979) emphasises the importance of firm size in the literature and this has featured more prominently in the empirical literature on adoption determinants than any other firm characteristic. This is mainly because it is easily observable and can be used as a measure for other variables that are unobservable or believed to be wrongly measured (Geroski, 2000). Large firms are thought to employ more skilled and technically able human resources making it easier for such firms to adopt the new technology. In addition, they have the financial and technical ability to adopt new technologies (Geroski, 2000).

Despite this, there is a lack of conclusive empirical evidence suggesting that firm size influences the adoption decisions of firms. While some studies find a positive correlation between technology adoption and firm size (Bayo-Moriones and Lera-Lopez, 2007; Giunta and Trivieri, 2007; Morgan et al., 2006; Fabiani et al., 2005; Dholakia and Kshetri, 2004), other studies also find a negative or lack of a significant relationship (Teo et al., 1997; Lucchetti and Sterlacchini, 2004; Lefebvre et al., 2005; Love et al., 2005). For instance, Fabiani et al. (2005) find strong evidence to suggest that firm size is an important determinant in a firm's ICT adoption decision. Their results show that the larger firms are more likely to adopt ICT compared to smaller firms in Italy's manufacturing sector. Bayo-Moriones and Lera-Lopez (2007), also examine the role of five sets of factors in ICT adoption: firm structural characteristics, human capital, environment, internal organisation and competitive strategy. Using different measurements of ICT adoption they conclude that it is important to analyse various ICT components individually. Their results indicate that firm size is significant in ICT adoption decisions.

Haller and Siedschlag (2008) examine the effect of firm size on access to computers, Internet access, website hosting and access to e-mail using data from Irish manufacturing firms over the period 2001-2004. They find firm size to have a positive effect on adoption of a website. By contrast, firm size has no significant effect on the decision to adopt computers, Internet and email. The empirical literature at best provides mixed evidence of the association between adoption and firm size.

Hollenstein (2004) points out that the correlation between firm size and adoption decisions suggests a nonlinear relationship.

Age of the firm has been considerably overlooked by researchers as a determinant of ICT adoption. The age of the firm and its square are used as a proxy for measuring both the accumulation of experience in general and reductions in the perceived risk of investments in ICT adoption. In both the empirical and theoretical literature, there is a lack of conclusive evidence to suggest that age influences adoption decisions. There are two schools of thought on the impact of age on adoption. One suggests that younger firms may have higher rates of adoption mainly because it is easier to align themselves to the more recent technological generation. On the other hand, the second school of thought suggests that older and incumbent firms due to their experience with previous generations of technology, have learning advantages, and are more likely to adopt newer generation technologies (Barbosa and Faria, 2008).

The empirical literature provides a mixed result. Dunne (1994) finds that plant age and technology use are uncorrelated as the rate of usage of advanced manufacturing technology seems to be the same for both younger and older plants. In contrast, Arora et al (2001) find younger firms embark on organisational restructuring to provide an enabling atmosphere for IT investment as they are more receptive to innovation. Giunta and Trivieri (2007) find a direct and significant relationship between firm age and adoption and this contradicts that of Arora et al (2001). Furthermore, Faria et al. (2002, 2003) also find that older plants in Portugal are more likely to adopt technology compared to younger ones.

The technological demand of firms is dependent on the nature of the industrial sector they operate in as adoption decisions may differ sector to sector. The industrial sector differences in adoption depend on the needs of a particular industry, the nature of demand for the firm's product and also its awareness of innovation and ICT (Love et al., 2005). In addition to these differences, industries may differ in terms of information intensiveness, technology diffusion, industry competition as well as customer and supplier pressures. All these can potentially influence the firm's ICT adoption decisions. The relationship between the firm's industry and the decision to adopt ICT is not clear in the empirical literature. Tan et al (2010) find no evidence

suggesting that the industrial sector is a significant moderating factor in SMEs decisions related to ICT adoption in Malaysia. Their finding is similar to that of Fabiani et al (2005) who find no significant relationship between the industrial sector and adoption decisions of Italian manufacturing firms. Although Thong (1999) also finds that the intensity of information demand, which differ from industry to industry, is not correlated with adoption, he however finds a positive correlation between industrial sector and the extent of adoption.

Bayo-Moriones and Lera-Lopez (2007) draws the conclusion that the effect of the industrial sector in influencing adoption decision is ambiguous. They find that with the exception of computers per employee, Internet and computer users, the industrial sector has no significant effect on firms' adoption decisions. The study of the Indian manufacturing sector Lal (1999) shows differences in the adoption decision of firms across industries. Bilter (2001) also find that firms operating in the manufacturing, services and wholesale trade subsectors of the economy tend to use computers to a larger extent compared to other subsectors such as retail firms.

Other characteristics such as ownership structure, the educational level of the firm owner, the formality of the firm as well as the management structure of the firm have not been examined in both the empirical and theoretical literature. This chapter assesses the effect of these firm level characteristics on the adoption decision of firms.

2.2.2 Market characteristics

The nature of the market that a firm is affiliated to also has the potential to influence its decision to adopt ICT or technology, thus affecting the rate of diffusion. Arduini et al. (2010) points out that a large number of firms in a market is likely to lead to greater competition and will speed up the adoption of new technology. Arduini et al (2010) find that firms operating in competitive sectors, characterized by a large number of firms and high elastic demand, have greater incentive to employ new technologies, including ICT, to withstand competitive pressures. Their findings are in tune with the epidemic and probit models. Their results are similar to the findings of Bayo-Moriones and Lera-Lopez (2007); Bocquet et al. (2007); Hollenstein (2004)

and Kowtha and Choon (2001) provide empirical evidence that the complementary effects between strategies, organisation and information technologies tend to influence the adoption of ICT as much as the traditional factors. They study authentic ICT[11] usage as most of the recent literature has focused on computer capital stocks or automation tools. The data enabled them to construct several measures of the traditional factors that influence diffusion. They also studied three types of practice that may lead to a "system effect" in the complementarity view and conclude that perceived competitive environment by a firm positively impacts the adoption decision of firms.

Other studies have gone further and decomposed competition into local and international competition. These studies have argued that exposure of firms to international competition increases the probability of adopting new technologies and increases innovation. Lucchetti and Sterlacchini (2004) found that Italian SMEs that engage in export and are faced with international competition are more likely to adopt ICT compared to those absent from foreign markets. They used data from a stratified random sample of 168 SMEs located in Central Italy and employed a Tobit model to determine the factors of ICT adoption. Their findings are similar to that of Giunta and Trivieri (2007), who examined the determinants of ICT adoption using data on SMEs from Italy, with less than 100 employees. They found that export propensity was positively and significantly related to the adoption of information technology among SMEs in Italy. Hollenstein (2004) and Bayo-Moriones and Lera-Lopez (2007) also found that SMEs engaged in export of their products or services were more likely to adopt ICT.

Generally, studies have found competitive pressure to be a major determinant of ICT adoption among firms; however, some empirical studies do not find a significant relationship between the competitive environment and the decision to adopt ICT. Jeon et al (2006) investigated the determinants of adoption of e-business using survey data of 1200 Korean SMEs. Their empirical analysis was based on the use of *t*-tests to examine the differences between adopters and non-adopters, further a linear probability model alongside a logit model was applied to determine the factors of

[11]Authentic ICT include the use of Electronic Data Interchange (EDI) systems, Enterprise Resources Planning (ERP) software and Customer- or supplier-dedicated web sites.

adoption. They find that competitive pressures do not influence e-business adoption decisions. Similar conclusions were reached by Teo et al (1997) and Thong (1999), they emphasise that the effect was more pronounced when the adoption of ICT is driven by an attempt to imitate rivals in the market.

Another form of market characteristic that has been prominent in the literature is the ownership structure of the firm. Some studies have found differences in adoption of ICT between foreign- and locally-owned firms, while others have asserted that there is no significant difference between adoption among locally owned firms and those with foreign ownership. Narula and Zanfei (2005) argue that there is a significant difference between multinational corporations and locally owned firms in adoption of new technology, as the foreign-owned firms are more likely to be early adopters of technology. Bayo-Moriones and Lera-Lopez (2007) also find that multinationals were more prone to adopt computers and email in the organisation compared to locally owned SMEs in Spain, similar results were found by Haller and Siedschlag (2008) and Keller (2004). Contrary to these findings, other studies find no difference between foreign-owned adoption of ICT and that of locally-owned firms. Teo and Ranganathan (2004) find that there was no difference between foreign-owned firms and the domestic plants in Singapore in the adoption of business-to-business electronic commerce.

3 Empirical model specifications

In this section of the study, the empirical techniques used in determining the factors driving adoption of ICT among SMEs in Africa are presented. To estimate ICT adoption among SMEs in Africa, the study draws inspiration from the rank and the epidemic theories of technology diffusion discussed within the theoretical literature review. The stock and order effects of technology adoption are not examined due to limitations of the dataset. There is no information on the initial dates of adoption of ICT by the sampled firms. The study will estimate the likelihood of ICT adoption among SMEs across SSA.

ICT comprises of a number of technologies, therefore, it is appropriate to examine the factors that determine a series of these technologies. This will make the results more robust and accurate compared to using aggregate measures of ICT adoption.

This method will allow us to determine whether the various set of ICT devices or tools employed by SMEs in Africa are influenced by different factors. Based on the data available two different measures of the probability or likelihood of ICT adoption in twelve[12] African countries are constructed: computer and Internet adoption. Internet adoption is measured by whether a firm uses the Internet at the work place or not and computer adoption is captured by whether a firm has a computer, which is in working condition, in the organisation or not. Thong (1999) uses a similar approach to capture adoption of a particular type of ICT. The literature refers to this approach as the likelihood of adoption. There are other measures of ICT adoption: extent of adoption, which measures quantities of a particular type of ICT owned and used by a firm (Thong, 1999). This is beyond the scope of this thesis due to data limitations.

The determinants of ICT adoption vary considerably across countries and as such a meta-regression analysis (MRA) is conducted to obtain consistent predictors across the sampled countries. Meta-analysis is a statistical tool which enables comparison of findings across numerous studies: in this case, the same regression repeated across several countries. The technique is commonly applied in medical research, and psychology literature, and in recent times in social science studies, but less so in economic research. This chapter uses Meta-analysis techniques for a variety of reasons:

- MRA allows for the synthesis of literature by bringing together results from different but related studies;
- It is appealing because the data points employed in the analysis are derived from individual studies, and this case, it is from individual country estimations; and
- MRA also adds rigour to the search for consistency in the determinants of ICT adoption across the sampled countries.

3.1 Empirical model

This chapter aims to replicate existing studies (Hollenstein, 2004; Bayo-Moriones and Lera-Lopez, 2007; Haller and Siedschlag, 2010), using the SMEs e-Access and Usage dataset, for SSA countries. It begins by estimating a likelihood of adoption

[12] Namibia and Tanzania are dropped from this study as they have several missing observations.

model. These results are then used to conduct a meta-regression analysis to derive consistent determinants of adoption of both computers and Internet usage among SMEs across SSA. The study uses two different variables to measure the likelihood of ICT adoption – computer and Internet accessibility.

Computer accessibility indicates whether the firm has a computer at the work place, which is in working condition and used on a daily basis. This is a binary variable that takes the value one if the firm has a computer in working condition and zero otherwise. This variable is extensively used in the literature as a measurement of ICT adoption (Tiffin and Balcombe, 2011; Bayo-Moriones and Lera-Lopez, 2007; Gretton et al., 2004; Maliranta and Rouvinen, 2004; Hollenstein, 2004) as it is easily observable making it a good measure of computer usage. Internet access is also used to measure ICT adoption and it is a binary variable, taking a value of one when there is an Internet connection at the workplace and zero otherwise.

3.2 Likelihood of ICT adoption model

The likelihood of ICT adoption variables are measured based on the firm's accessibility of these elements of ICT. The likelihood of adoption of ICT in firm *i* is modelled as a function of firm size, age, human capital, competitive pressure (local or national competitive pressures)[13], industry concentration, particular type of ICT user ratio (internet and computer user ratios), industry specific characteristics and country specifics[14]. An empirical model is constructed to analyse the likelihood of ICT adoption among firms based on the epidemic and rank/probit models of technology adoption. In accordance with the literature, we represent the net benefit from adoption of the *z* ICT adopted by firm *i* as Π_z^i. It is observed that if firm *i* adopts *z* technology then the net benefit function of the firm is,

$$\Pi_z^i = \pi\left(x_z^{1,i}\right) - \pi\left(x_z^{0,i}\right) \qquad (2.1)$$

Thus, firm *i* will choose to adopt the *z* ICT equipment if the net benefit associated with its adoption is higher than the net benefit associated by not adopting; that is $\pi\left(x_z^{1,i}\right) > \pi\left(x_z^{0,i}\right)$. According to Davies (1979) the decision of adoption by a firm

[13] Local and national perceptions of both local and national competitive pressures are self-reported variables with yes or no response.
[14] See Appendix A-2 for the description of these explanatory variables.

is conditioned on the expected return from adoption of a particular technology, which is unobservable. Geroski (2000) also asserts that the factors that determine adoption of new technology are observable variables. It must therefore be noted that the net benefit of adoption functions are continuous and unobservable, thus Π_z^i is a latent variable. Therefore, we only observe:

$$\begin{cases} x_z^i = 1 \\ x_z^i = 0 \end{cases} \text{ if } \begin{cases} \Pi_z^i > 0 \\ \Pi_z^i \leq 0 \end{cases} \tag{2.2}$$

We define the variable x such that $x_z^{1,i} = 1$ if the *i*th firm adopts the *z* ICT equipment and x such that $x_z^{0,i} = 0$ if the firm does not adopt the *z* equipment. Then $\pi\left(x_z^{1,i}\right)$ is defined as the net benefit accrued to firm *i* from the adoption of the *z* ICT equipment, whilst $\pi\left(x_z^{0,i}\right)$ is the net benefit assigned if the firm fails to adopt. Thus, the probability that the *i*th firm adopts the *z* ICT equipment is given below as:

$$\Pr\left(x_z^{1,i} = 1\right) = \Pr\left[\pi\left(x_z^{1,i}\right) > \pi\left(x_z^{0,i}\right)\right] = \Phi[\mathrm{X_i}(\beta_\mathrm{a} - \beta_\mathrm{n})] \tag{2.3}$$

Where Φ is the cumulative distribution function of $[\varepsilon_{i,a} - \varepsilon_{i,n}]$. If we normalise the benefit accrued by the firm for failing to adopt the *z* ICT to zero (which is given as $\pi\left(x_z^{0,i}\right) = 0$), we derive the empirical equation for the firm's ICT adoption:

$$\Pr\left(x_z^{1,i} = 1\right) = \Pr\left[\pi\left(x_z^{1,i}\right) > 0\right] = \Phi(\mathrm{X_i}\beta_\mathrm{a}) \tag{2.4}$$

From here we can empirically examine the determinants of ICT adoption among firms in SSA through the estimation of the empirical equation (2.4) using a Probit model. However, given the non-linearity nature of the model, it implies that linear estimators are not applicable, thus we rely on Maximum Likelihood Estimation (MLE). There are two underlying assumptions of the Probit model: a normally distributed error of mean equal to 0 and a variance of 1; it also assumes a cumulative distribution function of a random variable given by the function Φ(.).

A general problem associated with using a single equation approach is that it overlooks the possible correlation that may exist between a firm's choice of computer and Internet usage. In reality the availability of an Internet connection at the work place is based on the precondition of computer adoption. Hence the

prerequisite for Internet adoption within the firm is access to a computer. Conversely, computer adoption decisions are based on Internet adoption decisions, that is, a computer in itself is an intermediate good to Internet accessibility. The fundamental argument is that conditional on the characteristics of usage, a computer in the organisation can serve as a final commodity or an intermediate commodity used in accessing the Internet.

A limitation of the Probit model is that the error terms of the computer and Internet adoption models are likely to be correlated. Consequently, the MLE is not an efficient estimator mainly because it disregards the possibility that the error terms of the two decisions may be correlated. The appropriate approach that captures this correlation is a Bivariate Probit model (Greene, 2003). In the Bivariate Probit model, the error terms follow a Bivariate normal distribution:

$$\begin{aligned} &Pr\left(ict_v^i = 1\right) = \Phi[X_i, \beta] \\ &Pr\left(ict_t^i = 1\right) = \Phi[X_i, \theta] \\ &E(\varepsilon_v) = E(\varepsilon_t) = 0; V(\varepsilon_v) = V(\varepsilon_t) = 1;\ Cov(\varepsilon_v, \varepsilon_t) = \rho \end{aligned} \tag{2.5}$$

The Full Information Maximum Likelihood (FIML) technique is used to estimate the Bivariate Probit model. It uses a likelihood function which is defined in terms of a standard normal Bivariate probability function. The possible correlation of the two models offers a comprehensive basis to model both adoption decisions of firms together. If ρ is equal to zero, it implies the that two adoption models are independent and the Probit model is appropriate, however if ρ is not equal to zero then the error terms of the two adoption models are correlated and the Bivariate Probit is the best approach of estimating our two models of adoption. However, we are able to observe Internet usage by a firm only if it has access to a computer, consequently the usage of Internet by the firm is dependent on the probability of the firm having an internet connection. According to Heckman (1974) the sample of firms with Internet access are not randomly selected hence a possible selection problem arises. This selection problem, if it exists, makes the bivariate probit model an inappropriate technique as it does not deal with selection bias.

To deal with a possible selection bias problem that may arise we resort to using a Bivariate Probit model with sample selection, which is based on the Heckman two-

step estimation technique of dealing with a dichotomous response in the presence of sample selection. The technique proposed by Heckman solves the sample selection problem within a framework of a specification problem. For the Heckprobit to be well defined it is appropriate to have at least one variable not captured in the bivariate probit model to represent the omitted part of the sample. Otherwise, the coefficients have no structural interpretation and are only recognised by their functional form. The chapter thus estimates a Bivariate Probit model which deals with the problem of sample selection (*HeckProbit*) for the decision to adopt computer and the Internet at the firm level.

The chapter estimates two equations with binary choice dependent variables (Internet accessibility and access to a computer), which we use as a measurement of the likelihood of ICT adoption. We thus estimate the determinants of ICT adoption using the Bivariate Probit model accounting for selection biasness, based on the rank and epidemic effects[15] of ICT adoption. Unobserved industry specific characteristics are controlled by creating industry level dummies. The chapter draws the factors that motivate adoption of ICT from both the theoretical and the empirical literature. Empirically, the chapter estimates the ICT adoption model given below as:

$$\Pr(\mathrm{ict}_{\mathrm{i}}^{\mathrm{z}} = 1) = \Phi(\propto + \beta_1 \mathrm{lnw}_{\mathrm{i}} + \beta_2 \mathrm{lnem}_{\mathrm{i}} + \beta_3 \mathrm{age}_{\mathrm{i}} + \beta_4 \mathrm{exp}_{\mathrm{i}} + \beta_5 \mathrm{own}_{\mathrm{i}} + \beta_6 \mathrm{edu}_{\mathrm{i}} + \beta_7 \mathrm{for}_{\mathrm{i}} + \beta_8 \mathrm{com}_{\mathrm{i}}^{\mathrm{r}} + \beta_9 \mathrm{com}_{\mathrm{i}}^{\mathrm{n}} + \beta_{10} \mathrm{pen}_{\mathrm{i}}^{\mathrm{z}} + \psi_{\mathrm{k}} + \varepsilon_{\mathrm{i}}) \quad (2.6)$$

Where, ict_i^z is the *z* ICT tool that firm *i* adopts; lnw_i is the log of the average wage of firm *i*; $lnem_i$ is the log of the number of employees of firm *i*, including the owner if he/she works in the organisation; age_i measures the age of firm *i* in years; exp_i is square of firm *i*'s age; own_i measures the ownership structure of firm *i*; $educ_i$ is the educational level of firm *i*'s owner; for_i represent the formality of firm *i*; com_i^n measures whether firm *i* faces competition at the national level; com_i^r measures the regional competition faced by firm *i*. The pen_i^z measures the proportion of firms with ***z*** ICT equipment/facility operating in a particular industry and ψ_k represents industry specific characteristics. Since we have a two different ICT variables - Internet and computer usage the Bivariate Probit model extents to a Seemingly Unrelated Bivariate Probit (SUR Biprobit) model.

[15] We are unable to identify stock and order effects models of ICT adoption due to a limitation in the dataset, which does not have the initial ICT adoption dates by firms.

3.3 Meta-regression analysis

The purpose of meta-analysis is to amalgamate results from a set of studies and control for heterogeneity which might exist in the different studies. Meta-analysis has the ability to solve issues of subjectivity which are linked with traditional narrative literature surveys, and may indeed provide a more systematic and objective (quantitative) assessment of an existing body of findings (Mekasha and Tarp, 2013). The Meta-analysis approach is not without its problems (Stanley 2001) and care must be taken lest the technique provides an assessment of the existing body of findings which may not be objective. The technique requires a great deal of effort as a small violation of the underlying rules can lead to misleading results. Meta-regression describes observational relationships across studies, which are based on random samples. However, MRA pools these studies and does not have the benefit of randomisation to underpin a causal interpretation (Higgins and Thompson, 2002). Further, meta-analysis has been criticised as simply putting together results from quite different studies and calculating a summary statistic as if it is one big study. This is an erroneous perception as meta-analysis goes beyond providing summary statistics. Meta-analysis explores results within each study, in our case each country, and calculates a weighted average.

The Bivariate Probit models are estimated for each of the 12 sampled countries. The determinants of ICT adoption is expected to vary across the region, therefore, the study uses meta-regression analysis (MRA) to identify consistent determinants of ICT adoption across the countries. According to Hunt (1997), meta-analysis is a "means of combining the numerical results of studies with disparate, even conflicting research methods and findings to discover the consistencies in a set of seemingly inconsistent findings". MRA enhances the search for consistency of the determinants of ICT adoption across Africa, as a single study will not offer appropriate and decisive answers on which policy can rely across the continent.

An appropriate MRA would determine whether the combined effect size[16] of individual country estimations is significantly different from zero or not. The approach is to pool coefficients for each of the covariates of the various countries

[16] The effect size quantifies the effectiveness of a particular intervention or study, relative to some comparison. In this thesis effect size is the coefficients of various variables for each of the countries.

and examine the overall weighted mean effect of the determinants of ICT adoption. The fixed and random effects models are the two approaches used to estimate the average pooled effect. The fundamental difference in the two methods lies in the underlying assumptions of the models. The fixed effects model assumes that the effect sizes are the same for all studies and are drawn from the same sample, implying homogeneity in the true effects for all studies. Consequently, the fixed effect model uses the sample variation (this is assumed to be a result of random sampling error) within the studies to estimate the combined effect size. This is referred to as the within-study variance. This assumption implies that all factors which influence the combined effect size are the same for all studies. Contrary to the fixed effects model, the random effects model assumes that the effect sizes of the different studies are not the same for all studies. The studies are drawn from a sample of possible studies where effect sizes are different. Thus, the model assumes a sampling variation between and within studies. Random treatment effect between the various studies is referred to as heterogeneity.

Meta-analysis estimates the combined effect by assigning weights to each study's effect size (coefficients of the determinants of IC adoption). Greater weights are assigned to studies carrying more information (Borenstein, et al., 2011) and are based on the inverse of the variance[17] obtained from each study. The inverse variance is given by $1/v_i$ where v_i is the within-study variance. On the other hand, the random effects model in addition to the within-study variance recognises the between-study variance and accounts for both the former and the latter in estimating the weights to be assigned. The weights assigned in the case of random effects model is given as $1/(v_i + \tau^2)$ where τ is the between study variances and v_i is defined above.

To generate a consistent combined effect size it is imperative that the conduct of meta-analysis is devoid of any form of bias. This is because the technique suffers from different forms of bias. Heterogeneity in effect sizes as well as poor methodology associated with smaller studies may bias meta-analysis results. Harbord

[17] The inverse variance is roughly proportional to the sample size, but is more a nuanced measure and serves to minimise the variance of the combined effect (Borenstein, et al., 2011)

et al. (2009) suggests the use of the funnel plot[18] to determine the presence of any bias, however, asymmetry in the funnel plot can be used to examine small study effect[19] rather than as a tool for diagnosing a specified type of bias (Mekasha and Tarp, 2013). A major limitation of the funnel plot is that it is subjective, due to its dependence on the researcher's own assessment. In this thesis, we account for other forms of bias such as differences in sample size across countries.

To estimate the combined effect size for each of the determinants of computer and Internet adoption, we follow Stanley and Jarrell (1989) and Phillips (1994) and specify our MRA as follows:

$$E_{is} = \sigma_0 + \sum \sigma_{is} Z_{is} + \varepsilon_{is} \qquad (2.7)$$

Where the dependent variable, E_{is} is the reported estimate of ICT determinant *s* for country *i* and Z_{is} are the independent variables of different characteristics which may explain variations across countries. The variable σ_s measures of the impact of these biasing effects resulting from variations in countries and ε_{is} are error terms. However, the sample size differs from country to country and hence we account for these variations due to random sampling errors. That is there is the likelihood of heteroscedasticity of the estimates. To control for this we follow Stanley (2005) by estimating a weighted least squares by dividing equation (2.7) by the estimated standard errors (SE_{is}). We therefore control for the differences in samples across the various country studies thus eliminating heteroscedasticity challenges. Equation (2.7) can be written as:

$$T_{is} = \frac{E_{is}}{se_{is}} = \sigma_0 \frac{1}{se_{is}} + \sigma_1 \sum \sigma_{is} \frac{z_{is}}{se_{is}} + \mu_{is} \quad \text{where } \mu_{is} \text{ is given as } \varepsilon_{is}/se_{is} \qquad (2.8)$$

Equation (2.8) implies that in the absence of any form of bias and assuming a non-zero underlying effect, small studies will have a low precision ($1/se_{is}$) and a standardized effect (E_{is}/se_{is}) close to zero (Mekasha and Tarp, 2013). Conversely, the equation also shows that large studies are expected to have high level of precision

[18] The funnel plot is a scatterplot which shows the relationship between the estimated effect sizes of individual studies, measured on the horizontal axis, against their standard errors or in other cases based on sample size or precision, measured on the vertical axis. The principle behind the plot is that larger studies will spread narrowly at the top of the plot while smaller studies will have a wider and more even dispersion around the mean effect size at the bottom of the plot. It assists in the determination of bias in the conduct of MRA.

[19] This is the tendency for small studies in a meta-analysis to show larger treatment effects.

and standardised effect. Smaller studies on average are assigned lower weight while bigger studies are assigned greater weight. The study employs the same data for all the countries and the same methodology is used for the estimation of the coefficients in the various country studies. In addition the study was conducted by the same author and all results are used in the meta-analysis, thus the independent variable of different characteristics which explains the variation across countries reduces to zero in equation (2.8). We therefore drop the *Z* variable from equation (2.8).

4 Empirical results

The presentation and discussion of results are divided into two parts. We present and discuss results of the Biprobit models and proceed to present the results from the meta-analysis. It is imperative to state that there are clear endogeneity concerns with some of the independent variables: firm size, formality decision and ownership structure. In this regard, the interpretations of the results are essentially correlation rather causal effects. An approach of dealing with this problem is the use of Instrumental variable Biprobit technique. However, the lack of suitable instrumental variable does not allow us to apply this technique. In spite of this limitation, the uniqueness of the dataset and the lack of comprehensive studies on the usage of ICT among firms in Africa make the study appropriate to pursue.

4.1 Bivariate probit results

Maximum likelihood estimates of equation (2.6), is presented in Table 2.1. The results show that, aside from Nigeria, the two adoption decisions are interdependent in the remaining countries as the ρ values of the Biprobit models (Table 2.1) are all significant. This implies that unobservable factors which influence decision to adopt a computer and the Internet are correlated and the two decisions must be modelled simultaneously. The study also accounts for possible problem of sample selection and estimates a Heckman Probit model. However the results indicate the absence of sample selection problems in the various countries. We report the marginal effects (evaluated at the means of the explanatory variables) in Table 2.2 for enthusiastic adopters (firms with access to both the Internet and computers) and complete non-adopters (firms without access to computers or Internet) and the levels of significance for all countries. However, we compute the marginal effects for Nigeria from the probit model.

Table 2. 1: Determinants of computer and Internet adoptions –Bivariate Probit

	Botswana		Cameroon		Ethiopia		Ghana	
	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption
log of wage	0.173	0.268*	0.590***	0.639***	0.207*	0.235*	-0.058	0.052
	(0.137)	(0.158)	(0.200)	(0.160)	(0.125)	(0.127)	(0.102)	(0.106)
log of employees	0.400*	-0.375	-0.140	-0.480**	0.074	-0.255	0.431**	-0.088
	(0.206)	(0.236)	(0.257)	(0.227)	(0.199)	(0.172)	(0.190)	(0.199)
age of firm	-0.086	0.041	-0.018	-0.090	-0.004	0.023	-0.071*	-0.041
	(0.059)	(0.055)	(0.059)	(0.056)	(0.040)	(0.043)	(0.038)	(0.047)
age squared	0.004	-0.001	-0.000	0.002	-0.0005	-0.001	0.002*	0.0003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
form of ownership+	-0.087	-0.780***	-0.488	-0.429	0.204	-0.156	-0.519**	-0.205
	(0.238)	(0.24)	(0.468)	(0.448)	(0.305)	(0.272)	(0.258)	(0.253)
primary education+	-0.969**	-1.314**	-0.983*	-0.519	-1.349***	-0.930*	-1.629***	-5.807***
	(0.472)	(0.550)	(0.527)	(0.551)	(0.351)	(0.522)	(0.458)	(0.390)
secondary education+	-0.607**	-0.140	-0.578	-0.524	-1.233***	-0.212	-0.913***	-0.585**
	(0.292)	(0.300)	(0.383)	(0.495)	(0.236)	(0.237)	(0.269)	(0.272)
vocational education+	0.095	-0.597**	-0.788	0.135	-1.413***	-1.122	-2.086***	-1.275***
	(0.296)	(0.302)	(0.501)	(0.481)	(0.523)	(0.741)	(0.389)	(0.389)
semi-formal sector+	-0.023	0.726*	-0.371	-0.128	0.485**	0.556**	1.397***	0.300
	(0.364)	(0.427)	(0.303)	(0.360)	(0.240)	(0.284)	(0.322)	(0.368)
formal sector+	0.889**	0.361	-0.399	-1.459**	0.856**	1.106***	2.085***	1.376***
	(0.363)	(0.457)	(0.463)	(0.608)	(0.392)	(0.375)	(0.381)	(0.370)
local competition+	1.018*	-0.042	-0.497	-0.857*	-0.355	-0.181	1.705***	0.008
	(0.557)	(0.740)	(0.469)	(0.510)	(0.391)	(0.466)	(0.651)	(0.538)
national competition+	0.695***	0.302	0.341	0.475	0.218 (	0.486**	0.447*	0.694**
	(0.259)	(0.287)	(0.348)	(0.408)	0.234)	(0.229)	(0.239)	(0.276)
market concentration	14.476	86.41***	60.674	5.049	197.295**	75.898*	-7.866	-4.197
	(56.557)	(28.32)	(46.170)	(7.003)	(85.240)	(39.89)	(8.193)	(6.936)
manufacturing	0.379	0.288	-0.266	0.346	-0.148	0.118	0.098	0.211
	(0.323)	(0.330)	(0.541)	(0.551)	(0.273)	(0.330)	(0.314)	(0.327)
construction	-0.934	-2.717***	-0.366	0.112	-1.196	-0.746	0.663	0.392
	(0.777)	(1.03)	(0.533)	(0.521)	(0.773)	(0.700)	(0.473)	(0.548)
internet user ratio		2.676***		6.435***		3.097***		1.365
		(0.770)		(1.686)		(0.507)		(0.979)
computer user ratio	7.111***(2.677)		4.322***(1.017)		2.909***(0.641)		2.952***(0.817)	
prob >chi^2	0.000		0.0000		0.0000		0.000	
log pseudo likelihood	-152.0724		-82.251733		-144.33408		-151.34806	
athrho	0.684*** (0.207)		1.117* (0.658)		1.431*** (0.229)		0.965***(0.233)	
rho	0.594*** (0.134)		0.806* (0.230)		0.892*** (0.047)		0.746(0.103)***	
observations	255		280		282		280	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. + indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Table 2.1: Continued – Determinants of computer and Internet adoptions – Bivariate Probit

Variables	Kenya		Mozambique		Nigeria†		Rwanda	
	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption
log of wage	-0.030	0.219	0.356***	0.349***	-0.004	0.250	0.343***	0.190*
	(0.151)	(0.143)	(0.103)	(0.106)	(0.144)	(0.183)	(0.113)	(0.109)
log of employees	0.362*	-0.264	0.158	0.118	0.047	-0.099	0.059	-0.075
	(0.215)	(0.209)	(0.154)	(0.139)	(0.223)	(0.251)	(0.176)	(0.163)
age of firm	0.005	-0.027	-0.013	-0.111***	0.063	-0.045	-0.030	-0.042
	(0.045)	(0.049)	(0.033)	(0.035)	(0.057)	(0.051)	(0.029)	(0.026)
age squared	-0.001	0.002	-0.0003	0.002***	-0.003*	0.001	0.0005	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
form of ownership+	-0.243	-0.514**	-0.174	-0.124	0.015	-0.175	-0.393	0.101
	(0.201)	(0.207)	(0.237)	(0.244)	(0.366)	(0.355)	(0.242)	(0.246)
primary education+	-6.21***	-4.789***	-0.613	-0.490	-7.826***	-6.150***	-0.426	-0.878*
	(0.319)	(0.254)	(0.520)	(0.441)	(0.637)	(0.557)	(0.400)	(0.474)
secondary education+	-0.288	-0.578***	-0.532**	-0.450*	-2.055***	-5.922***	-0.060	0.041
	(0.217)	(0.224)	(0.238)	(0.240)	(0.550)	(0.426)	(0.261)	(0.225)
vocational education+	-0.725	-1.029	-0.194	-0.461	-2.707***	0.151	0.052	0.011
	(0.455)	(0.672)	(0.365)	(0.406)	(0.623)	(0.587)	(0.430)	(0.360)
semi-formal sector+	0.394*	0.176	0.465	0.275	1.729***	0.393	0.610**	0.691***
	(0.216)	(0.269)	(0.304)	(0.381)	(0.408)	(0.512)	(0.274)	(0.257)
formal sector+	1.216***	0.742**	1.002***	0.789**	1.552***	-0.525	0.781**	1.285***
	(0.306)	(0.327)	(0.320)	(0.401)	(0.468)	(0.580)	(0.349)	(0.315)
local competition+	-0.417	0.243	-0.234	0.581	-0.673	-0.658	0.504	0.974**
	(0.582)	(0.636)	(0.390)	(0.459)	(0.524)	(0.696)	(0.340)	(0.394)
national competition+	-0.103	0.184	0.223	0.608**	0.408	1.037**	0.102	-0.050
	(0.237)	(0.238)	(0.241)	(0.256)	(0.288)	(0.418)	(0.209)	(0.196)
market concentration	28.48***	13.312*	22.505	28.771	65.821	1.852	0.340	-0.373
	(10.27)	(7.76)	(26.27)	(25.70)	(60.79)	(1.97)	(4.78)	(2.41)
manufacturing	0.382	0.226	-0.052	0.265	1.565***	-0.441	-0.189	0.074
	(0.289)	(0.309)	(0.529)	(0.429)	(0.605)	(0.620)	(0.281)	(0.255)
construction	-1.704**	0.140	-0.595	-0.308	0.825	-6.942***	-0.759*	-0.185
	(0.801)	(0.592)	(0.622)	(0.558)	(0.585)	(1.784)	(0.412)	(0.457)
internet user ratio		3.107***		2.375***		3.507***		2.181***
		(0.652)		(0.761)		(1.024)		(0.705)
computer user ratio	3.521*** (0.646)		1.878*(0.994)		1.743**(0.828)		3.350***(0.745)	
prob >chi^2	0.0000		0.0000		0.0000		0.0000	
log pseudo likelihood	-191.247		-168.634		-86.376		-135.470	
athrho	1.072*** (0.185)		0.931*** (0.202)		0.348 (0.276)		0.893*** (0.225)	
rho	0.790*** (0.069)		0.731*** (0.094)		0.334 (0.245)		0.713*** (0.111)	
observations	277		280		265		279	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. + indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Table 2.1: Continued – Determinants of computer and Internet adoptions – Bivariate Probit

Variables	South Africa		Uganda		Zambia		Zimbabwe	
	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption	Computer Adoption	Internet Adoption
log of wage	0.355**	0.202	0.488***	0.120	0.259**	0.147	-0.003	-0.189*
	(0.172)	(0.143)	(0.127)	(0.149)	(0.111)	(0.119)	(0.065)	(0.102)
log of employees	-0.047	-0.306	-0.131	-0.144	0.040	0.146	0.247*	0.651***
	(0.231)	(0.192)	(0.173)	(0.224)	(0.174)	(0.172)	(0.147)	(0.181)
age of firm	0.037	-0.005	-0.011	0.006	-0.105***	-0.066**	-0.029	-0.034
	(0.051)	(0.063)	(0.032)	(0.040)	(0.034)	(0.031)	(0.040)	(0.037)
age squared	-0.001	-0.001	0.001	0.0002	0.001*	0.002**	0.001	0.001
	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
form of ownership+	0.277	0.345	-0.763***	-0.295	0.198	0.047	-0.254	-0.164
	(0.262)	(0.314)	(0.187)	(0.227)	(0.218)	(0.217)	(0.206)	(0.205)
primary education+	-1.163***	-0.999*	-0.572	-6.030***	-0.421	-0.144	-1.075	0.641
	(0.433)	(0.566)	(0.525)	(0.229)	(0.568)	(0.677)	(0.692)	(0.543)
secondary education+	-0.702***	-0.360	-0.475**	-5.857***	-0.436	-5.872***	-0.447**	-0.995***
	(0.265)	(0.264)	(0.234)	(0.303)	(0.370)	(0.271)	(0.220)	(0.265)
vocational education+	-0.418	0.358	-0.199	-1.211***	-0.104	-0.831***	0.067	-0.699*
	(0.530)	(0.471)	(0.276)	(0.434)	(0.230)	(0.277)	(0.437)	(0.376)
semi-formal sector+	0.544*	0.665**	0.287	0.650**	0.528**	0.018	0.583**	-0.087
	(0.280)	(0.286)	(0.203)	(0.280)	(0.251)	(0.293)	(0.265)	(0.289)
formal sector+	1.497***	1.543***	0.053	0.883***	1.514***	0.462	0.978***	0.701***
	(0.357)	(0.341)	(0.268)	(0.329)	(0.338)	(0.333)	(0.248)	(0.256)
local competition+	0.860	-0.254	1.661***	0.536	-0.156	-1.077	-0.528	0.089
	(0.601)	(0.489)	(0.505)	(0.548)	(0.775)	(0.890)	(0.442)	(0.395)
national competition+	0.548**	-0.115	-0.018	-0.179	0.169	0.663***	0.263	0.471**
	(0.246)	(0.241)	(0.194)	(0.255)	(0.221)	(0.230)	(0.205)	(0.207)
market concentration	-1.940	10.574	38.292	-2.986	135.41*	0.061	-0.661	0.060
	(13.784)	(7.924)	(36.313)	(2.173)	(79.08)	(2.372)	(3.952)	(3.378)
manufacturing	0.476	0.020	0.223	-0.890*	-0.211	-0.100	0.159	0.147
	(0.337)	(0.450)	(0.284)	(0.519)	(0.296)	(0.358)	(0.232)	(0.232)
construction	-4.738***	-2.257	-0.207	-6.016***	-0.264	0.312	0.004	0.274
	(0.866)	(2.057)	(0.402)	(0.335)	(0.590)	(0.500)	(0.441)	(0.378)
internet user ratio		2.796**		2.309***		3.085***		2.658***
		(1.315)		(0.585)		(0.599)		(0.546)
computer user ratio	2.999***(0.677)		3.975*** (0.713)		1.899***(0.564)		2.778***(0.650)	
prob >chi^2	0.0000		0.0000		0.0000		0.0000	
log pseudo likelihood	-186.144		-203.0934		-180.915		-241.373	
athrho	1.282*** (0.229)		1.130*** (0.284)		0.981*** (0.188)		0.827*** (0.146)	
rho	0.857*** (0.061)		0.811*** (0.097)		0.754*** (0.081)		0.679*** (0.079)	
Observations	290		351		276		281	

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. + indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Firm Characteristics

Firm size, proxied by the logarithm of number employees is positive and significant in determining computer adoption in Botswana, Ghana and Kenya but insignificant for Internet adoption (see Table 2.1*)*. However, in Cameroon firm size has a significant and negative effect on the firms' decision to adopt Internet but is insignificant in the computer adoption decision. This result suggests that in Cameroon smaller firms are more likely to access the Internet relative to larger firms. This finding might be due to the lack of effective monitoring in larger firms over Internet usage, as inappropriate usage of the Internet at the work place can reduce productivity. The inconclusive nature of the result is not surprising as contrary to economic theory, which suggests a positive relationship, the empirical evidence has been mixed[20], thus the results across the countries confirm the mixed evidence presented in the empirical literature. The marginal effects in Table 2.2 also indicate that the simultaneous use of both computers and the Internet is not significantly influenced by the manpower of the firm except for SMEs located in Cameroon and Zimbabwe. On the other hand, increases in the workforce reduce the probability of not adopting both computer and the Internet among firms in Botswana, Ghana and Zimbabwe with lack of significant differences among firms located in the remaining countries.

The ownership structure of firms is a significant factor in the adoption decision of computers in Ghana and Uganda, while it is significant in Internet adoption decision in Botswana and Kenya (see Table 2.1). The marginal effect of the Biprobit estimation (Table 2.2) further reveals that sole proprietorships are less likely to adopt both computers and the Internet in their operations relative to other SMEs with other forms of ownership structure in countries such as Botswana and Kenya. In fact for Kenya, the results further suggest that sole proprietorships are more likely to be non-adopters of both computers and the Internet, this is also the case for Uganda and Ghana.

[20] Fabiani et al, 2005; Giunta and Trivieri, 2007 find a positive significant relationship between ICT adoption and firm size, while Love et al, 2005 and Lefebvre et al, 2005 all found an insignificant relationship.

Table 2. 2: Average marginal effect of Bivariate Probit model

Variables	Botswana		Cameroon		Ethiopia		Ghana	
	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0
log of wage	0.051*	-0.034	0.075***	-0.100***	0.036**	-0.044*	0.006	0.007
	(0.028)	(0.023)	(0.018)	(0.028)	(0.018)	(0.023)	(0.015)	(0.016)
log of employees	-0.059	-0.058*	-0.052**	0.031	-0.029	0.002	-0.004	-0.061**
	(0.042)	(0.034)	(0.025)	(0.039)	(0.026)	(0.036)	(0.027)	(0.030)
age of firm	0.006	0.013	-0.010	0.005	0.003	-0.001	-0.007	0.012*
	(0.010)	(0.010)	(0.006)	(0.009)	(0.006)	(0.007)	(0.007)	(0.006)
age squared	-0.000	-0.001	0.000	0.000	-0.000	0.000	0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
form of ownership+	-0.141***	0.030	-0.052	0.080	-0.013	-0.023	-0.038	0.084**
	(0.042)	(0.040)	(0.051)	(0.072)	(0.040)	(0.056)	(0.036)	(0.041)
primary education+	-0.252**	0.186**	-0.068	0.154**	-0.161**	0.256***	-0.814***	0.428***
	(0.099)	(0.076)	(0.059)	(0.076)	(0.074)	(0.073)	(0.087)	(0.083)
secondary education+	-0.036	0.102**	-0.063	0.096	-0.067*	0.200***	-0.096**	0.155***
	(0.055)	(0.050)	(0.052)	(0.059)	(0.035)	(0.041)	(0.039)	(0.041)
vocational education+	-0.104**	-0.003	0.003	0.111	-0.187*	0.275***	-0.212***	0.352***
	(0.052)	(0.050)	(0.053)	(0.073)	(0.101)	(0.102)	(0.057)	(0.058)
semi-formal sector+	0.129	-0.011	-0.018	0.057	0.085**	-0.104**	0.067	-0.218***
	(0.079)	(0.061)	(0.040)	(0.048)	(0.041)	(0.046)	(0.051)	(0.052)
formal sector+	0.081	-0.153**	-0.158**	0.092	0.166***	-0.189***	0.225***	-0.355***
	(0.083)	(0.060)	(0.070)	(0.070)	(0.056)	(0.071)	(0.051)	(0.059)
local competition+	0.012	-0.166*	-0.096	0.092	-0.034	0.064	0.033	-0.255**
	(0.132)	(0.093)	(0.062)	(0.076)	(0.065)	(0.075)	(0.084)	(0.110)
national competition+	0.067	-0.120***	0.054	-0.060	0.068**	-0.059	0.102***	-0.089**
	(0.051)	(0.042)	(0.045)	(0.055)	(0.033)	(0.045)	(0.037)	(0.038)
market concentration	0.157***	-0.042	0.014	-0.089	0.160***	-0.343**	-0.007	0.013
	(0.051)	(0.093)	(0.010)	(0.067)	(0.062)	(0.137)	(0.010)	(0.014)
manufacturing+	0.058	-0.068	0.032	0.030	0.010	0.016	0.030	-0.021
	(0.060)	(0.054)	(0.059)	(0.083)	(0.047)	(0.055)	(0.046)	(0.051)
construction+	-0.502***	0.210*	0.007	0.050	-0.133	0.223	0.065	-0.111
	(0.182)	(0.126)	(0.057)	(0.084)	(0.110)	(0.151)	(0.077)	(0.079)
Internet user ratio	0.477***	-0.056**	0.673***	-0.150**	0.386***	-0.162***	0.184	-0.044
	(0.129)	(0.023)	(0.174)	(0.065)	(0.053)	(0.042)	(0.130)	(0.031)
computer user ratio	0.134**	-1.163***	0.060**	-0.624***	0.096***	-0.447***	0.056***	-0.440***
	(0.060)	(0.417)	(0.023)	(0.114)	(0.022)	(0.084)	(0.021)	(0.117)

+ indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Table 2.2: Continued – Average marginal effect of Bivariate Probit model

Variables	Kenya		Mozambique		Nigeria		Rwanda	
	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0
log of wage	0.033	-0.006	0.071***	-0.083***	0.015	-0.007	0.029*	-0.059**
	(0.026)	(0.035)	(0.019)	(0.021)	(0.012)	(0.017)	(0.016)	(0.025)
log of employees	-0.026	-0.058	0.026	-0.035	-0.005	-0.002	-0.032	0.022
	(0.037)	(0.049)	(0.027)	(0.033)	(0.016)	(0.024)	(0.022)	(0.036)
age of firm	-0.004	0.001	-0.019***	0.007	-0.001	-0.005	0.000	-0.005
	(0.009)	(0.011)	(0.006)	(0.007)	(0.003)	(0.006)	(0.007)	(0.009)
age squared	0.000	0.000	0.000**	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
form of ownership+	-0.090**	0.078*	-0.027	0.038	-0.010	0.004	0.042	-0.056
	(0.037)	(0.047)	(0.045)	(0.050)	(0.025)	(0.042)	(0.034)	(0.043)
primary education+	-1.004***	1.521***	-0.104	0.138	-0.534***	0.979***	-0.130**	0.211***
	(0.109)	(0.115)	(0.088)	(0.113)	(0.069)	(0.102)	(0.061)	(0.076)
secondary education+	-0.102***	0.091*	-0.095**	0.120**	-0.402***	0.392***	-0.054*	0.115***
	(0.039)	(0.050)	(0.044)	(0.049)	(0.057)	(0.066)	(0.029)	(0.041)
vocational education+	-0.190	0.204*	-0.084	0.057	-0.046	0.268***	0.026	0.040
	(0.116)	(0.119)	(0.075)	(0.079)	(0.041)	(0.058)	(0.058)	(0.092)
semi-formal sector+	0.044	-0.089*	0.063	-0.100	0.059	-0.186***	0.081**	-0.109**
	(0.047)	(0.051)	(0.069)	(0.066)	(0.036)	(0.045)	(0.032)	(0.044)
formal sector+	0.166***	-0.287***	0.169**	-0.224***	-0.000	-0.140***	0.194***	-0.285***
	(0.057)	(0.067)	(0.072)	(0.067)	(0.039)	(0.051)	(0.035)	(0.049)
local competition+	0.020	0.070	0.089	0.019	-0.054	0.088*	-0.005	-0.107
	(0.108)	(0.133)	(0.082)	(0.084)	(0.042)	(0.053)	(0.057)	(0.095)
national competition+	0.024	0.010	0.110**	-0.069	0.071***	-0.073**	0.002	-0.070*
	(0.043)	(0.056)	(0.045)	(0.051)	(0.023)	(0.031)	(0.026)	(0.039)
market concentration	0.033**	-0.065***	0.056	-0.055	0.015	-0.067	0.010	-0.003
	(0.015)	(0.023)	(0.051)	(0.059)	(0.013)	(0.060)	(0.011)	(0.022)
manufacturing+	0.051	-0.090	0.043	-0.002	0.005	-0.144**	0.014	-0.067
	(0.053)	(0.065)	(0.080)	(0.107)	(0.040)	(0.057)	(0.051)	(0.063)
construction+	-0.050	0.335*	-0.073	0.126	-0.406***	0.134	-0.346	0.770***
	(0.105)	(0.173)	(0.110)	(0.136)	(0.132)	(0.100)	(0.232)	(0.223)
Internet user ratio	0.483***	-0.176***	0.399***	-0.104**	0.214***	-0.109***	0.284**	-0.139**
	(0.088)	(0.047)	(0.118)	(0.042)	(0.049)	(0.032)	(0.137)	(0.067)
computer user ratio	0.147***	-0.709***	0.068**	-0.355*	0.036**	-0.175**	0.074***	-0.417***
	(0.036)	(0.114)	(0.034)	(0.188)	(0.018)	(0.078)	(0.022)	(0.095)

+ indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Table 2.2: Continued – Average marginal effect of Bivariate Probit model

Variables	South Africa		Uganda		Zambia		Zimbabwe	
	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0	com=1, Int=1	com=0, Int=0
log of wage	0.057**	-0.076***	0.021	-0.108***	0.035*	-0.052**	-0.038*	0.013
	(0.026)	(0.024)	(0.019)	(0.027)	(0.020)	(0.023)	(0.021)	(0.015)
log of employees	-0.014	-0.008	-0.019	0.031	0.023	-0.017	0.146***	-0.090***
	(0.041)	(0.039)	(0.028)	(0.039)	(0.029)	(0.035)	(0.038)	(0.033)
age of firm	-0.011*	0.008	0.001	0.002	-0.015***	0.022***	-0.009	0.008
	(0.006)	(0.006)	(0.005)	(0.007)	(0.005)	(0.006)	(0.009)	(0.009)
age squared	0.000	-0.000	0.000	-0.000	0.000***	-0.000**	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
form of ownership+	0.007	0.072	-0.046	0.170***	0.017	-0.035	-0.050	0.060
	(0.061)	(0.053)	(0.028)	(0.038)	(0.037)	(0.044)	(0.048)	(0.047)
primary education+	-0.215*	0.123	-0.744***	0.234**	-0.043	0.078	0.053	0.169
	(0.111)	(0.088)	(0.077)	(0.118)	(0.124)	(0.136)	(0.137)	(0.156)
secondary education+	0.007	0.010	-0.722***	0.210***	-0.858***	0.485***	-0.228***	0.152***
	(0.057)	(0.057)	(0.068)	(0.059)	(0.093)	(0.092)	(0.057)	(0.052)
vocational education+	0.005	-0.011	-0.151***	0.065	-0.124***	0.075	-0.134*	0.032
	(0.092)	(0.094)	(0.056)	(0.061)	(0.043)	(0.048)	(0.072)	(0.082)
semi-formal sector+	0.181***	-0.150***	0.083**	-0.074	0.031	-0.087	0.023	-0.108*
	(0.062)	(0.057)	(0.035)	(0.045)	(0.049)	(0.053)	(0.065)	(0.059)
formal sector+	0.321***	-0.211***	0.109***	-0.028	0.147**	-0.277***	0.206***	-0.237***
	(0.073)	(0.075)	(0.041)	(0.060)	(0.058)	(0.066)	(0.057)	(0.051)
local competition+	0.240***	-0.143*	0.087	-0.369***	-0.161	0.101	-0.018	0.097
	(0.093)	(0.074)	(0.074)	(0.117)	(0.164)	(0.184)	(0.097)	(0.101)
national competition+	-0.007	-0.018	-0.022	0.007	0.103***	-0.074*	0.111**	-0.082*
	(0.049)	(0.046)	(0.032)	(0.044)	(0.037)	(0.045)	(0.048)	(0.047)
market concentration	-0.001	-0.000	0.001	-0.082	0.073*	-0.219*	-0.000	0.001
	(0.006)	(0.010)	(0.006)	(0.079)	(0.043)	(0.128)	(0.007)	(0.008)
manufacturing+	0.009	0.034	-0.106	-0.032	-0.026	0.041	0.040	-0.041
	(0.064)	(0.062)	(0.065)	(0.064)	(0.060)	(0.064)	(0.054)	(0.053)
construction+	-0.073	0.156*	-0.738***	0.155*	0.030	0.021	0.055	-0.019
	(0.110)	(0.090)	(0.085)	(0.094)	(0.095)	(0.121)	(0.084)	(0.093)
Internet user ratio	0.491***	-0.099***	0.282***	-0.042**	0.438***	-0.218***	0.527***	-0.173***
	(0.148)	(0.038)	(0.064)	(0.017)	(0.080)	(0.045)	(0.099)	(0.041)
computer user ratio	0.138***	-0.653***	0.053***	-0.859***	0.103***	-0.307***	0.190***	-0.544***
	(0.044)	(0.146)	(0.019)	(0.131)	(0.033)	(0.082)	(0.049)	(0.130)

+ indicates that the variables are dummies. Tertiary education used as the omitted category for the education variables. The informal sector is the omitted category in the case of formality of firms. The services sector is also the omitted category for industrial sector of firms.

Table 2.1 also provides evidence which suggests that in most countries the age of the firm is not a determining factor for adoption of either computers or the Internet. However in three countries, the firm's age does influence the adoption decisions of computers and the Internet. The results from these countries indicate that older firms are less likely to adopt computers and the Internet compared to younger ones. The evidence of effect of a firm's age on the probability of adoption of both Internet usage and computers are inconclusive across SMEs in sub-Sahara Africa. The marginal effects in Table 2.2 support this finding, suggesting that older firms are less likely to adopt computers which are connected to the Internet in South Africa, Zambia and Mozambique. The results in Table 2.2 further show that in Zambia older firms are more likely to be non-adopters of both computers and the Internet (see Table 2.2). It further indicates that doubling a firm's age reduces the probability of adoption of both technologies by 0.015 percent. Nonetheless, the probability of young firms not adopting the two technologies is greater, though marginally, than the probability that they adopt the technologies. This finding supports Giunta and Trivieri's (2007) conclusion, that younger firms have a high propensity to adopt ICT; however this contradicts Faria et al. (2002, 2003) who found that Portuguese older firms are more likely to adopt ICT compared to their younger counterparts.

Human capital

Several studies have shown that individual characteristics of the workforce help in the decision to adopt and install new technologies as their characteristics influence the view of other potential users (Venkatesh and Morris, 2000; Bayo-Moriones and Lera-Lopez 2007). Highly skilled and good quality labour force facilitates firm's decision to adopt and install new technologies. A highly skilled workforce is needed if more advanced and complex technologies are to be adopted and installed. Highly skilled workforces tend to command higher wages implying that firms with a high average wage are more likely to employ a highly skilled workforce. The study uses the log of the average wage as a proxy for workforce quality. The results of the Biprobit model in Table 2.1 indicate that the average wage has a significant effect on probability of adoption of the Internet and computers. It shows that SMEs with high average wage are more likely to be observed with computers at the workplace in seven of the countries. Table 2.1 suggests that the decision of Internet adoption is also strongly related to the average wage of firms in six countries. In general, there is

no consistent pattern between the average wage and the use both the Internet and computers in most of the countries studied. However, there is consistency of adoption of both computers and internet in Cameroon, Ethiopia, Mozambique and Rwanda, as the decisions to adopt these technologies are positively and significantly associated with the average wage. The results also further show that SMEs adoption decisions in Ghana, Kenya and Nigeria are not associated with their average wage. An assessment of the ICT Diffusion Index[21] of these countries shows that they all have relatively low indices. Overall, the results show that in eight countries increasing the average wage raises the probability of a firm adopting either computers or the Internet or adopting both technologies. The marginal effects in Table 2.2 also indicate that in eight countries doubling average wage of SMEs raises the probability of adopting both computers and the Internet by around 0.06 percent.

These findings underscore the significance of strengthening the human capital of SMEs across sub-Sahara Africa so as to enhance the adoption of ICT. The findings are consistent with Cohen and Levinthal's (1990) concept of absorptive capacity, which indicates that there should be the prior related knowledge so as to assimilate and use new knowledge. Also the marginal effects show that an increase in the average wage decreases the probability of not observing firms adopting both computers and the Internet in Cameroon, Ethiopia, Mozambique, Rwanda, South Africa, Uganda and Zambia. Therefore, the positive effect of the average wage on the probability of adopting both the Internet and computers is enforced by its negative effect on not having access to these technologies. The findings indicate that employing a high quality human resource increases the probability of adopting, though marginally, both computer and the Internet among African SMEs.

[21] Broadly speaking, the index is a function of connectivity in a nation and the people's ability to access and utilize it. The index according the ITU, measures ICT average development in two dimensions: Connectivity and Access. Connectivity broadly measures ICT infrastructure development in a country by assessing the number of Internet hosts per capita, number of PCs per capita, the number of telephone mainlines per capita and the number of mobile subscribers per capita. Access is measured by number of estimated Internet users, the adult literacy rate, the cost of a local call and GDP per capita (PPP US$). In other word the access component of the Index illustrates the opportunity available to individuals to take advantage of being connected. An index score is calculated for each of these indicators by applying the following formula: value achieved / maximum reference value. Connectivity and access indices are then calculated as an average of index scores of their respective components and index of ICT Diffusion is itself an average of these two dimensions. (UNCTAD, 2006)

The level of education of the firm's owner is also used as a proxy for the human capital. MacGregor and Vrazalic (2007) assert that the education of the firm's owner may influence the decision to adopt new technologies. In most countries, the results of the Biprobit models in Table *2*.1 show that if a firm's owner has tertiary education the firm is more likely to adopt ICT compared to firms owned by an individual with lower educational qualifications. The marginal effects of the Biprobit (Table 2.2) further support these findings.

Environmental factors

Perceived competition both at the local and national level are drivers of computer usage and the Internet in two countries, though the evidence is not consistent. The perceived presence of competition at both local and national levels influences firms' decisions to adopt computers in Botswana and Ghana. In these countries the presence of competition increases the probability of observing computer usage among firms (Table 2.1). The presence of competitive pressure increases the probability of SMEs adopting ICT. The marginal effects in Table 2.2 also show that the decision to adopt both computers and the Internet in most countries does not depend on SMEs' perception of competition. However, the probability of adopting both computer and the Internet in Botswana, Ghana and Uganda declines when SMEs perceive an increase in local competition by 0.17, 0.26 and 0.37, respectively. In South Africa the marginal effects suggest that perceived increase in local competition increases adoption of computers and Internet by 0.2 and also reduces the decision not to adopt both technologies by 0.14. Perceived competition at the national level also positively influences the firms' adoption of the Internet decision in Zambia, Mozambique, Nigeria, Ethiopia and Ghana. It also drives firms to adopt computers in South Africa, Botswana and Ghana. It must also be acknowledged that increase of ICT could in itself increased perceived competition at both local and national levels.

Table 2.1 further indicates that firms operating in highly concentrated markets are more likely to adopt the Internet in Botswana, Ethiopia and Kenya, while such firms are also more likely to use computers at the work place in Ethiopia and Kenya. The marginal effects suggest that the probability of a firm adopting a computer and connecting it to the Internet increases by 0.03 and 0.16 if market concentration increases by 100 percent in Kenya and Ethiopia respectively. High market

concentration also reduces the probability of firms falling into the group of firm with no computer and no Internet by 0.07 in Kenya and 0.3 in Ethiopia.

The ICT adoption penetration rates measured by the Internet and computer user ratio are positive and significant in almost all countries. The ratio of firms with access to the Internet in industry ***j*** to the number of firms in industry ***j*** is positive and significant in all countries except Ghana. The result is similar to the adoption of computers, which shows that in all the countries the decision to adopt a computer is largely determined by the number of firms with access to the device. The findings imply that rival firms in a particular industry are more likely to adopt either Internet or computers if their competitors employ these ICT facilities in their operations. The efforts of governments across the Sub Saharan Africa (SSA) region to increase access to ICT among firms could be more successful if more firms resort to ICT usage as indicated by this finding. The marginal effects provide further insight as it reveals that increases in the ratio of firms with computers increases the probability of adopting both computers and also high ratio of firm with access to the Internet increases the probability of the firm adopting both technologies. On the other hand, high ratio of firms with computer access reduces the probability of a firm falling into the group of firms with no access to computers or the Internet in all the countries. This is similar for the Internet user ratio variable.

In summary, the empirical evidence on determinants of ICT adoption is at best mixed and inconsistent across different countries as shown from the results presented above. The uncertainty and inconsistency of the determinants of adoption makes it quite challenging to recommend clear policy targets. The wide disparity in the determinants of ICT adoption among firms across sub-Sahara Africa obfuscates our understanding of the factors that determine a firm's decision to adopt ICT. To address the inconsistency in determinants of ICT adoption we apply a meta-analysis.

4.2 Results from meta-regression analysis

Due to country differences and heterogeneity, it is challenging to pool several countries estimates together and draw general conclusions from these different studies. Meta-analysis provides an appropriate approach of pooling results from different studies to draw general inferences. It therefore provides an easier way to

interpret the findings from a series of country regressions. The results of the ICT adoption model show that the determinants of ICT adoption vary from country to country across the continent. This finding does not provide a consistent and universal determinant to ICT adoption across the continent. To obtain a universal and consistent determinant of ICT adoption across the sampled countries we employ a meta-regression analysis to estimate parameter (effect size). We proceed by taking a "vote count" of the corresponding sign and number of significant/insignificant combine or overall effect size of each covariate. Based on the results of the vote count the covariates are deemed to have either a positive or negative effect on the adoption of ICT. This approach though crude, as it does not take into consideration difference in the effect sizes and the standard error, affords the opportunity to ascertain which of the variables are determining factors of ICT adoption in the sampled countries and whether it affects adoption positively or negatively. The procedure is undertaken for both computer and Internet adoption.

We present results of a fixed effect MRA model, as it assumes that the effect sizes (coefficients of the determinants of ICT adoption) are derived from similar studies. The study examines the presence or otherwise of heterogeneity in our estimated effect size by a visual assessment of the forest plot, I-square and Cochran's Q. Heterogeneity may be as a result of differences between studies, methodological differences and unknown study characteristics. In this study we rule out differences in methodological issues as the same methodology is used for all countries.

The results indicate the fixed effect model is more appropriate in determining the weighted average effect size for all the factors that explain the adoption of both computers and the Internet. Therefore, this implies homogeneity among firms from the various countries and that there is a uniform effect size for the determinants of ICT adoption for all the countries. This further indicates that the countries are not heterogeneous in their adoption of ICT. Cochran's Q measures heterogeneity among studies (countries) and is estimated as the weighted sum of the squared differences between an individual country study effect and the combined effect across countries. The Cochran test revealed the lack of between-country variability for most of the variables. The test is confirmed by the I-square and the chi-square techniques. The chi-square tests the hypothesis that all studies evaluated exhibit the same effect with

high values suggesting homogeneity. The I-squared statistic shows the extent of variation across countries and studies which is explained by heterogeneity in the country studies rather than sampling errors. In meta-regression the test statistic for significance of each covariate is based on the Z-distribution, and this is the method used in this thesis. The Z-test is used to test the statistical significance of any single covariate holding other covariates constant. The test is given as: $Z = \beta/SE(\beta)$. Where β is the coefficient of any single covariate and SE(β) is the standard error of the coefficient of any single covariate.

Table 2.3 and Table 2.4 present the results of meta-regression analysis based on the fixed effect model for computer and Internet adoption among firms, respectively. The first column of both tables shows the estimated combined or weighted average effect size of each variable. The last column of the tables also displays the un-weighted average effect of coefficients of each variable; this allows a comparison to be made with the weighted average effect from the MRA. We also present forest plots (Lewis and Clarke 2001) in Figure 2.1 and Figure 2.2 of all the determinants of computer and Internet adoption, these plots show the results of an inverse-variance weighted fixed effect meta-analysis.

Table 2. 3: Meta-regression analysis of determinants of computer adoption

Variable	Meta-Regression Analysis			Vote counting		Average un-weighted effect
	Coefficient	Z – value	Chi-square (*p* – values)	Positive (sig.)	Negative (sig.)	Average coeff.
Firm structural characteristics						
log of employees	0.139***	(2.62)	10.76 (0.550)	10 (4)	3 0)	0.1321
age of firm	-0.030	(2.67)	13.97 (0.302)	3 (0)	10 (2)	-0.0270
age squared	0.001**	(1.97)	14.54 (0.268)	10 (2)	3 (1)	0.0006
form of ownership+	-0.213***	(3.14)	20.79 (0.054)	4 (0)	9 (2)	-0.1797
Human capital						
log of wage	0.178***	(5.48)	36.89 (0.000)	9 (8)	4 (0)	0.2449
primary education+	-2.082***	(16.42)	316.3 (0.000)	0 (0)	13 (8)	-1.8804
secondary education+	-0.618***	(8.31)	24.13 (0.020)	0 (0)	13 (9)	-0.7088
vocational education+	-0.482***	(4.67)	46.59 (0.000)	3 (0)	10 (3)	-0.7225
Environment						
semi-formal sector+	0.477***	(6.28)	29.24 (0.004)	11 (8)	2 (0)	0.5301
formal sector+	0.918***	(9.77)	41.04 (0.000)	12 (10)	1 (0)	0.9380
local competition+	0.189	(1.38)	32.86 (0.001)	6 (4)	1 (1)	0.3407
national competition+	0.228***	(3.47)	11.01 (0.001)	11 (3)	2 (0)	0.2543
market concentration	0.024	(0.91)	21.27 (0.47)	10 (3)	3 (0)	0.0114
manufacturing	0.146*	(1.65)	12.84 (0.380)	8 (1)	5 (0)	0.2118
construction	-0.474***	(3.18)	41.94 (0.000)	3 (1)	10 (4)	-0.7852
Computer user ratio	2.873***	(13.77)	15.04 (0.239)	13 (0)	0 (0)	3.2012

Notes: *** p<0.01, ** p<0.05, * p<0.1. Z-values for each parameter in parentheses. +indicate dummy variables.

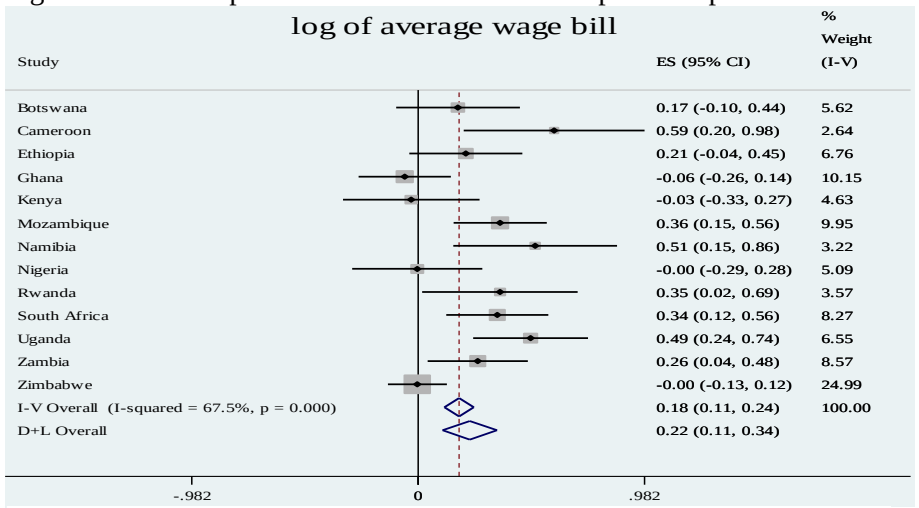
Table 2. 4: Meta-regression analysis of determinants of Internet adoption

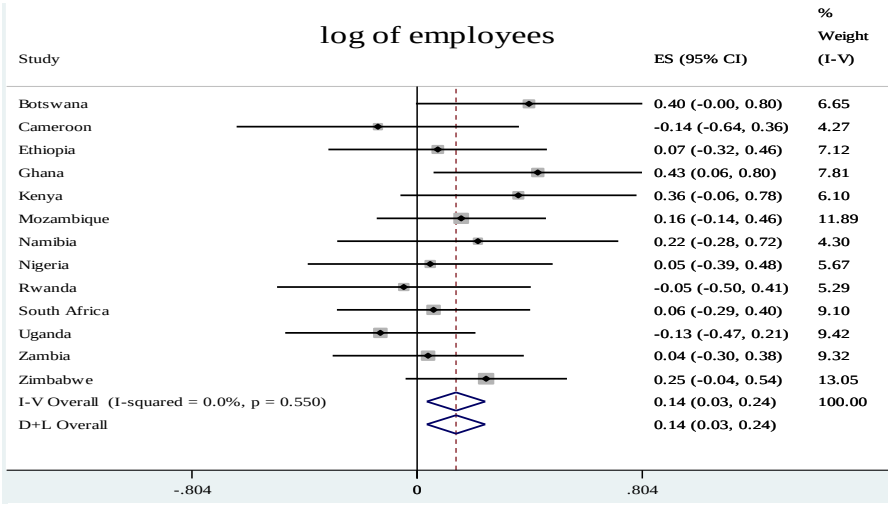
Variable	Meta-Regression Analysis			Vote counting		Average un-weighted effect
	Coefficient	Z – value	Chi-square (*p* – value)	Positive (sig.)	Negative (sig)	Average coefficient
Firm structural characteristics						
log of employees	-0.058	(1.07)	28.16 (0.005)	3 (1)	10 (1)	-0.1107
age of firm	-0.038 ***	(3.32)	12.35 (0.418)	4 (0)	9 (2)	-0.0292
age squared	0.001***	(2.30)	10.20 (0.598)	10 (2)	3 (0)	0.0008
form of ownership^{+}	-3.473***	(3.03)	14.77 (0.254)	3 (0)	10 (2)	-0.2122
Human capital						
log of wage	0.189***	(5.22)	36.44 (0.000)	12 (6)	1 (0)	0.2645
primary education^{+}	-3.473***	(30.68)	478.9 (0.000)	1 (0)	12 (9)	-2.2082
secondary education^{+}	-1.411***	(18.35)	744.3 (0.000)	0 (0)	13 (8)	-1.7497
vocational education^{+}	-0.857***	(7.44)	175.5 (0.000)	4 (0)	9 (6)	-1.1393
Environment						
semi-formal sector^{+}	0.323***	(3.76)	13.33 (0.345)	10 (5)	3 (0)	0.3095
formal sector^{+}	0.746***	(7.32)	42.16 (0.000)	10 (8)	3 (2)	0.4855
local competition^{+}	0.112	(0.77)	14.59 (0.265)	7 (1)	6 (1)	-0.0042
national competition^{+}	0.295***	(4.15)	23.73 (0.022)	9 (6)	4 (0)	0.3236
market concentration	0.005	(0.53)	25.50 (0.013)	10 (4)	3 (0)	0.0175
manufacturing	0.103	(1.06)	5.87 (0.922	10 (0)	3 (0)	0.0383
construction	-1.344***	(8.97)	271.03 (0.000)	5 (1)	8 (1)	-1.4484
Internet user ratio	2. 753***	(13.65)	9.93 (0.622)	13(12)	0 (0)	2.9378

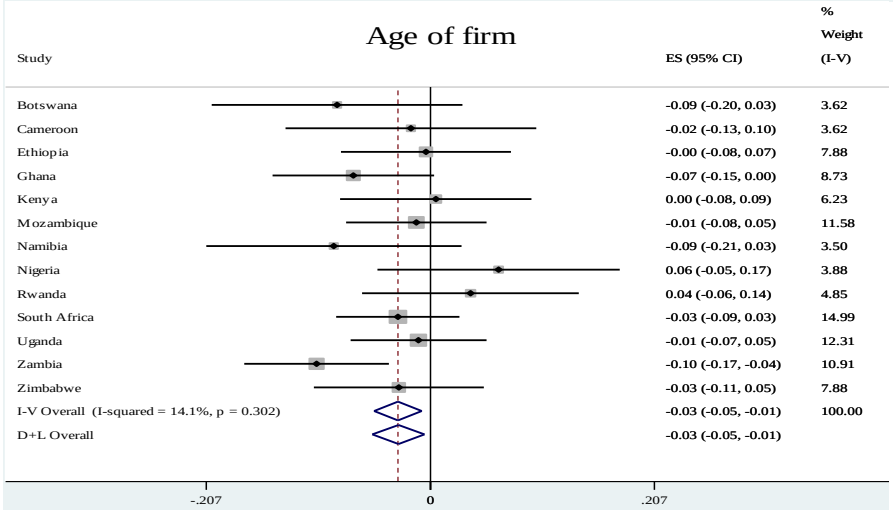
Notes: *** p<0.01, ** p<0.05, * p<0.1

Notes for Figure 2.1 and Figure 2.2 Below: The vertical solid line is the line of no effect while the dashed red line is the average or combined effect size. The grey shaded box represents the point estimate for each country study, with the size of the box depicting the weight assigned to the corresponding study. The larger box denotes greater weights and the smaller box implies smaller assigned weights. Each of the solid horizontal lines emanating from the shade box represents the 95% confidence interval for that particular study. The meta-analytic summary of all the country studies is given as the diamond in plots. The peaks of the diamond relate to the estimated overall effect size and the edges indicate the confidence interval. If the diamond crosses the line of no effect it indicates that the effect size is not significant. The forest plot also provides information on the heterogeneity test, given by the I-squared value. The limitation of the chi-square is it has a low power and is unable to capture significant levels of heterogeneity due to the small number of studies that are captured in our meta-analysis. I-squared thus provides a better approach of assessing heterogeneity as it quantifies the level of heterogeneity by capturing the percent of variation between studies.

Figure 2. 1: Forest plot of the determinants of computer adoption







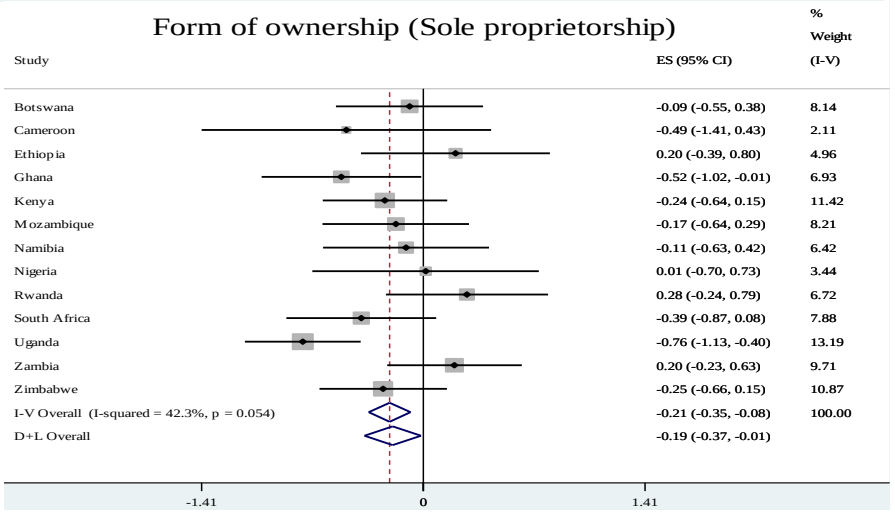
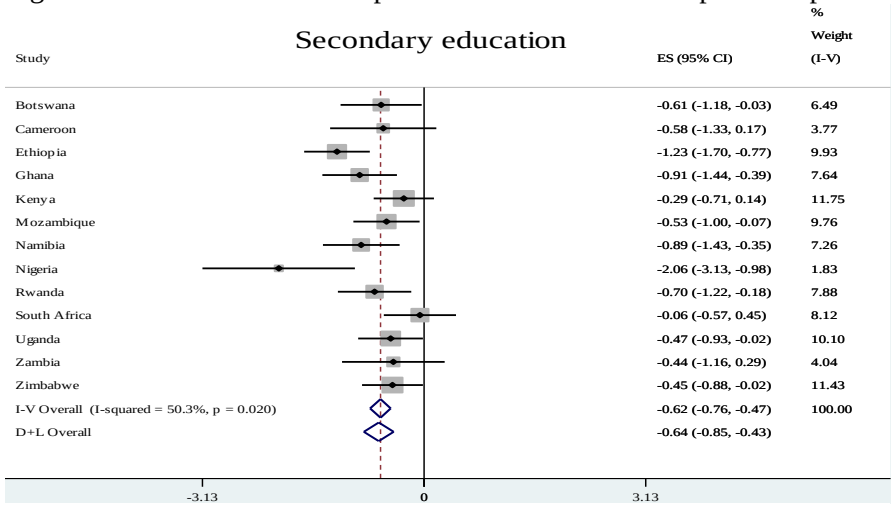
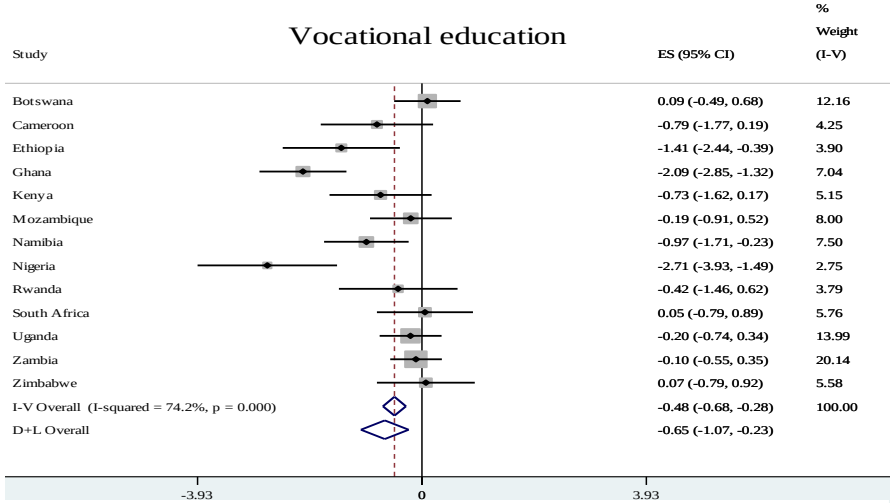
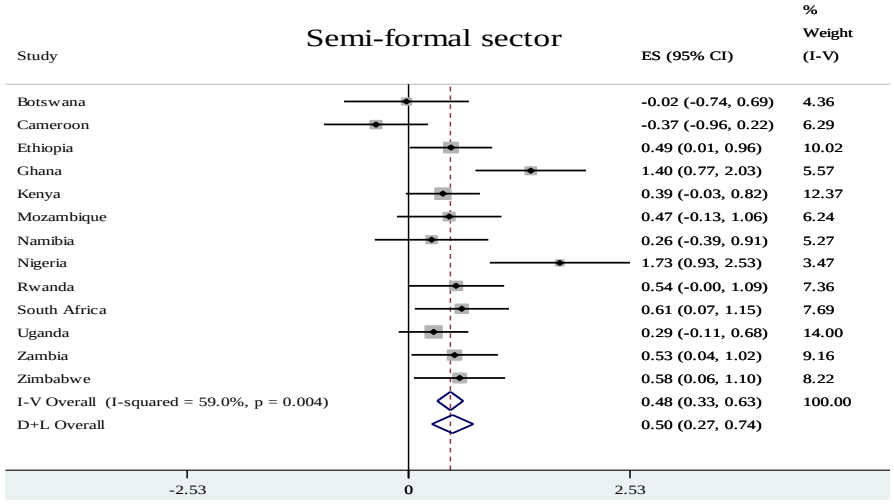


Figure 2.1: Continued – Forest plot of determinants of computer adoption







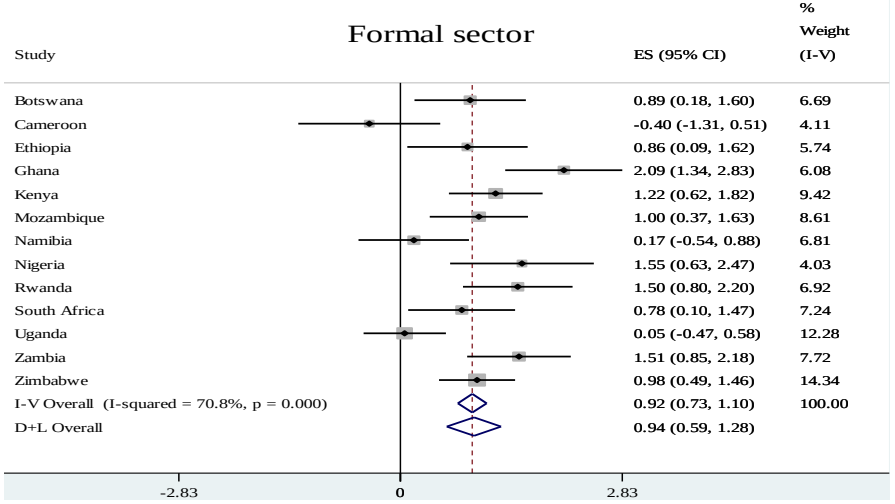
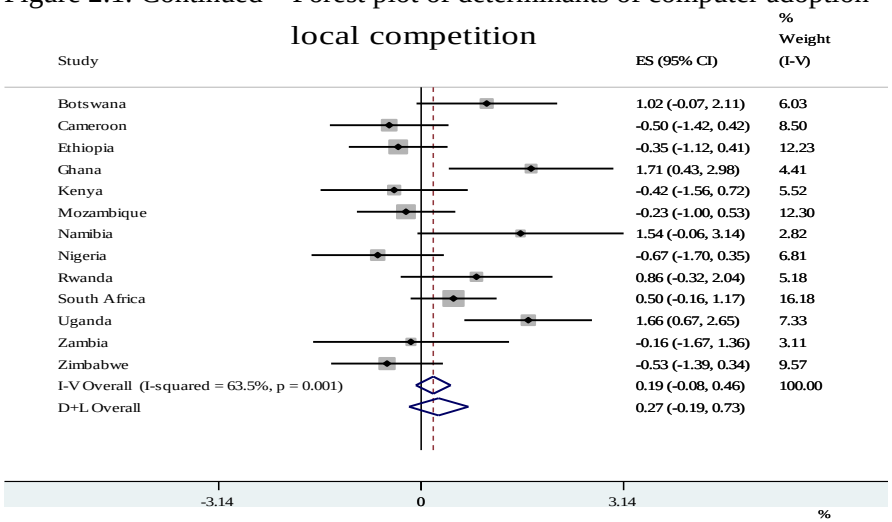
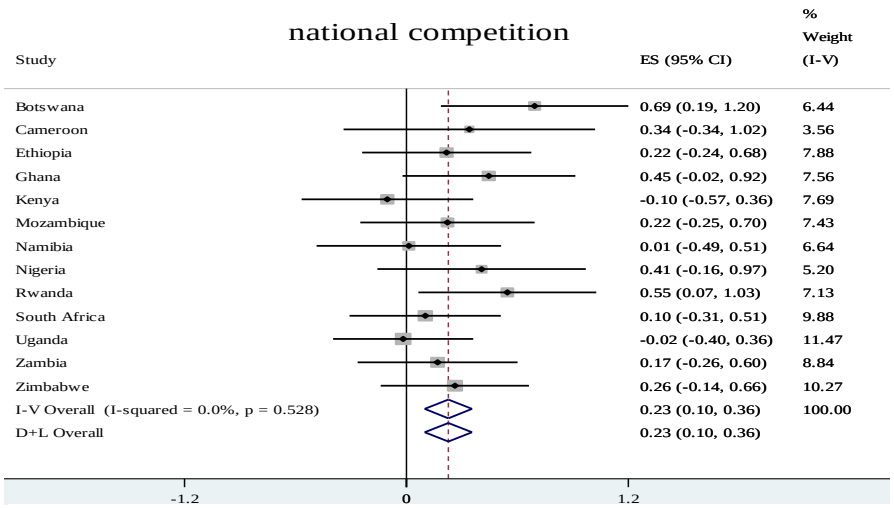
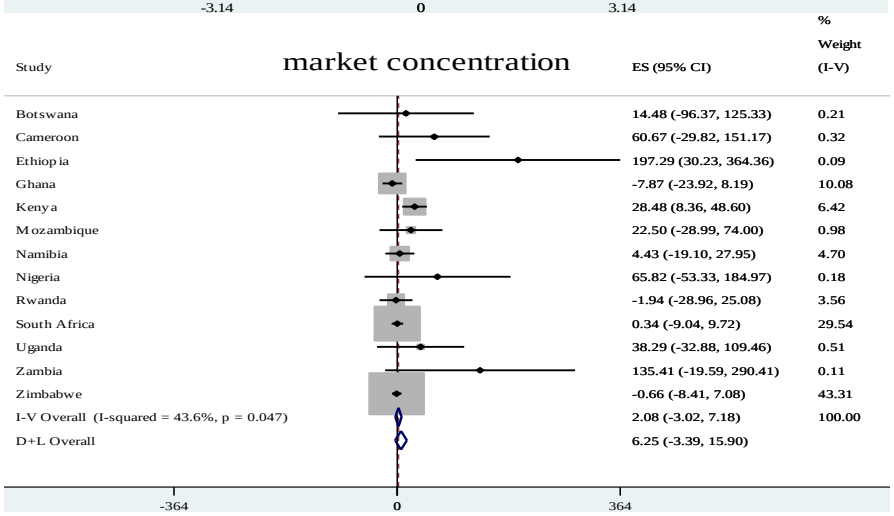


Figure 2.1: Continued – Forest plot of determinants of computer adoption







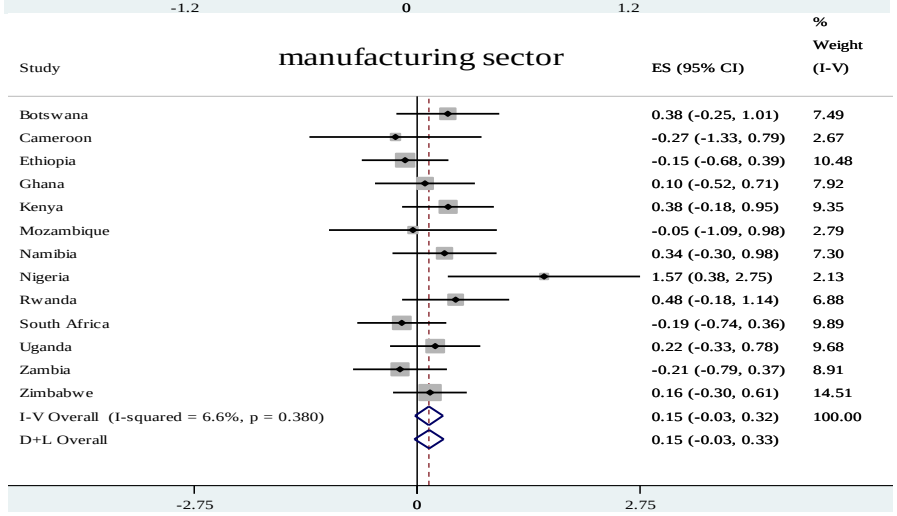
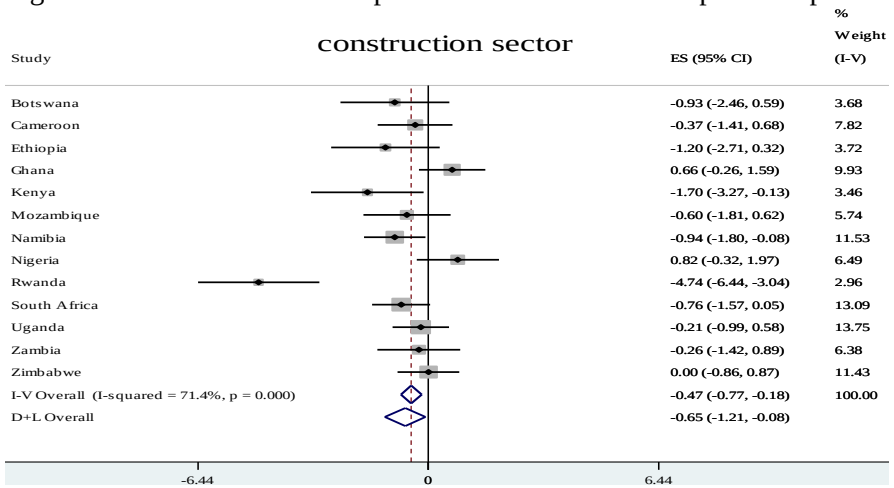


Figure 2.1: Continued – Forest plot of determinants of computer adoption



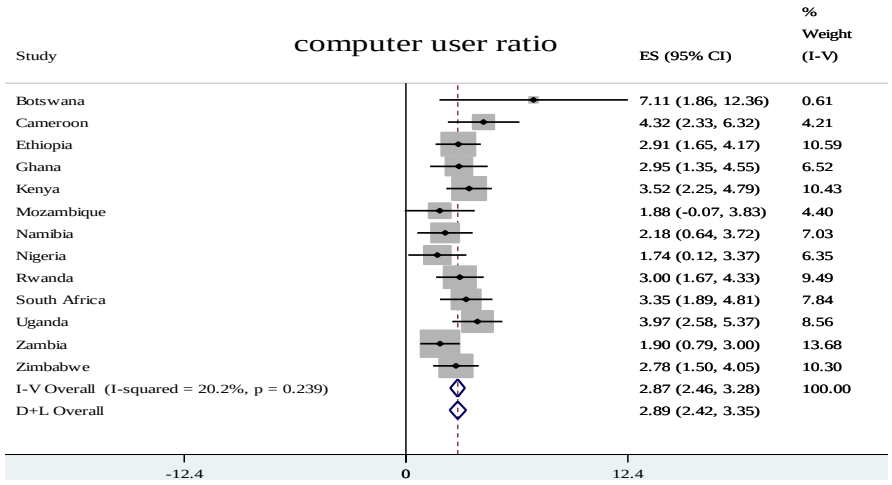
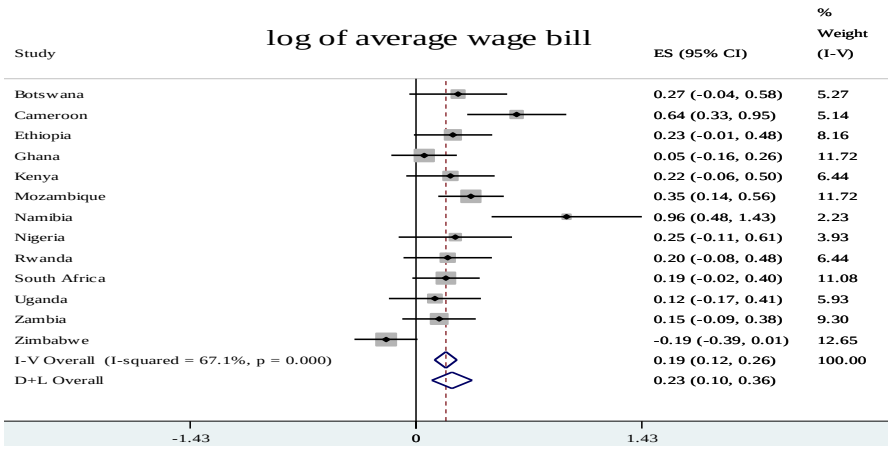


Figure 2 2: Forest plot of the determinants of Internet adoption



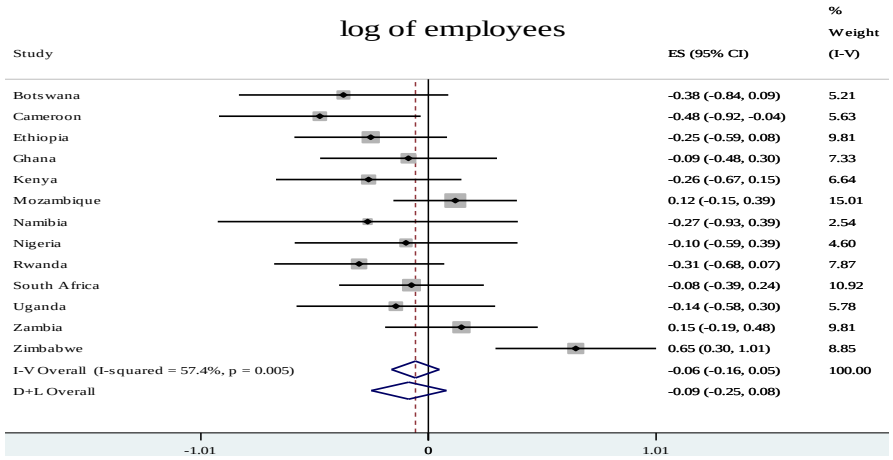
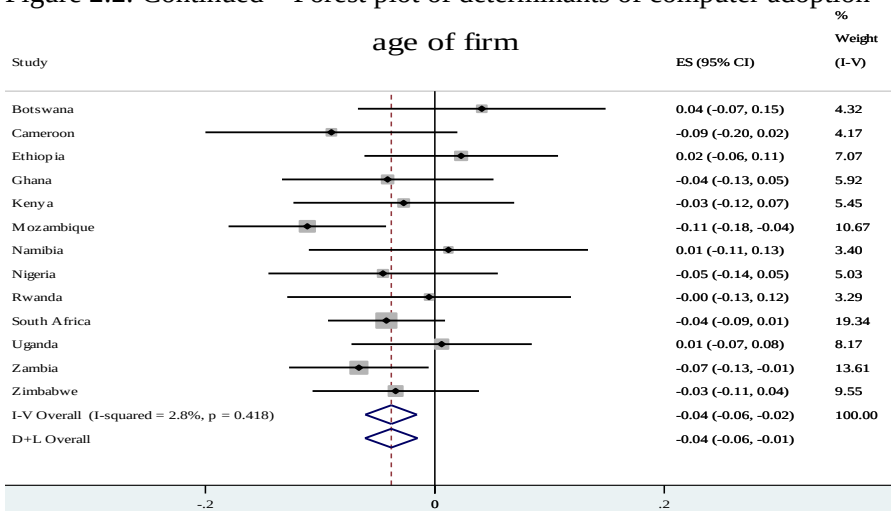
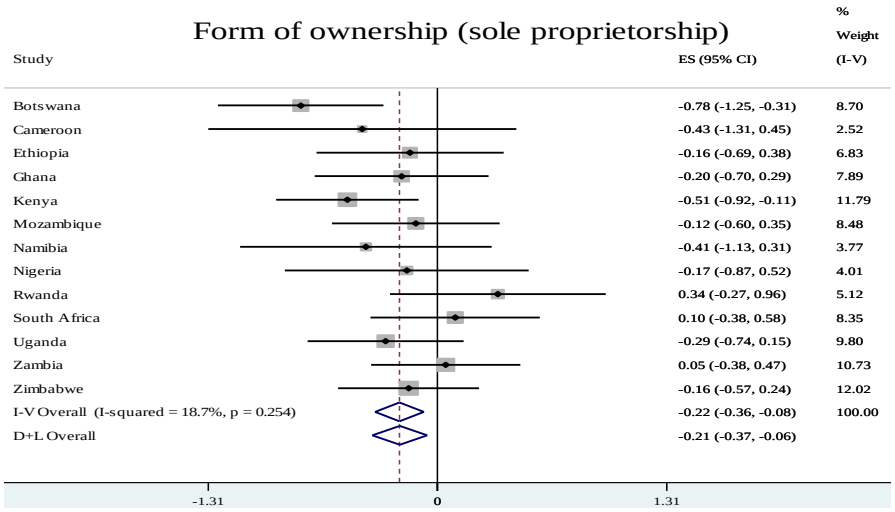
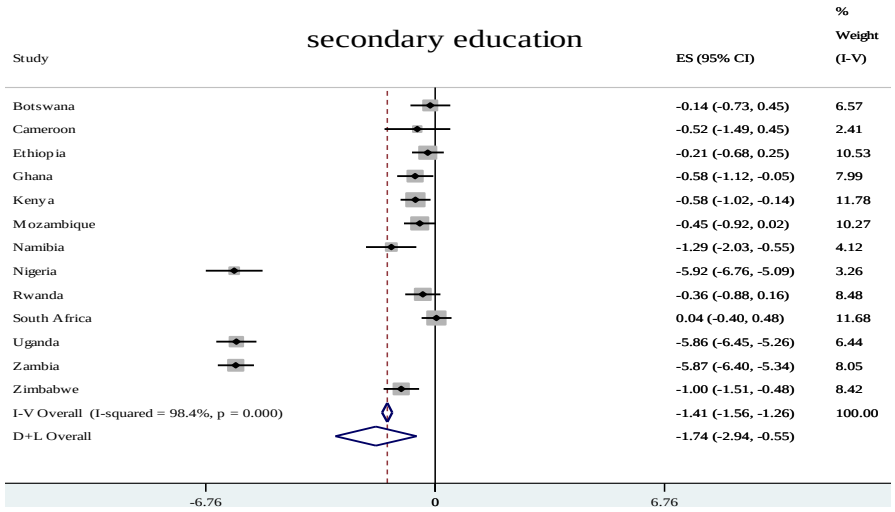


Figure 2.2: Continued – Forest plot of determinants of computer adoption







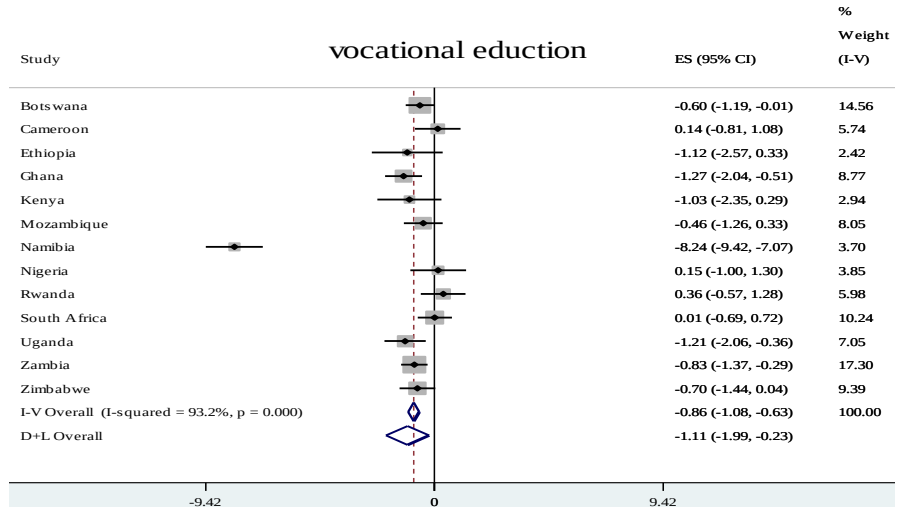
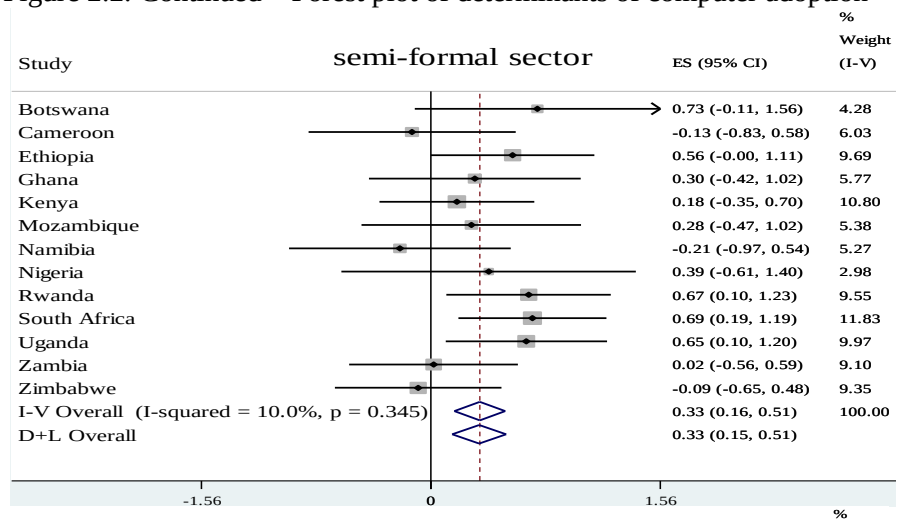
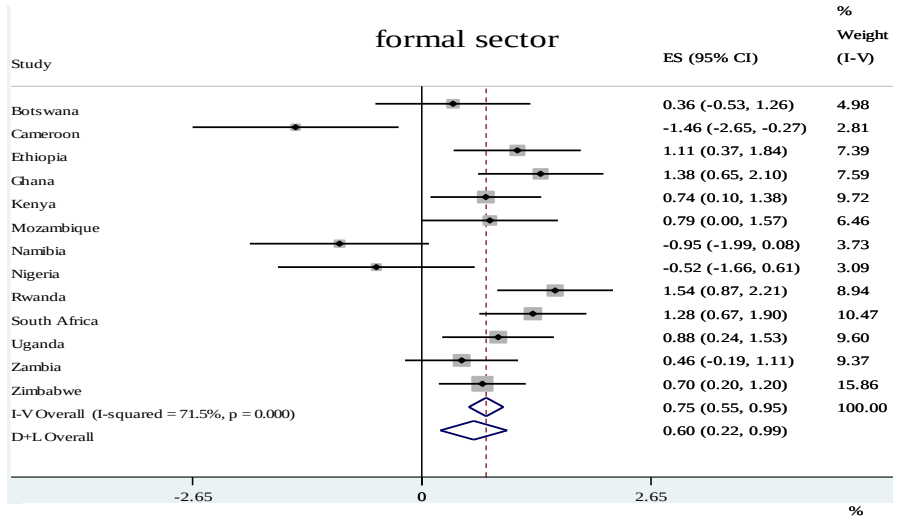
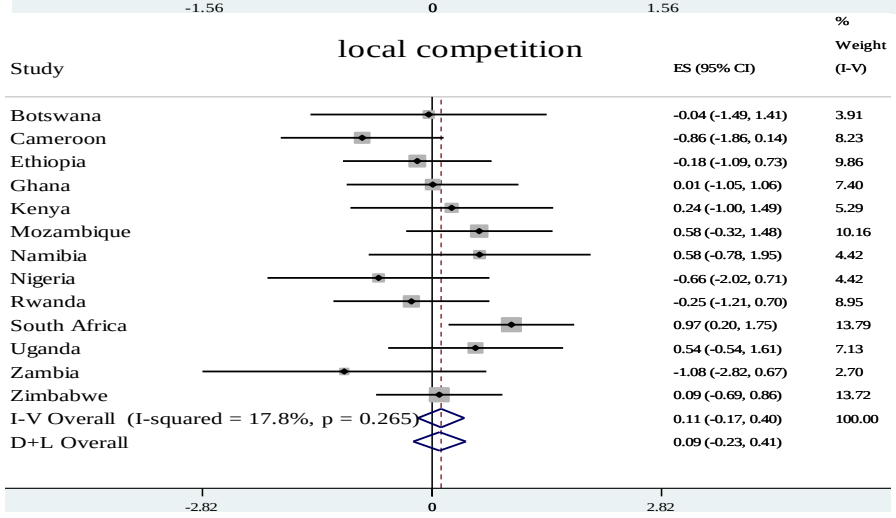


Figure 2.2: Continued – Forest plot of determinants of computer adoption







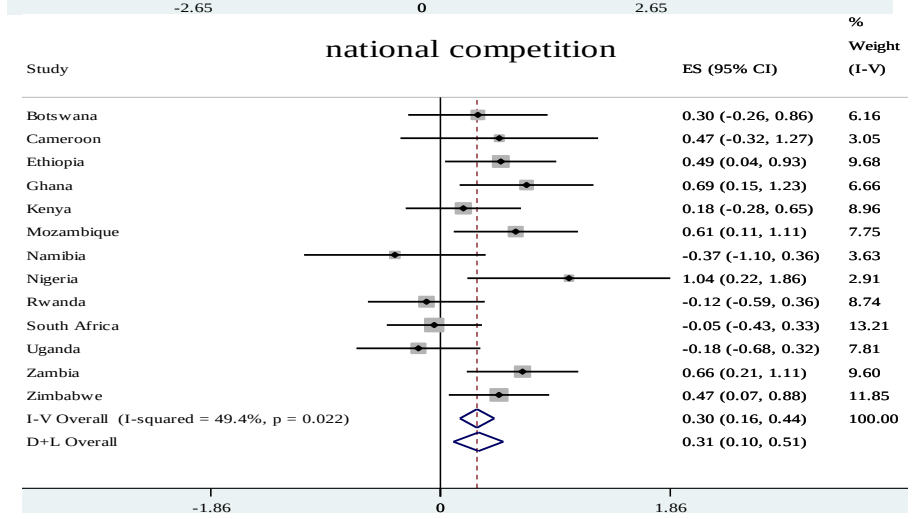
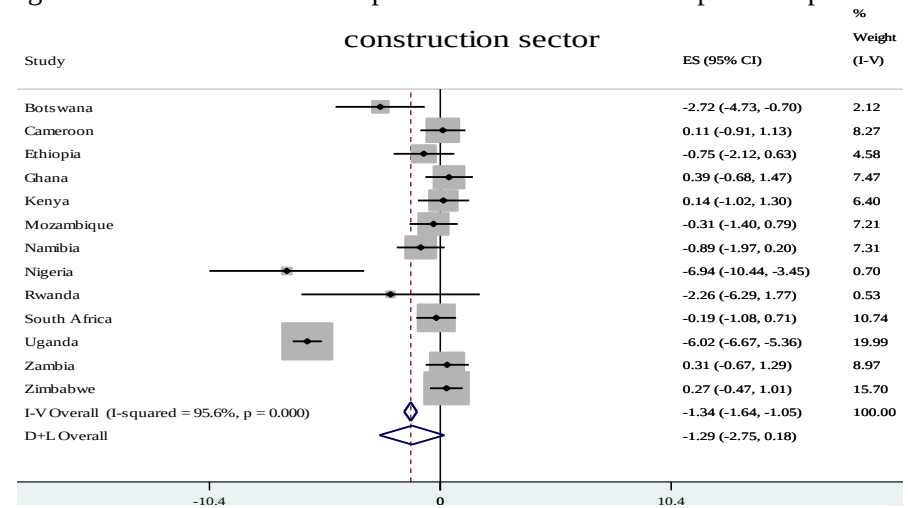
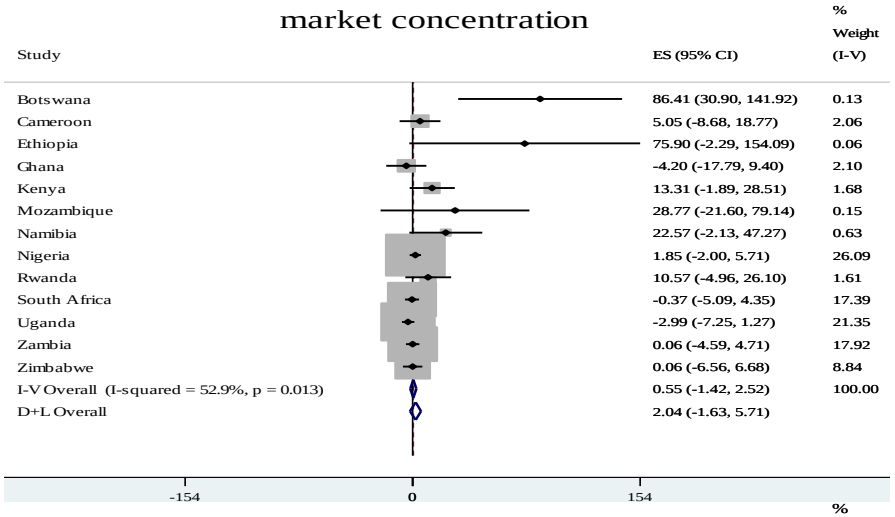
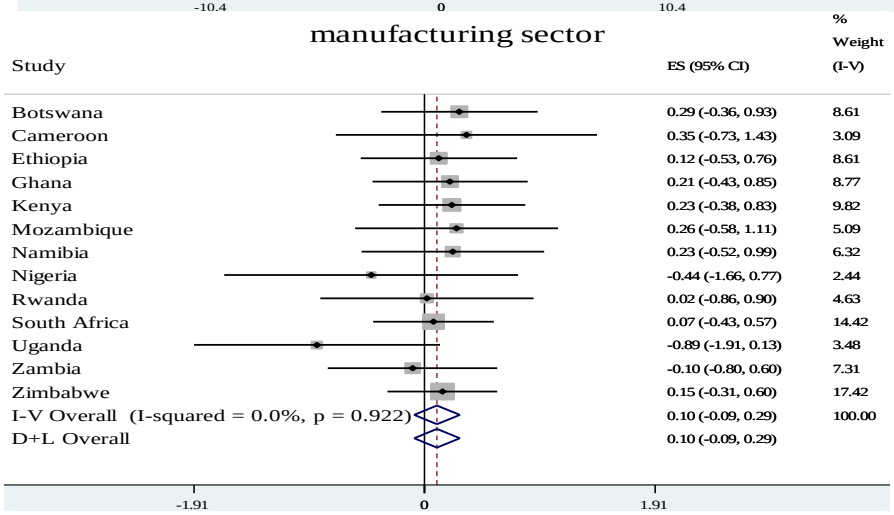
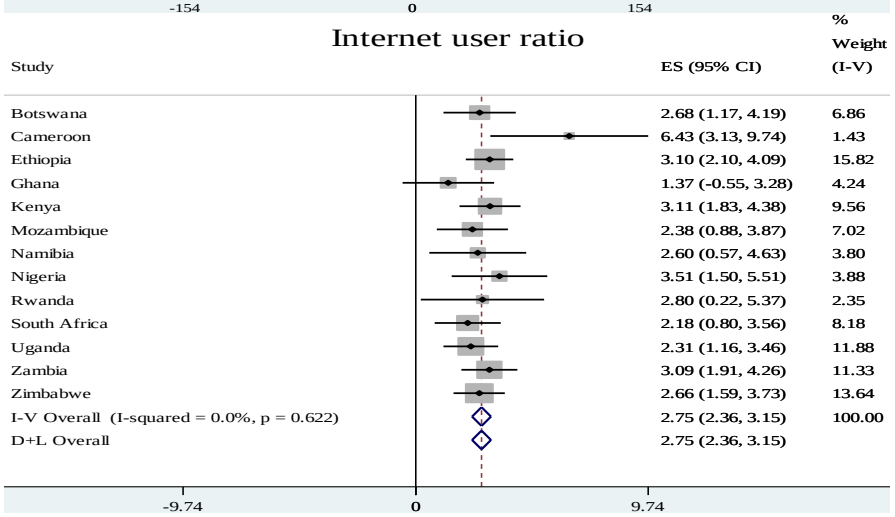


Figure 2.2: Continued – Forest plot of determinants of computer adoption









MRA: Firm characteristics

A MRA of computer adoption shows that all the firm level characteristics, except age of firm, influence a firm's decision to adopt computers. Three out of four indicators emerge as being significant in the MRA as determining factors for computer adoption across SMEs in the sampled countries. In the case of the Internet adoption model, the MRA shows that all firm characteristics captured are significant in determining the firm's decision to adopt the Internet. The log of number of employees, used as a measure of firm size, is significant and has a positive impact on a firm's decision to adopt computers. Although the impact of firm size is inconclusive in the literature our finding is in agreement with that of Battisti et al. (2007), who found that large firms are more likely to adopt ICT compared to smaller firms. This finding suggests that the rank effect model of technology diffusion explains adoption of computers among SMEs in SSA. However, the results of MRA for Internet adoption show that there is no relationship between the decision to adopt Internet usage and the firm size. In summary, our finding is inconclusive in determining the effect of firm size on adoption of ICT: the results for computer adoption and that of Internet are contrasting.

Firm age emerged as insignificant in all countries except Ghana and Zambia, where it had a negative relationship with computer adoption (older firms are less likely to adopt computers compared to younger firms). There is inconclusive empirical evidence on the relationship between ICT adoption and firm age. Dunne (1994) finds there is no relationship between age of plant and the decision to adopt technology, similarly, the MRA results for this study finds no relationship between the age of firms and their decision to adopt computers. In relation to Internet adoption, the age of the firm exhibits a negative and significant relationship. The finding suggests that younger firms are more likely to adopt Internet access than older firms. This might be due to the belief on the part of older firms that Internet adoption will not improve their business activities. The lack of awareness on the part of older firms regarding the benefits of Internet adoption, coupled with the lack of Internet need within the organisation may be the reason for such findings. Also the low propensity for older firms to adopt Internet access may be due to high switching cost for these firms. On the other hand, younger firms tend to adopt the Internet as they recognise its benefits and in an effort to improve their competitiveness.

Though we do not find a systematic relationship between a firm's age and its adoption decision in most countries, the square of age used as a proxy for experience is significant in three countries: Ghana, Nigeria and Zambia. This may imply a non-linear relationship between age and computer adoption (As suggested by Hollenstein, 2004). The null hypothesis of linearity is accepted for both Ghana and Zambia however, it is rejected in the case of Nigeria. Thus a firm's age and decisions about computer adoption exhibit a negatively decreasing quadratic relationship in Nigeria, with a threshold of 8 years 5 months. This implies that at the early ages of the firm the decision to adopt computers is increasingly negative until the firm is about eight and half years old. The experience (Aged Square) of firms across the different countries plays an influencing role in determining the factors that form a firm's decision regarding Internet adoption. The MRA find that the square of firm age is positive and significant in ten countries. However, the square of age registers a positive and significant relationship with the decision to adopt internet in only two countries (Mozambique and Zambia), with no relationship in the remaining countries. In spite the absence of a relationship in most of the countries MRA estimation shows that the average weighted combined effect size of age square registers a positive relationship with Internet adoption.

Finally, the ownership structure of the firm defined as sole proprietorship and other forms of ownership (partnership or co-operative) is also analysed. The results from both Internet and computer adoption models suggest the absence of a relationship between firm ownership structure and the decision to adopt these technologies in most countries. Though ownership structure is significant only in two countries for the case of both computer and Internet adoption, the MRA revealed that sole proprietorships across the countries are less likely to adopt these technologies relative to businesses owned by partners or close corporations. This finding may be due to the high cost of purchasing and installing these technologies in Africa. Also the cost of training employees in the use of these technologies and the lack of knowledge on their benefits deter sole proprietorships from adopting the technologies.

Overall, the MRA estimation shows that the structural characteristics of firms are significant determinants of ICT adoption among SMEs across selected countries in SSA. Notwithstanding, the log of employees lacks any relevance in Internet adoption within the firms. Also the firm's age does not have any significant influence in the determination of computer adoption across the sampled countries.

MRA: Human Capital

The results show overwhelming evidence that the presence of a highly skilled workforce influences the decision of firms to adopt both computers and Internet usage in most countries. The MRA confirms the positive relationship between log of average wage and ICT adoption, with the results showing that for SMEs in Africa to adopt and use ICT there is the need to provide basic education in the use of these technologies. The results of the MRA indicate a negative relationship between ICT adoption and all the educational[22] dummies. This implies that SMEs owned by individuals with tertiary education are more likely to adopt ICT compared to SMEs owned by individuals with lower educational attainment.

The results for human capital highlight a positive and significant association between adoption of computer, Internet usage and human capital which is measured by the log of the average wage and the educational level of the firm owners. The findings are reflected in the rank effect model which proposes that if technology is to be adopted and used effectively then human capital of a firm must acquire a certain level of basic skills.

MRA: Environmental factors

The environment in which a firm operates gives similar results for the computer adoption model and the Internet adoption model. The results suggest that the formality status of the firm is critical in its decision to adopt both technologies. The MRA suggests that formal and semi-formal sector firms are more likely to adopt these technologies in comparison to their counterparts operating in the informal sector of the various economies. This finding is similar to the situation in many of

[22] Measuring education of the firm owner as continuous variable by looking at the number of years spent in school yield similar results. The results show that firms are more likely to adopt both computers and internet usage if the owner spends more years in school.

the sampled countries: formal and semi-formal firms have higher probability of adoption of computers in ten countries compared to those in the informal sector. However, though the MRA indicates that formal sector firms are more like to adopt Internet usage, in Cameroon and Namibia the results suggest that informal sector firms also have a high probability to adopt. However, in both countries there is no difference in the probability of informal sector firms adopting Internet and that of semi-formal sector firms.

There is ample evidence to suggest that the presence of competitive pressure leads to firms searching for innovative ideas in the innovation literature. Thus competitive pressure motivates the adoption of new technologies in order to control a higher share of the market and enhance the firm's competitiveness. The adoption of Internet usage facilitates sales over long distances. However, Fuentelsaz et al. (2003) indicates that competitive pressure also raises the uncertainty surrounding the adoption of new technologies, which can hinder a firm's adoption decision. On the other hand, Hollenstein (2002) indicates that competitive pressure creates net effects or spillovers which in turn lead to rapid adoption of ICT by the firm. The competition faced by firms is measured at both the local and national levels. The results show that a firm's perception of the existence of local competition is relevant to the decision of whether to adopt both technologies. At the individual country level the results show that local competition influences a firm's decision to adopt computers to be positively significant in four countries and negatively significant in one country.

Although the presence of local competitive pressure is irrelevant to adoption of these technologies, a firm's perception of the existence of national competition has a positive and significant association with the adoption of both computers and the Internet. This finding may suggest that firms perceive competition from a national market as more important than that of local competition and the adoption of these technologies facilitate sales to a broader market. However the market concentration which also measures the level of competition at the industry level proved to be irrelevant to the decision to adopt both computers and internet usage. Overall, market competition does not determine a firm's adoption decision in these countries. This finding contradicts the theory that the present of competition drives firms to search

for new technologies in order to increase their competitiveness. However, the chapter finds empirical evidence to support Fuentelsaz et al. (2003).

According to Hollenstein (2004) that "a firm's propensity to adopt a technology at a certain point in time is positively influenced by the present (or lagged) level of diffusion in the economy as a whole, or by the proportion of adopters in the industry or sector to which the specific firm is affiliated." The results of the MRA confirm the finding of the bivariate probit model for the individual countries. The MRA indicates that a high number of users of both Internet and computer users tend to increase the propensity of adoption of these two technologies. This is depicted by the positive relationship between the ratio of users and the decision to adopt computers and Internet by the organisation. Taking the vote count shows that the significant positive relationship is driven by all thirteen countries in the case of computer adoption and twelve in the case of Internet adoption. This chapter therefore finds the epidemic effect of technology adoption among SMEs in SSA.

5 Conclusion

This chapter investigates the determinants of ICT adoption among SMEs, measured by the adoption of computers and Internet usage, in thirteen SSA countries, using the SME e-Access and Usage dataset. Common among SMEs in these countries is low use of computers and the Internet in business transactions; however this phenomenon is beyond the scope of this chapter. The SME e-Access and Usage survey provides a distinctive dataset, with information collected on SMEs operating in manufacturing, construction and services sectors across fourteen SSA countries. The uniqueness of the dataset is that ICT variables are defined the same across all the countries and the data enable us to disaggregate ICT into two distinct but related technologies (computers and Internet), unlike other studies that have aggregate ICT usage. The chapter examines factors that influence SMEs adoption decisions of computers and the Internet in each country. To obtain consistent determinants of adoption of both computers and the Internet we use a meta-analysis technique to pool all country estimates and obtain a weighted average determinant of adoption.

The results present in this chapter are, to the best of our knowledge, the first to examine the determinants of the adoption of computers and Internet among SMEs

across a series of SSA countries. It uses a meta-analysis technique to obtain consistent determinants of both computer and Internet adoption. The study finds evidence indicating that the presence of a highly skilled workforce facilitates the adoption of computers in eight countries, while it increases the SMEs' propensity to adopt the Internet in six countries. The meta-regression analysis of the human capital variable overwhelmingly confirms the importance of providing certain levels of basic skills for the workforce to increase the probability of SMEs adopting both computers and the Internet. The educational level of the firm owner is also relevant in adoption of both computers and Internet. The adoptions of both computers and Internet are relatively enhanced among firms in which the owners have tertiary education compared to firms owned by individuals with lower educational level. The findings are in line with evidence from developing countries (Gallego et al., 2014).

This chapter also finds that a firm's age influences computer adoption decisions in a few countries. The findings are mixed and at best inconsistent across SSA, in some countries we find that older firms are more likely to adopt these two technologies while in other countries younger firms have greater tendency to adopt. However, in most countries age does not influence the SMEs' adoption decisions. Conducting a meta-regression analysis provides consistency across countries with the findings indicating that younger firms have greater propensity to adopt the internet compared to older firms in SSA. Formal and semi-formal sector firms are more likely to adopt both computers and the Internet compared to informal sector firms. This finding is important to policymakers in SSA, considering the fact that economies of these countries are largely dominated by the informal sector and if ICT is to propel these countries to a higher growth path then adoption in this sector must catch up with other sectors of the economies.

Although competition at the local level does not influence a firm's decision to adopt computers and the Internet, the threat of national competitive pressure facilitates the firm's decision across selected countries in the SSA region. This finding may be due to the fact that the firm does not transact its business at the local level and therefore it is not deterred by local competition. Also, consistent with previous studies of technology diffusion, we find the presence of the epidemic effect of technology diffusion for both computer and Internet adoption. The computer and Internet user

ratios are positive and statistically significant confirming that if a greater proportion of SMEs in industry $\boldsymbol{j}$ use either a computer or the Internet the probability of non-adopters using a computer and the Internet respectively increases. The existing literature on ICT adoption has mainly focused on developed economies and a few developing economies, hence much is not known about the epidemic effect of technology diffusion in Africa. This result is therefore of much importance to policymakers as the epidemic effect is empirically confirmed in SSA countries. This is more relevant considering the fact that ICT industry is now developing and over 90 percent of firms in these countries are SMEs.

The chapter's findings are of utmost importance to policymakers in order to embark on efficient and effective public policy interventions. Many of these ICTs are still relatively new to many SMEs in SSA and the findings of the chapter could provide a platform for government to provide support to expedite the adoption of both computers and the Internet. The presence of the epidemic effect of ICT adoption among SMEs requires governments in SSA to develop technology oriented policies which will provide infrastructure that would aid the rapid spread of these technologies across the region. It is also imperative that governments and organisations in these countries provide technical training for the labour force in the use of ICT so as to derive the full benefits of adoption.

CHAPTER 3 – EFFECT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON A FIRM'S TURNOVER AND TECHNICAL EFFICIENCY

1 Introduction

Information and Communication Technologies have become fundamental to economic growth and development, and also in poverty reduction strategies in both developed and developing economies. It is perceived that if developing countries are to catch up with developed ones, it is imperative that they adopt and make use of ICTs. In many developed countries it is a widely accepted fact that ICT has had significant and positive impact on the productivity of firms.

The last two decades have seen huge financial investment into the ICT economy leading to significant technological advancement in ICT equipment and facilities, such as fax machines, personal computers, printers, mobile telephone, Internet and different types of software. The prices of these ICT tools have declined rapidly over the last decade making them affordable and accessible, thus making usage of this equipment a requirement in the business sector. According to Brynjolfsson and Hitt (2000) adoption of these technologies was expected to change the operations of firms, as prior to their introduction economic institutions and practices were defined by the high cost of communication, limited computational capability and related constraints. In spite of the huge investment into technological advancements in developed countries, earlier research showed the lack of evidence of a positive impact of these new technologies on the productivity of firms. Morrison (1997) for instance found that ICT has no significant impact on economic growth.

This led to Robert Solow stating: "one can see the computer age everywhere except in the productivity statistics" (The New York Times Book Review, July 12, 1987, p. 36). It was not until the late 1990s that some studies found a positive and significant effect of ICT on productivity growth among firms in developed countries. In recent times several reasons have been given for the productivity paradox, among them is

that the analyses were done at an aggregated level, either at the macroeconomic or industry level. Another explanation to the productivity paradox is the fact that earlier research analyses were based on data constructed using wrong deflators or non-representative samples. Finally, it could be that the expected positive relationship between investment in ICT and productivity is more complex and/or long term (Brynjolfsson, 1993).

African countries have not been left out in the rapid adoption and usage of these new technologies, as several of them are rapidly adopting and implementing ICT policies and strategies with the expectation that it can lead to higher levels of growth and development of SMEs. The International Telecommunication Union (2006) asserts that Africa has the world's fastest penetration rate for mobile telephony and has seen the number of Internet users increasing by about 300 per cent over the last two decades. In 1996 for instance, only five African countries had access to Internet facilities, but today there is Internet connection in virtually every urban centre in Africa. The fast adoption rate of ICT has been fuelled by the belief that ICT has had significant and positive impact on the productivity of firms in developed countries.

In recent times, contrary to the earlier "productivity paradox", there is a large and growing literature on the impact of ICT and resulting changes in firm's operation, productivity, profitability, market value, and market share, as well as on intermediate performance measures (Arvanitis, 2005; Black and Lynch, 2004; Brynjolfsson and Hitt, 2000; Dewett and Jones, 2001). ICT adoption has drastically modified communication, sales, and information methods (Wang et al., 2007), thus enabling firms to achieve greater competitiveness. Despite recent developments, most of the literature in the area is related to developed economies, especially the United States and Western European countries. In developing countries there is little to no empirical evidence on the impact of ICT adoption on productivity at the firm level. However, what is obvious is the existence of a wide variation of ICT adoption across and within countries and also various sectors. This variation can be traced to a variety of factors including differences in pricing and government policy.

Despite these limitations, the available evidence suggests that ICT adoption has accelerated and may exert a positive impact on the performance adopters (Basant et

al., 2006). The World Bank (2006) posits that correlations between a simple measure of ICT usage and a number of firm performance indicators, including growth in sales, employment and reinvestment indicate that ICT usage is associated with enhanced performance in developing countries. The effect of ICT on firms and, to a larger extent, the economy has not been widely exploited in developing countries, especially in African countries. Yet in spite of the lack of empirical evidence, several firms and SMEs are supplementing their inputs with these new technologies, facilitated by falling prices. ICT diffusion has increased in Africa, but the effectiveness with which this has happened however, remains unclear. Consequently, this chapter analyses the relationship between investment in ICT and productivity among small-medium scale enterprises in fourteen sub-Saharan African countries. It also examines the effect of ICT on the technical efficiency of SSA in these selected countries.

The chapter investigates the effect of ICT capital stock on SMEs' turnover in 14 African countries, using Cobb-Douglas and a Translog production functions. We also apply meta-analysis to compute a weighted average effect of ICT on turnover. Firms are heterogeneous in nature and their production process varies, in this respect the chapter uses quantile regression estimations to deal with potential heterogeneity problem that may arise. The study also examines the effect of ICT adoption on technical efficiency of SMEs. The chapter's contribution to the existing literature is twofold: first, the uniqueness of dataset allows us to undertake a comparative study of the effect of ICT on turnover across selected SSA countries; second, the study is the first that examines the effect of ICT on technical efficiency among SMEs in SSA.

The structure of the chapter is as follows. Section 2 provides a brief review of the literature on ICT adoption and firms' output and productivity growth. Section 3 shows the methods the study uses. Section 4 presents results and a discussion of the study. Section 5 summarizes and concludes the chapter.

2 Literature review

Since the 1970s, several studies have examined the impact of ICT on productivity and growth at the firm level. Earlier empirical studies in the 1970s and 1980s reveal a negative or lack of relationship between ICT and productivity of firms

(Strassmann, 1985, 1990; Roach, 1987; Banker and Kauffman, 1988; Weill, 1992; Brynjolfsson, 1993; Kettinger et al., 1994; Loveman, 1994; Wilson, 1995; Davenport et al, 1996). This became known as the "ICT productivity paradox" (Solow, 1987). The negative or a lack of relationship between ICT adoption and productivity is surprising as these studies focused on labour productivity, and it was expected that increase in ICT investment will increase productive capital stock which in theory should contribute to the growth of labour productivity.

Several reasons have been given for the productivity paradox. Triplett (1999) for instance points out that all benefits derived from ICT investment were not captured in the productivity statistics due to problems associated with productivity measurement, in particular, the services sector, an aspect of the economy where most ICT investments occurred. Second, several studies carried out in the 1970s and 1980s failed to find a positive impact mainly because return from investment in ICT takes a considerable length of time to be realised just as with all other new technologies. According to Triplett, the slow process of adjustment on the part of firms in the use of a new technology delays the realisation of expected benefits from adoption. He further asserts that most of the studies from the 1970s, 1980s to early parts of 1990s relied on comparatively small samples of firms obtained mainly from private sources thus questioning the authenticity of the data sources and sampling techniques used. At the initial stages of adoption, the impact of ICT on performance is expected to be low and this might be captured by econometric noise in the estimation process hence the negative or lack of relationship.

Subsequently, since the beginning of the 1990s, studies using data from manufacturing firms find a positive ICT productivity effect (Siegel 1997; Brynjolfsson and Hitt 1996; Lehr and Lichtenberg 1999). This has mainly been attributed to improvements in output measurement to account for qualitative[23] effects of ICT on productivity. Berndt and Morrison (1995) assert that in spite of improvements in measurements of ICT-created value there remain some serious challenges to appropriately assess qualitative measurements of ICT. The challenge of

[23] This is an enhancement of the quality of output, labour input, and an increase in variety of products the firm produces, as well as an improvement in the quality of customer services and reductions in delays when a firm adopts ICT. These are not easy to measure quantitatively.

qualitative measurement of ICT is illustrated when Berndt and Morrison (1995) and Jorgenson and Stiroh (1995) use different qualitative measurements and employing the same data over the same period found contradictory results. Generally, such contradictions are common in the empirical literature and are attributed to differences in methodology, as well as the quality of data. In recent times, the results have been more consistent with several studies finding a significant and positive relationship between ICT and labour productivity growth. Several studies carried out recently on some Organisation for Economic Co-operation and Development (OECD) countries provides more conclusive evidence to support ICT enhancement of labour and multi-factor productivity (Triplett and Bosworth, 2003; Pilat, 2004; Gretton, *et al.*, 2004; Tambe and Hitt, 2012). With improvements in methodology a common trend emerges, especially in studies conducted on developed countries. Most of these studies find a positive and significant effect of ICT on the performance of firms (OECD, 2003). For instance both Maliranta and Rouvinen (2004) and Arvanitis (2005) show that ICT usage has a positive relationship with labour productivity among firms in Finland and Switzerland, respectively. Hempell and Zwick (2008) also find ICT to have a positive and significant impact on German firms.

Draca et al. (2006) surveys both micro and macro literature and points out that the use of micro-level data is more appropriate in understanding relationship between ICT and firm performance than the use of macro-level or aggregated data. Most studies that use micro-level data have unravelled the impact of ICT on multi-factor productivity. Several of these empirical works (for example Brynjolfsson and Hitt, 2003; Hempell, 2005; Bloom et al., 2005) find a positive and significant relationship between productivity growth and ICT usage at the firm-level. Draca et al. (2006) actually finds that these studies reveal greater ICT productivity effect than expected from the neoclassical assumptions underlying the growth accounting model, perhaps due to a spill over effect of ICT. Firms that are able to use ICT more productively, are more likely to increase market share (Pilat, 2004) and gain competitive advantage, making spill over effects relatively more prominent at the firm-level rather than at the aggregate. This is because firms have different abilities to undertake effective organisational restructuring to accommodate ICT usage, this results in differences in ICT-enabling productivity at the firm level. However, these differences are not reflected at both the industry and national levels. In this regard,

the rate of increasing ICT productivity effect at both national and industry level is lower than at the firm level.

Investment in ICT potentially improves product quality by providing faster delivery services as well as producing tailored-need products. Aggregated data fails to capture this product enhancing aspect of ICT investment, but it can be well accounted for at the micro level. The failure to capture or appropriately measure the quality enhancing aspect of ICT especially in the area of services (the sector has enjoyed rapid growth in ICT investment) will understate the impact of ICT in the services industry, a situation that existed in the 1970s and 1980s. Hence relative to aggregate data, firm-level data are less prone to measurement errors and controlling for differences in the product quality. In this regard, firm level analysis of ICT is more appropriate if ICT productivity is to be captured as the impact of ICT on output derived from aggregated data is most probably underestimated.

Studies that have estimated the ICT productivity effect have used a production function framework and estimated the ICT capital elasticity with varying results from one study to another. Various econometric techniques and varying model specifications have been employed by these studies and this may be accountable for the differences in results. Using a standard growth accounting model, productivity measurement techniques, and employing data on 527 large firms in the United States between 1987 and 1994, Brynjolffson and Hitt (2003) explore the effect of computer expenditure on output growth and multi-factor productivity. Their findings indicate that computerisation contributes to productivity and growth in output and this is consistent with normal returns from computer investments over the short term period. They conclude that the observed impact of computerisation is accompanied by relatively large and time-consuming investments in complementary inputs such as organisational capital. They therefore suggest an investment in complementary inputs if the firm is to benefit fully from investment in ICT. These findings are supported by Bloom et al (2005), who assert that differences in organisational capital account for differences in productivity growth between U.S. multinational and non-U.S. multinational as well as domestic firms based in the United Kingdom.

The need for complementary organisational restructuring in order to derive the maximum possible gains from ICT investment is further backed by Bresnahan et al (2002). They employ a detailed firm-level dataset on United States firms to examine the proposition that the combination of three related innovation variables – information technology, complementary workplace reorganization and new products and services – lead to technical change which is skill-biased and affects the demand for labour. They find evidence of complementarities among all three types of innovations in factor demand and productivity regressions. They further find firms who adopt these innovations employ highly skilled labour. According to the authors, information technology has a greater effect on labour demand if combined with organizational change and investments in organisational computing such as mainframes.

Using a large and representative data set of German firms, Hempell and Zwick (2008) regress measures of organisational flexibility on ICTs and other control variables and point to flexibility as an important link between ICTs and firm performance. They contend that firms that adopt ICTs have organisational labour flexibility which improves their innovative capacity. Organisational flexibility leads to high employee mobility between various activities and tasks as well as empowering employees with greater responsibility in decision-making. Given the importance of complementarities of ICT, Tambe et al. (2012) examine the type of organisational changes that might lead to ICT-derived productivity gains using a dataset on 253 firms. Among other things, their results suggest that information technology needs to be combined with decentralisation of decision making as well as have an external focus[24].

In line with the theoretical literature on technology adoption, the empirical literature provides evidence to suggest that gains from ICT adoption differ across firms, as gains from ICT are not equally distributed (Cerquera and Klein, 2008). They argue that some firms derive gains at the early stages of ICT adoption; simply some firms derive greater benefits than others. This, according to the authors, is a source of firm heterogeneity and has the potential to generate competitive advantage in the market,

[24] These are business practices which enable firms identify and respond to changes in the operating environment (Tambe et al., 2012)

which influences aggregate productivity growth. Using a dataset on ICT usage in Germany, Cerquera and Klein (2008) find that ICT-induced firm heterogeneity impacts on the incentive to innovate, particularly with investment in research and development personnel.

The empirical literature is full of studies that treat ICT as a homogeneous aggregate factor of production and examine its impact on productivity. However, in recent times some studies decompose ICT into various types and assess the impact of each component on firm specific performance (see Van Reenen *et al.* 2010; Agrawal and Goldfarb, 2008; Engelstätter 2009).

Most studies in the area of ICT productivity have largely been on developed economies with little evidence from developing countries. In spite of inadequate empirical research on the impact of ICT on development of firms in developing countries, there is adoption and huge investment in the use of ICT within these countries. Differences in adoption rates across countries can be attributed to declining relative prices and government policies. However, only a limited amount of literature on this exists on developing countries. The World Bank (2006) shows positive correlations between measures of ICT and firm performance indicators. However, Matambalya and Wolf (2001) find that ICT investment has a negative and significant effect on labour productivity using a dataset on 300 Small and Medium Scale Enterprises (SMEs) operating in the tourism and textile industries in Kenya and Tanzania. Their results echo the productivity paradox observed earlier in industrialised countries. Chowdhury (2006) finds that ICT investment has a positive impact on market expansion but impacts negatively on labour productivity.

Commander et al (2011) employs a unique data set on firms in India and Brazil to examine the impact of ICT on firm productivity. They find a strong positive association between ICT capital and productivity in both India and Brazil which is robust to a variety of specification tests. They further find that poorer infrastructure quality and labour market policy are both associated with lower levels of ICT adoption, with poorer infrastructure also associated with lower returns to investment in India.

In summary, there is overwhelming and convincing evidence for developed countries that ICTs have positive and significant effect on productivity within firms, but the issue for developing countries and Africa in particular is far from being resolved. This is due to the paucity of robust empirical analyses. In a study on Brazil and India, Commander et al. (2011) takes into account the impact of organizational changes while estimating the effect of ICT investment on firms' output. Their result is likely to be biased as they do not deal with the potential issue of simultaneity in the input and output choices at the firm level. Furthermore heterogeneity in firms may affect ICT productivity gains as the impact of ICT may differ along the distribution of the firm's turnover. This chapter aims at filling this gap in the literature.

3 Methodology and estimation techniques

The chapter conducts three sets of analyses. First, we conduct a detailed investigation to determine the effect of ICT capital on firm's turnover, using both Cobb-Douglas and a second-order transcendental logarithmic (hereafter Translog) production function specifications (applying both OLS and instrumental variable techniques). Second, we examine the impact of ICT adoption on turnover at different quantiles of the distribution. Third, we use three measures of ICT adoption and examine the effect of adoption on technical efficiency of SMEs.

We begin by considering a modified Cobb–Douglas production function, which relates various inputs with a final output. The Cobb–Douglas production function has been widely used in production economics research as a functional specification of output, revenue/sale or labour productivity, partly because it complies with quasi-concavity and monotonicity, which are basic requirements for determining production frontiers. This is important as the production function is required to be non-decreasing in inputs or a non-negative so that the marginal products can be obtained. Several studies have used the Cobb-Douglas functional form to examine the behaviour of firms in Africa (Bigsten et al., 2004, 2004; Barr, 2000; Söderbom and Teal 2004; Van Biesebroeck, 2005; Baptist and Teal, 2008; Kudo, 2011).

The Cobb-Douglas framework has also been used partly because it imposes fixed returns to scale and unitary elasticity of substitution properties upon the production structure. In addition, a Cobb-Douglas functional form is quite flexible with respect

to the number of factors of production that can be incorporated to examine their effects on production/sales. Output is defined as a function of the traditional factors of production, capital and labour. From here we embark on additional examination to ensure our estimation is robust to issues such as unobserved variables, endogeneity, and choice of controls. The chapter further estimates a Translog production function, which is less restrictive than the Cobb-Douglas function. This also allows us to explore interaction between ICT capital and the other traditional factors of production. Lastly, the chapter uses these two functional forms – Cobb-Douglas and Translog – to establish the relationship between ICT usage and the average distance from the optimal production frontier by using a stochastic frontier approach, thus estimating the effect of ICT usage on the technical efficiency of SMEs in SSA.

Furthermore, in contrast to several studies, which have attempted to estimate the production function at the firm level, this chapter does not a priori assume the functional form of the production function. The study uses a non-nested J-test to determine which production functional form best fits the structure of the dataset. Estimating different production functions that fit the data structure is highly important for policy makers as the wrong functional form is likely to be misleading. We then conduct a meta-analysis of ICT coefficients from the various countries obtained from the appropriate model that best fits the data. This enables us to provide a consistent impact of ICT capital across SSA.

3.1 Cobb-Douglas production function

In order to estimate the effect of ICT on the firm's output we follow Hempell (2005), and make a distinction between ICT capital stock and non-ICT stock. It is hypothesized that ICT capital stock is positively related to the output of the firm. The chapter augments the Cobb-Douglas production function by following Commander et al. (2011) and Hempell (2005), and includes the value of raw material inputs (intermediate goods) used by the firm. Raw material input is defined as the amount of intermediary inputs or other goods that the firm purchases/uses to undertake the production process. The use of raw material input is important in the production process in virtually every sector of an economy. In spite of its importance in the production process, the common total factor productivity measures and estimates have ignored the use of intermediate goods as a determinant of a firm's output.

Intermediate good is introduced in the output function because the extent to which capital and labour contribute to firms' output levels is dependent on the quantity and price of intermediate goods employed by a firm.

Our output is a function of physical capital stock (decomposed into ICT capital stock and non-ICT capital stock), labour employed, value of raw materials and a set of variables to capture observable firm heterogeneity, and is given as,

$$Y_{ic} = F(A_{ic}\ ,\ L_{ic}\ , ICT_{ic}, K_{ic}\ , M_{ic}) \qquad (3.1)$$

Where Y_i *i*s output of firm *i*, L_i represents labour input, ICT_i and K_i are the corresponding amounts of ICT and conventional (non-ICT) capital[25] respectively, while A_i captures the multifactor productivity[26] and M_i measures the value of raw materials used by the firm. The subscripts *i* and *c* represents firm *i* and country *c*, respectively. Taking logs on both sides, equation (3.1) can be rewritten,

$$y_{ic} = \alpha l_{ic} + \beta ict_{ic} + \delta k_{ic} + \varphi m_{ic} + \gamma z_{ic} + \varepsilon_{ic} \qquad (3.2)$$

Where lowercase letters denote the corresponding logarithmic values and the multifactor productivity is given as,

$$log(A_{ic}) = \gamma z_{ic} + \varepsilon_{ic} \qquad (3.3)$$

Here log (A_i) is decomposed into firm specific characteristics denoted by z[27] and error term. The firm–effect captures fixed or quasi–fixed factors affecting productivity, such as management style, education attainment of the firm owner, industrial sector of the firm, and age of the firm, also the formality of the firm (formal, informal or semi-formal sector firm). The residual ε_i comprises measurement errors and firm–specific productivity shocks as well as firm heterogeneity in terms of unobserved firms' endowments. The parameters α, β, δ and φ are the elasticities of output with respect to labour, ICT capital, non-ICT capital and raw material respectively. Dobbelaere and Mairesse (2010), point out that under

[25] Non-ICT capital is calculated by the perpetual inventory method from replacement investments (Black and Lynch, 2001; Hempell, 2002; Zwick, 2003).

[26] Marschak and Andrews (1944) note that the firm is aware of A_i when input choices are made, but this is not observed by the econometrician.

[27] To avoid the problem of omitted variable bias, firm-specific and employee characteristics are added to the vector of control variables.

the assumption of perfect competition these parameters indicate the share of the input in total production. The sum of the parameters is indicative of the return to scale.

Most empirical studies have used the ordinary least squares (OLS) approach to analyse the relationship between ICT capital and a firm's output. This approach expresses the expected value of production output as a function of a set of explanatory variables. Two major challenges are anticipated in our attempt to estimate the effect of ICT on firms' output. We anticipate the presence of unobserved heterogeneity and endogeneity problems. The productivity of firms may be enhanced by the adoption and usage of technology, which in turn increase the profit margins of firms. On the other hand, firms with higher profit margins or higher output levels, and hence higher incomes will find it easier and less expensive to adopt and use technology. Thus, there is the possibility of a reverse causality of adoption of ICT, and productivity of firms. Also it is likely that unobserved firm and employee characteristics, which are captured by the idiosyncratic term, are correlated with some of our explanatory variables. There is also the possibility of measurement errors in non-ICT and ICT capital, which has the potential downward bias effect of these variables on a firm's output. Furthermore, differences in productivity levels of adopted firms and non-adopted firms could be as a result of unobserved heterogeneity among the firms. The presence of a significant level of firm heterogeneity may restrict the average output effect of ICT adoption, when OLS estimation is used, to efficiently explain the effect of ICT capital stock on firm's output.

In this regard, OLS estimation of the productivity effect of ICT adoption is bound to lead to inconsistent and biased estimates, which could have adverse implications on policy if we fail to account for the causal effect of technology adoption and unobserved heterogeneity. Most studies examining the impact of ICT and firms productivity have used an instrumental variables (IV) approach to solve the problem of endogeneity, while other studies have resorted to lagging of both ICT and non-ICT capital before employing OLS techniques to ascertain the impact productivity of ICT capital. It is also possible to apply generalized method of moments (GMM) to deal with the endogeneity problems. These methodologies may solve the problem of endogeneity.

3.1.1 Instrumental variable estimation

As stated under this section there is the likelihood of a reverse causality of ICT adoption and firm output, also there is a high probability that ICT capital may be correlated with some omitted variables such as managerial and employee skills, as well as other specific firm and industry characteristics. Non-ICT capital is also potentially endogenous in the baseline model, as presented in Table 3.1, as it is possible that it may be correlated with other unobserved firm characteristics, furthermore, there is the possibility of the existence of a reverse causality between non-ICT capital and output. The potential endogeneity of non-ICT capital may also stem from measurement errors. This may cause ICT capital and non-ICT capital to be correlated with the error term, which can result in inconsistent OLS estimates. To deal with the issue of endogeneity, the chapter could employ the instrumental variables approach and estimates the production function using a two-stage least-squares (2SLS) method.

However, it is quite difficult to find suitable instruments in which the structural variables are correlated with the error terms and this case is made even more complicated as we need to find suitable instruments in all the 14 countries' estimations. The criteria for a good instrument are a high correlation with the endogenous independent variable but not correlated with the error term. Due to the lack of suitable instrument(s), this chapter does not proceed to with the estimation of the two-stage least-squares (2SLS) method technique.

3.2 Meta-regression analysis

Given that the impact of ICT on firm's turnover may vary considerably across countries the chapter uses Meta-analysis to obtain an overall estimate for the effect of ICT on firm turnover. A Meta-analysis is usually used to combine results of various studies while controlling for heterogeneity to obtain an average weighted effect size. A detailed discussion on meta-analysis is provided in chapter two of this thesis.

3.3 Translog production function

There are various restrictions that are associated with the Cobb–Douglas specification, which in turn impose restrictions on the explanatory power of the estimated parameters. The Cobb–Douglas production function for instance assumes

that an input elasticity remains unchanged across the entire production range, which is not a reasonable assumption for most production technologies. Furthermore, it assumes that the value of elasticity of substitution between inputs is unitary, and homothetic. This indicates that the relative demands for the inputs are independent of the level of output, which is inaccurate in most situations. Lastly, the specification, in its log-linear form, does not include any product or squared terms, which inhibits some of the important relationships between the output and various inputs. In contrast, the Translog function allows for varying elasticity of substitutions and changes in economies of scale. In view of these limitations associated with the Cobb-Douglas specification and the attractiveness of the Translog production framework we relax the assumptions underlying the Cobb-Douglas function and extend our analysis to estimate a Translog specification of the production function.

This chapter thus, applies a Translog production function to estimate the effect of ICT capital on a firm's turnover, and also to ascertain whether the cross elasticity of substitutions (especially that of ICT-capital and the other factors) have a significant effect on a firm's turnover across Africa. The adoption of the Translog production function is used because of its flexibility as the function is both linear and quadratic in nature with the ability of taking more than two inputs. This property of the Translog production function allows the relationship between the firm's output and inputs to pass from a linear to a non-linear relationship. Furthermore, unlike the Cobb-Douglas production function, the Translog function does not assume rigidity of substitution between the factors of production or a perfect competitive factor market. The Translog production function is approximated by a second order Taylor series (Christensen, et al. 1973). In this chapter, we use a four-input Translog production function given below,

$$y_{ic} = \gamma_0 + \gamma_1 k_{ic} + \gamma_2 l_{ic} + \gamma_3 rm_{ic} + \gamma_4\, 1/2\,(k_{ic})^2 + \gamma_5\, 1/2\,(l_{ic})^2 + \gamma_6\, 1/2\,(rm_{ic})^2 + \gamma_7(k_{ic})(l_{ic}) + \gamma_8(k_{ic})(rm_{ic}) + \gamma_9(rm_{ic})(l_{ic}) + \gamma z_{ic} + \varepsilon_{ic} \qquad (3.4)$$

Here the variables are the same as defined in equation (3.1) and α_l, α_t α_k and α_m, α_{ll}, α_{tt}, α_{kk}, α_{mm}, α_{lt}, α_{lk}, α_{lm}, α_{tk}, α_{tm}, and α_{km} are unknown parameters to be estimated.

A perfectly competitive market assumes that the coefficient elasticity of an input corresponds to the cost share of the factor in question. In this respect, we derive a

system of four equations by taking the first derivatives of the Translog production function with respect to each factor of production. This is given below as,

$$\frac{\partial y}{\partial l} = \Psi_l = \alpha_l + \alpha_{ll} l + \alpha_{lt} ict + \alpha_{lk} k + \alpha_{lm} m$$
$$\frac{\partial y}{\partial ict} = \Psi_t = \alpha_t + \alpha_{tt} ict + \alpha_{lt} l + \alpha_{kt} k + \alpha_{tm} m \quad (3.5)$$
$$\frac{\partial y}{\partial k} = \Psi_k = \alpha_k + \alpha_{kk} k + \alpha_{lk} l + \alpha_{tk} ict + \alpha_{km} m$$
$$\frac{\partial y}{\partial m} = \Psi_m = \alpha_m + \alpha_{mm} m + \alpha_{mt} ict + \alpha_{mk} k + \alpha_{lm} l$$

Here the parameters are defined as follows, $\alpha_k, \alpha_t, \alpha_l$ and α_m represent the average cost share of non-ICT capital, ICT-capital labour and raw material input respectively. While $\alpha_{kk}, \alpha_{tk}, \alpha_{kl}$and α_{km} represent constant non-ICT capital share elasticity with respect to non-ICT capital, capital share elasticity with respect to ICT capital, and non-ICT capital share elasticity with respect to labour and non-ICT capital share elasticity with respect material input respectively. Young's theorem of partial derivatives imposes the following restrictions:

$$\alpha_{ml} = \alpha_{lm};\ \alpha_{mt} = \alpha_{tm};\ \alpha_{mk} = \alpha_{km};\ \alpha_{lk} = \alpha_{kl};\ \alpha_{lt} = \alpha_{tl};\ \alpha_{kt} = \alpha_{tk}$$

The output elasticities of various factors are estimated from equation (3.5) and the sum of the coefficient of elasticities gives an indication of the nature of returns to scale of the firms across the countries.

Unlike other studies that have attempted to estimate the effect of ICT on output at firm level, this chapter estimates the elasticities of substitution from the Translog production function. We do not estimate the elasticity of substitution of the inputs under the Cobb-Douglas framework as it is assumed that the elasticity of substitution is unitary.

3.4. Exploring the fitness of the models

This chapter explores the fitness of both the Cobb-Douglas and Translog models with respect to the structure of the data in each of the sampled countries. We test the hypothesis to determine which of the production function specifications best fit the data structure in each of the fourteen countries. The chapter thus tests the hypothesis of which framework best fits the structure of the data in each country, or both frameworks and none fits the data structure. This is necessary as the homogeneity or

otherwise of the production function indicates the extent of the relationship among production inputs. A constant return to scale is assumed under a Cobb-Douglas framework, however, a Translog functional form assumes a more complex relationship between the factors of production, a perfect elasticity of substitution is not assumed. With the production function indicating the degree of interrelationship between inputs, which may differ from country to country, it is imperative to determine which production framework best fits the data structure of each country.

One strategy of choosing the appropriate model that best describes the data structure is to examine the goodness of fit by comparing the root of the mean squared errors, or by comparing the R^2 or adjusted R^2 of the different models and concluding that the model with the highest goodness of fit is more appropriate. However, according to Baum (2006) this approach is flawed, unlikely to produce conclusive results and lacks statistical rationale. In this chapter, to determine which production framework best describes the data structure of each country we employ a non-nested J-test introduced by Davidson and MacKinnon (1981). According to MacKinnon (1983) a model is nested in an alternative model if the alternative model can be reduced to the model in question by imposing one or more restrictions on its parameters. However, the models may be said to be non-nested if model 1 is not nested within the second model. In the case of this chapter, the Cobb-Douglas production function is nested within the Translog production function. From equation 3.4, if the parameters α_{ll}, α_{tt}, α_{kk} and α_{mm} (the coefficient of the squared of the inputs) and α_{lt}, α_{lk}, α_{lm}, α_{tk}, α_{tm}, and α_{km} (estimated parameters of the products of the inputs) are statistically not different from zero then the Translog production specification reduces to a Cobb-Douglas production function. The J-test, based on a non-nested hypothesis is adopted to compare the Translog and Cobb-Douglas production frameworks to ascertain which of these two best fits the data structure in each country. The result of a J-test indicates four possibilities:

(i) The test fails to reject both the null and alternative hypotheses, implying that both production frameworks specified are good fit for the data structure;

(ii) A second possible outcome is that both null and alternative hypotheses are rejected, indicating that the two production specifications do not fit the data structure;

(iii) Third, possible outcome is to accept the alternative hypothesis;

(iv) A final possible outcome is to accept the null hypothesis.

The last two possible outcomes indicate that either the null or alternative is rejected by the test, indicating that only one of the specifications fits the data structure.

Estimation of the J-test requires two steps. First, we estimate the alternative hypothesis using OLS technique to obtain the fitted values. Second, we estimate the null hypothesis, using the same technique, but we include the fitted values from the alternative hypothesis. For the null hypothesis to fit the data structure the fitted values included in the null hypothesis must be significant, however, if the fitted values are not significant then the model is not a good fit for the data. The second step requires that we alter the null and alternative hypotheses using OLS estimation techniques to repeat the first step. In this instance, for the alternative model to be accepted as a good fit for the structure of data the coefficient of the fitted values from the null hypothesis included in the OLS estimation of the alternative hypothesis must be significant. The chapter performs a J-test for all fourteen countries.

3.5 Quantile regression estimation

The chapter further attempts to deal with endogeneity and unobserved heterogeneity by using a two pronged approach, an instrumental variable approach and a quantile regression estimation. We lag values of ICT and non-ICT capital by a twelve month period, which are used as instrumental variables for ICT and non-ICT capital respectively in an attempt to deal the endogeneity problem. Thus, the first part of the estimation procedure employs both OLS estimation and instrumental variables (two-stage least squares approach) estimation techniques. Second, we estimate a quantile regression QR analysis, introduced by Koenker and Bassett (1978), to deal with issues of heterogeneity. Furthermore, quantile regression enables the examination of the effects of ICT capital and non-ICT capital on the entire conditional distribution, with the effects made to differ across different quantiles.

The Quantile Regression (QR) analysis, introduced by Koenker and Bassett (1978), represents one of the best strategies to address the heterogeneity problem for four main reasons. First, the theoretical frameworks suggest the presence of a multimodal distribution in the production process (Quah, 1996 and Basu and Weil, 1998). This is supported by empirical evidence at both micro (Bartelsman and Doms, 2000) and

macro (Kumar and Russell, 2002) levels. Second, QR estimators are more efficient compared to OLS estimates in cases where the error terms are not normally distributed. Third, the QR estimator is less sensitive to outliers relative to the OLS estimator, as it places weight on outliers. Thus, QR is found to be robust to departures from normality in contrast to the ordinary least squares approach (Koenker and Basset, 1978). Finally, QR shows robust results and does not require the existence of a conditional mean for consistency. Quantile regression is the estimation of conditional quantiles, compared to OLS estimation, which estimates coefficients as a single measure at the distribution's mean. The QR method allows for the estimates of the effects of ICT capital stock together with other explanatory variables at various points of the conditional output distribution and not just at the mean. We follow Koenker and Basset (1978) and Buchinsky (1998) by illustrating the quantile regression as follows:

$$\boldsymbol{y_i} = \boldsymbol{x}_i'\beta_\theta + u_i \ \textbf{with}\ \boldsymbol{Q}_\theta(y_i / x_i) = \boldsymbol{x}_i'\beta_\theta \qquad (3.6)$$

Where $\boldsymbol{y_i}$ is the vector of log output, $\boldsymbol{x_i}$, is a vector of all the explanatory variables in (3.2), while β is the vector of estimated parameters, and **u** is a vector of residuals. While $\boldsymbol{Q}_\theta(y_i / x_i)$ represents the θ^{th} conditional quantile of $\boldsymbol{y}$, *given the* $\boldsymbol{x_i}$. The $\boldsymbol{\theta^{th}}$ regression quantile, $0 < \theta < 1$, solves the follow problem:

$$\underset{\beta}{\text{Min}}\ \tfrac{1}{n}\left\{\sum_{i:y_i \geq x_i'\beta_\theta} \theta\left|\mathbf{y_i} - \mathbf{x}_i'\beta_\theta\right| + \sum_{i:y_i \geq x_i'\beta_\theta} (1-\theta)\left|y_i - x_i'\beta\right|\right\} = \underset{\beta}{\text{Min}}\ \tfrac{1}{n}\sum_{i=1}^{n}\rho_\theta(u_{\theta i}) \qquad (3.7)$$

Where the check function is $\rho_\theta(.)$ and is defined as:

$$\rho_\theta(u_{\theta i}) = \begin{cases} \theta u_{\theta i} & \text{if } u_{\theta i} \leq 0 \\ (1-\theta)u_{\theta i} & \text{if } u_{\theta i} < 0 \end{cases} \qquad (3.8)$$

The θ^{th} regression quantile as stated, ranges from zero to one and by changing θ continuously any quantile of the distribution of y_i conditional on x_i can be obtained. Least squares assumes that parameter estimates are the same at all points on the conditional distribution due to the independent and identically distributed (i.i.d) assumption, however under quantile regression as θ changes from zero to one this assumption is relaxed.

3.6 ICT and technical efficiency

Production frontier functions have been widely used in estimating technical efficiency and in this regard we use both the Cobb-Douglas and Translog production

functions in exploring the relationship between ICT equipment/facilities and technical efficiency of the firm. It must however be emphasised that the traditional econometric estimation techniques (for example OLS) used to measure the production frontier fail as they allow some of the observed output bundles produced by a given set of inputs to be greater than the estimated maximal producible output (Arestis et al. 2006). Several techniques of estimating the firm's technical efficiency of production have been suggested, both parametric and nonparametric. Seiford (1996) indicates that the choice of technique is a major of source of debate among researchers, with no clear view on which is best. This is due to the fact that each approach has its own merits and demerits. One major advantage of using a non-parametric estimation technique such as Data Envelopment Analysis (DEA) is that there is no need for fundamental assumptions underlying the functional form to be estimated. Shao and Lin (2002), opine that DEA does not require any explicit assumptions regarding inefficiency, an assertion also stressed by Odeck (2007). A major limitation of the non-parametric approach according to Odeck (2007) is that it is impossible to determine whether the source of inefficiency is actually due to technical inefficiency or statistical noise in the dataset. Another limitation of the DEA is that it has non-stochastic frontier with no probability distribution, however the efficiency of producers relative to the frontier might be probabilistic.

However, the parametric techniques in comparison with non-parametric techniques are based fundamental assumptions, regarding the functional form and also an explicit distributional assumption for the inefficiency term. Unlike the non-parametric approach, the parametric method uses econometrics methods to estimate the parameters of the production function and the technical efficiency. Econometric techniques accounts for stochastic noise, a limitation in using non-parametric approaches. Parametric approach also enables the statistical testing of the production structure and the extent of technical inefficiency. The determinants of technical inefficiencies are identified in a one stage approach, when parametric techniques are used rather than the traditional two stage approach. Technical inefficiency measures difference between a firm's actual output and the maximum possible output. It estimates the ability of a firm to produce the optimal output, given its resources. ICT effect is measured by its contributions towards enhancing the efficiencies in the utilization of existing factor inputs and technology.

It is important to determine the best production function specification that must be used in parametric approach of estimating technical efficiency. We estimate both Cobb-Douglas and Translog functional forms and test the null hypothesis that the Cobb-Douglas function adequately represents the dataset.

The Cobb–Douglas stochastic production frontier comprises of three inputs, capital (K), labour (L) and raw materials (RM). The general form of the Cobb-Douglas stochastic frontier production model for firm *i* is specified as,

$$Y_{ic} = \gamma K_{ic}^{\delta_1} L_{ic}^{\delta_2} RM_{ic}^{\delta_3} e_{ic}^{v_{ic}-u_{ic}} \quad (3.9)$$

Where *ic* is in reference to the *i*th firm located in country *c*. Taking logs on both sides, equation (3.9) can be rewritten as:

$$y_{ic} = \delta_0 + \delta_1 k_{ic} + \delta_2 l_{ic} + \delta_3 rm_{ic} + v_{ic} - u_{ic} \quad (3.10)$$

Where, lower case letters denote the corresponding logarithmic values and multifactor productivity variable. The random error denoted by v_{ic} is assumed to be independent and identically distributed (i.i.d.) with zero mean and constant variance $N(0, \sigma_v^2)$. As specified in the previous section there are restrictions, such as fixed returns to scale and unitary elasticity of substitution, which are imposed on the Cobb–Douglas production frontier. In this regard the chapter tests the Cobb-Douglas production frontier against a three input Translog stochastic production frontier specified as,

$$y_{ic} = \gamma_0 + \gamma_1 k_{ic} + \gamma_2 l_{ic} + \gamma_3 rm_{ic} + \gamma_4 1/2\,(k_{ic})^2 + \gamma_5 1/2\,(l_{ic})^2 + \gamma_6 1/2\,(rm_{ic})^2 + \gamma_7 (k_{ic})(l_{ic}) + \gamma_8 (k_{ic})(rm_{ic}) + \gamma_9 (rm_{ic})(l_{ic}) + v_{ic} - u_{ic} \quad (3.11)$$

Again the lower case letters are defined as the logarithmic values of capital (*k*), labour (*l*) and raw materials (*rm*). The value u_i in both Cobb-Douglas and Translog production frontiers is assumed to be a non-negative random variable which represents the technical inefficiency of the production process and is assumed to be independently but not identically distributed and truncated at zero[28]. It measures the gap between the maximum possible output and what is actually produced; this is the "efficiency gap".

[28] The distributional assumption necessary for determining the inefficiency term requires the use of a Maximum Likelihood estimator to achieve efficient parameters.

Technical efficiency takes the value one only if the estimated potential output gap is equal to zero and otherwise it is less than one, implying the absence of technical inefficiency in the production process. If $u_i$is equal to zero, and the firm produces at its maximum potential output; it is technically efficient in production. While u_i less than zero implies the presence of technical inefficiency in the production process of the firm, indicating that the firm produces less than the potential maximum output level.

To estimate the effect of ICT on the technical efficiency of the firm there is the need for a second set of explanatory variables assumed to determine the level of efficiency at which the firm converts inputs into output. The literature on technical efficiency theory fails to designate specific variables that influence technical efficiency of the firm as it is an empirical issue and as such the set of independent variables are selected based on economic intuition (Carroll et al, 2007). Given data availability, the variables included in the second set of explanatory variables are types of ICT equipment or facility available to the firm (ICT_{ih}) and other firm characteristics such as firm size, ownership structure, management style, firm owner educational attainment, industrial sector of the firm, firm's age and also the formality of firm (formal, informal or semi-formal sector firm). The inefficiency equation to be estimated from both Cobb-Douglas and Translog production frontiers is specified as:

$$u_{ic} = \varphi_0 + \varphi_1 ict_{ich} + \varphi_2 age_{ic} + \varphi_3 size_{ic} + \varphi_4 educ_{ic} + \varphi_5 for_{ic} + \varphi_6 own_{ic} + \varphi_7 mgt_{ic} + \varphi_8 ind_{ic} + \omega_{ic} \quad (3.12)$$

Where ict_{ich} represents whether firm *i* operating in country *c* has access to a particular type of ICT equipment or facility, say equipment/facility *h* and it also captures the total ICT capital in the firm, with age_{ic} representing the age of firm *i* in country *c*. Educational attainment of firm *i*'s owner in country *c* is represented by $educ_{ic}$ and for_{ic} represents the formality level of firm *i* in country *c*. The ownership structure of the firm *i* in country *c* is denoted by own_{ic} with mgt_{ic} and ind_{ic} denoting the management style and industrial sector of firm *i* operating in country *c*. While ω_{ic} represents the random variable term, which is defined by the truncation of the normal distribution with zero mean and variance, σ_u^2, such as $\omega_{ic} > -Z_{ic}\delta$. The set Z_i is the set of explanatory variables specified in the technical inefficiency equation (3.12). The ICT variable is added to the technical inefficiency equation so

as to establish the relationship that exists between ICT and efficiency at the firm level. If the estimated parameter of ICT turns out to be significant and negative this will suggest that there is empirical evidence that the ICT equipment or facility has a positive effect on the technical efficiency of the firm.

Test for the present of technical inefficiency

The maximum likelihood estimation of the stochastic production frontier gives estimates of the variance parameters of the likelihood function, which is given in terms of $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2/\sigma^2$, as well as $\lambda = \sigma_u^2 / \sigma_v^2$. If λ=0 it implies that technical inefficiency effects are relevant in determining the levels and variations in the production of firms (Battese and Coelli, 1992). Further, if γ=0, it supports the point that technical inefficiency effects are significant in explaining the variation in the dependent variable.

4 Estimation Results

This section is divided into three sub-sections. The first sub-section presents results of OLS estimation using both Cobb-Douglas and Translog production function forms. The sub-section also presents results of a meta-regression analysis. Finally, the sub-section presents results of an instrumental variable estimation of the Cobb-Douglas production function. The second and third sub-sections present results of the quantile and the stochastic production frontier estimations, respectively.

4.1 Cobb-Douglas production functions

This chapter estimates three different Cobb-Douglas production functions for each of the sampled countries. In the first model, which is the basic model, we regress a firm's turnover on the log values of employment, ICT capital, non-ICT capital and raw materials. We also control for firm specific characteristics which have the potential to influence the turnover of the firm. The result of this model and the associated return to scale is presented in Table 3.1. Returns to scale for the Cobb-Douglas production function is the sum of the estimated coefficient of elasticities of the inputs. In the second model, the log value of ICT capital stock is replaced with

ICT dummy variables[29], which measures the extent of ICT adoption among firms depicted in Table 3.2. This is aimed at capturing the effect of the extension of ICT adoption on the firms' output. The dummy variables are defined by the number of pieces of ICT equipment at the disposal of the firm. It ranges from zero, where the firm has no access to any ICT equipment/facility to nine, which indicates that a firm has access to all nine different[30] types of ICT equipment (facilities) captured in our dataset. Firms with no access to any form of ICT are used as the reference group in our econometric estimation. In the third of the Cobb-Douglas production functions we estimate an OLS regression which uses the log value of ICT capital stock variable as well as the ICT dummies, measuring the extent of adoption, at the same time. This aims at controlling for the different types of ICT equipment used and the extent of ICT adoption by firms.

4.1.1 Elasticity of ICT capital

Table 3.1 presents results of the Baseline specification and it shows that all estimations have high adjusted R^2 values (in all cases above 50 per cent explanatory power). The baseline results provide evidence of a positive and a highly significant relationship between ICT capital and firm's turnover in most of the sampled countries, except Ghana, Nigeria and Zambia In these countries, the evidence indicates that ICT capital stock has no impact on the turnover of the firm. The lack of significant association between ICT capital and firms' turnover in these countries is perhaps due to technological progress, which enhance output growth, is probably exogenous and driven by other variables other than investment in ICT capital. The evidence also suggests that ICT capital has the greatest impact on turnover among firms in South Africa compared to the other countries, with Uganda recording the smallest impact (that is also statistically significant).

[29]The study follow the approach of Commander et al. (2011) which uses dummy variables to capture the extent of adoption of ICT ranging from ICT is not used at all to almost all processes are automated and integrated into central system of the firm.

[30]The dummy is ranked based on the number of pieces of ICT equipment/facility the firm can access. The various types of ICT equipment/facilities are not ranked due to limitations of the data. Thus if a firm has computer, Internet and fixed telephony the value three is assigned and also if the firm has access to fixed line telephony, mobile phone and a fax machine it is also assigned the value three.

Table 3. 1: Results of baseline Cobb-Douglas model and returns to scale

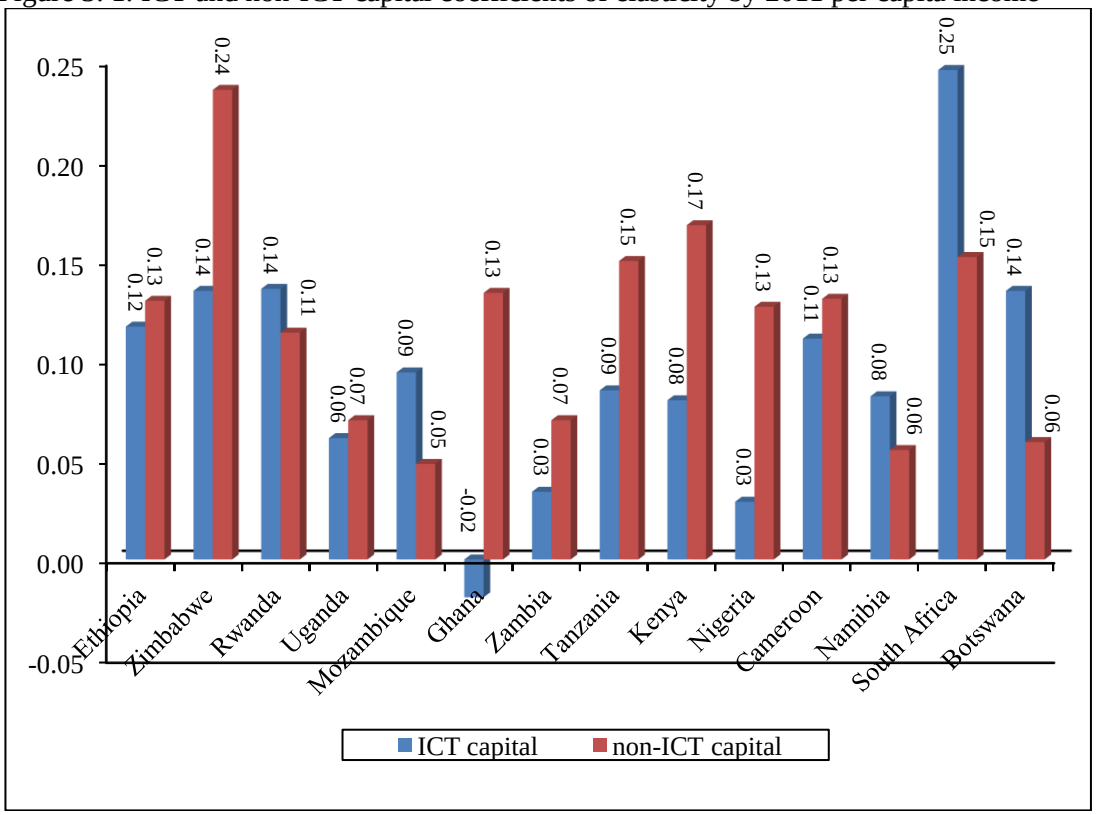
Country	log of employment	log of ICT capital	log of non-ICT capital	log of raw materials	returns to scale	Obs.	**a**djusted R-squared
Botswana	0.409*** (0.096)	0.135*** (0.037)	0.059** (0.026)	0.145*** (0.036)	0.748	255	0.727
Cameroon	0.308*** (0.114)	0.111** (0.045)	0.131** (0.060)	0.247*** (0.051)	0.797	280	0.583
Ethiopia	0.412*** (0.084)	0.117*** (0.038)	0.130*** (0.048)	0.325*** (0.057)	0.984	282	0.714
Ghana	0.491*** (0.082)	-0.019 (0.029)	0.134*** (0.028)	0.290*** (0.043)	0.896	280	0.685
Kenya	0.370*** (0.085)	0.080*** (0.029)	0.168*** (0.047)	0.327*** (0.070)	0.945	277	0.794
Mozambique	0.501*** (0.075)	0.094*** (0.021)	0.048** (0.021)	0.138*** (0.026)	0.781	280	0.711
Namibia	0.541*** (0.148)	0.082*** (0.023)	0.055 (0.036)	0.199*** (0.055)	0.877	307	0.570
Nigeria	0.201** (0.097)	0.029 (0.040)	0.127*** (0.043)	0.238*** (0.037)	0.595	265	0.721
Rwanda	0.193*** (0.066)	0.136*** (0.043)	0.114*** (0.030)	0.155*** (0.025)	0.598	279	0.676
South Africa	0.566*** (0.179)	0.246*** (0.075)	0.152** (0.072)	0.141*** (0.033)	1.105	290	0.528
Tanzania	0.398*** (0.088)	0.085** (0.035)	0.150*** (0.054)	0.167*** (0.047)	0.800	263	0.719
Uganda	0.367*** (0.057)	0.061*** (0.019)	0.070*** (0.023)	0.342*** (0.053)	0.840	351	0.769
Zambia	0.377*** (0.064)	0.034 (0.021)	0.070** (0.028)	0.398*** (0.043)	0.879	276	0.864
Zimbabwe	0.472*** (0.144)	0.135*** (0.031)	0.236*** (0.082)	0.115*** (0.029)	0.958	281	0.621

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note: Full table is presented in Appendix Table A-3.1. Firm and industry level specific characteristics are controlled for in all estimations.

We explore whether the impact of ICT differs across the countries based on their level of development. The impact of ICT capital on firm's turnover is expected to be greater in countries with high per capita incomes compared to countries which have low per capita income. The possible presence of a diffusion gap informs our expectation, with countries with high per capita income having experience ICT for many years compared to countries with lower per capita income. Furthermore, relatively high per capita income countries have a high intensity use of ICT and explain the difference in productivity effect of ICT between high and low per capita income countries. However, the evidence from the results does not support this expectation. The evidence suggests that there is no pattern with regards to the impact of ICT capital on firm's turnover and across the country's GDP (see Figure 3.1). Figure 3.1 compares the impact of both ICT and non-ICT capital on a firm's turnover, with the sampled countries ranked based on 2011 per capita income (beginning with the lowest to the highest per capita income in 2011). The evidence

suggests that ICT capital does not have any significant impact on LMIC, as ICT capital stock was not significant in Ghana, Nigeria and Zambia, three of the four LMIC sampled. This is surprising, especially, as evidence from Table 3.1 suggests that ICT capital has a significant and positive correlation with turnover in LIC.

Figure 3. 1: ICT and non-ICT capital coefficients of elasticity by 2011 per capita income



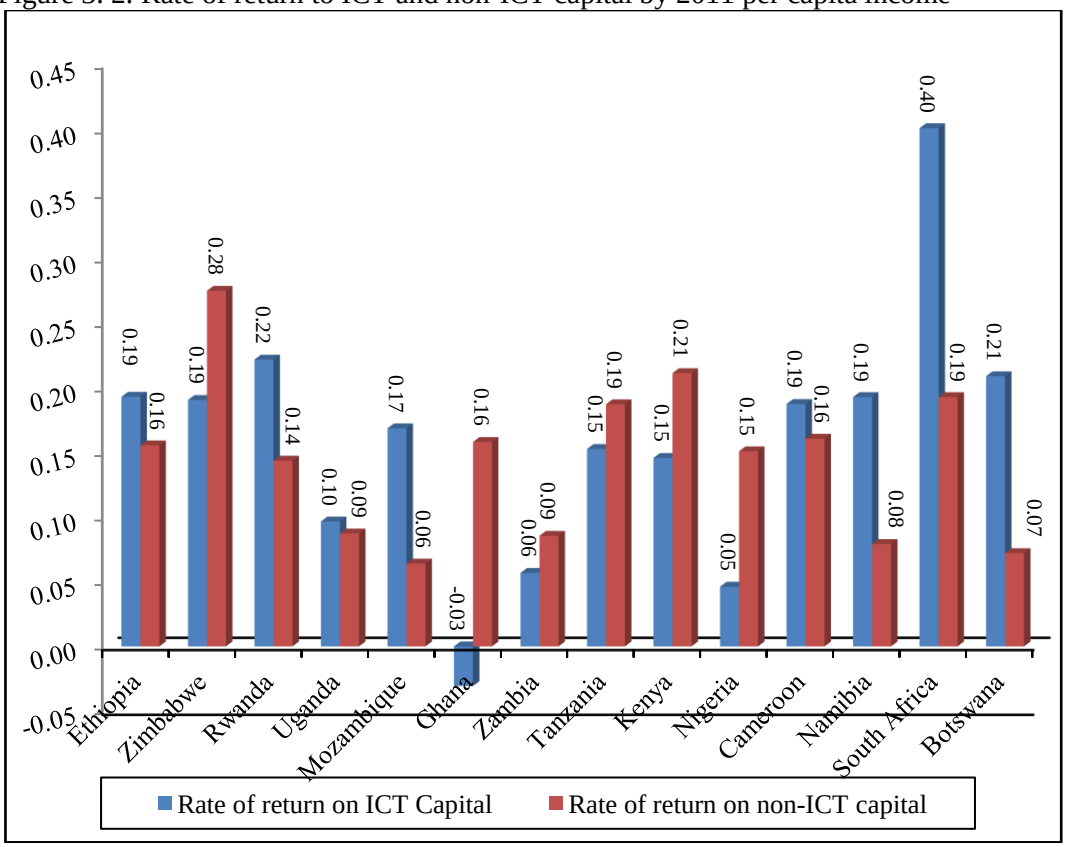
Note: ICT coefficients for Ghana, Nigeria and Zambia are not significant. Non-ICT capital stock is also not significant in Namibia.

The results also suggest that non-ICT capital has a positive and significant effect on the turnover of firms. The elasticity of output with respect to non-ICT capital for countries, with the exception of Namibia, exhibits a positive significant relationship with firm's turnover. The evidence shows that non-ICT capital was more productive in terms of turnover in Zimbabwe compared to other African countries. Furthermore, the evidence suggests that comparatively ICT capital has a greater impact on turnover of the firm in all the upper middle income countries as against non-ICT capital stock. The reserve was the case for LIC, where the evidence suggests that non-ICT capital has a greater impact on firm's turnover relative to ICT capital. Mozambique and Rwanda were the only two exceptions, which show that ICT capital was more productive compared to non-ICT capital.

4.1.2 Returns to ICT capital across Africa

Figure 3.2 compares returns to ICT capital[31] and non-ICT capital. The figure shows that richer countries such South Africa, Botswana and Namibia have relatively high returns to ICT capital compared to less richer countries. The Figure 3.2 also shows that returns to ICT capital do not exhibit a consistent pattern across GDP per capita (comparing SMEs in LIC and those in LMIC). Figure 3.2 also shows that return to ICT capital stock is greater than the return to non-ICT capital in most of the sampled countries: Botswana, Cameroon, Ethiopia, Mozambique, Rwanda, Namibia, South Africa and Uganda.

Figure 3. 2: Rate of return to ICT and non-ICT capital by 2011 per capita income



Note: ICT coefficients for Ghana, Nigeria and Zambia are not significant. Non-ICT capital stock is also not significant in Namibia.

In relation to richer countries such as South Africa, Botswana and Namibia, the return on ICT capital stock was twice as that of non-ICT capital stock. This finding is explained by the fact that investment in ICT capital is accompanied by changes in organisational and managerial practices, which have greater effect on turnover in

[31]The return to ICT capital for any given firm is given as by the elasticity of output with respect to ICT capital divided by ICT intensity [$\beta/(ICT_i/Y)$]

these countries. This is also possibly due to correlation between ICT and omitted observable and unobservable variables. This finding is consistent with other studies[32] that find a higher rate of return to ICT capital compared to non-ICT capital in developed countries.

To understand the different ways by which ICT development relates to return to ICT in SSA countries, we undertake a statistical analysis by relating the return to ICT capital of the various countries to their corresponding ICT diffusion index in Figure 3.3. The ICT diffusion index evaluates the development of ICT across different countries. It measures the average achievements in ICT development in a country in two dimensions: connectivity to ICT and access to ICT. Connectivity measures ICT infrastructural development. It assesses the number of personal computers per capita, the number of internet hosts per capita, the number of telephone mainlines per capita and the number of mobile subscribers per capita. The aim of ICT access is to capture the opportunity of getting connected and the ability to take advantage of being connected.

The Figure 3.3 shows that countries with relatively high diffusion index also have high return to ICT capital. Figure 3.3 shows that countries such as Rwanda, Ethiopia, Cameroon, Mozambique, Tanzania as well as Zimbabwe have a low diffusion index of less than 1.5 but these countries have relatively high returns to ICT capital. By contrast, countries such as Ghana, Nigeria and Kenya have relatively high diffusion index however, return to ICT capital is relatively low in Kenya. Two factors may explain differences across countries with regards to the relationship between ICT diffusion and returns to ICT capital. First, the state of production technology, which determines the optimal ICT capital that is required for a given level of technology, this may differ across countries. Second, if the optimum level of ICT capital accumulation is surpassed for a country, the return to ICT capital decreases due to diminishing marginal returns.

[32]For instance Brynjolfsson and Hitt (2003); Stiroh (2002) all found higher rate of return to ICT capital compared to non-ICT capital.

Figure 3. 3: Returns to ICT and ICT diffusion index, 2004

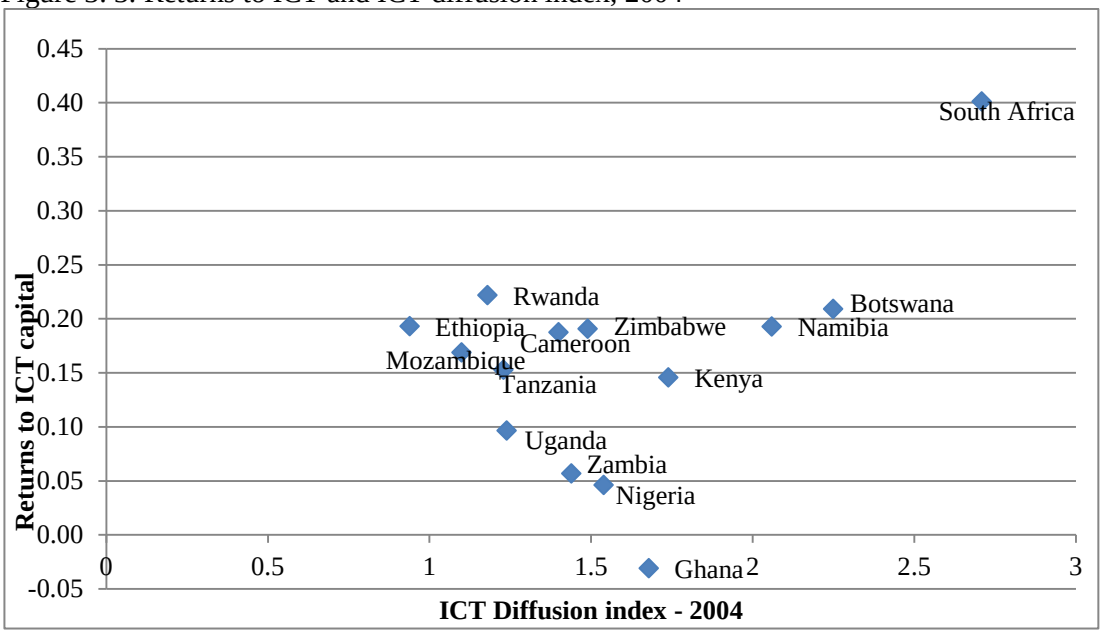
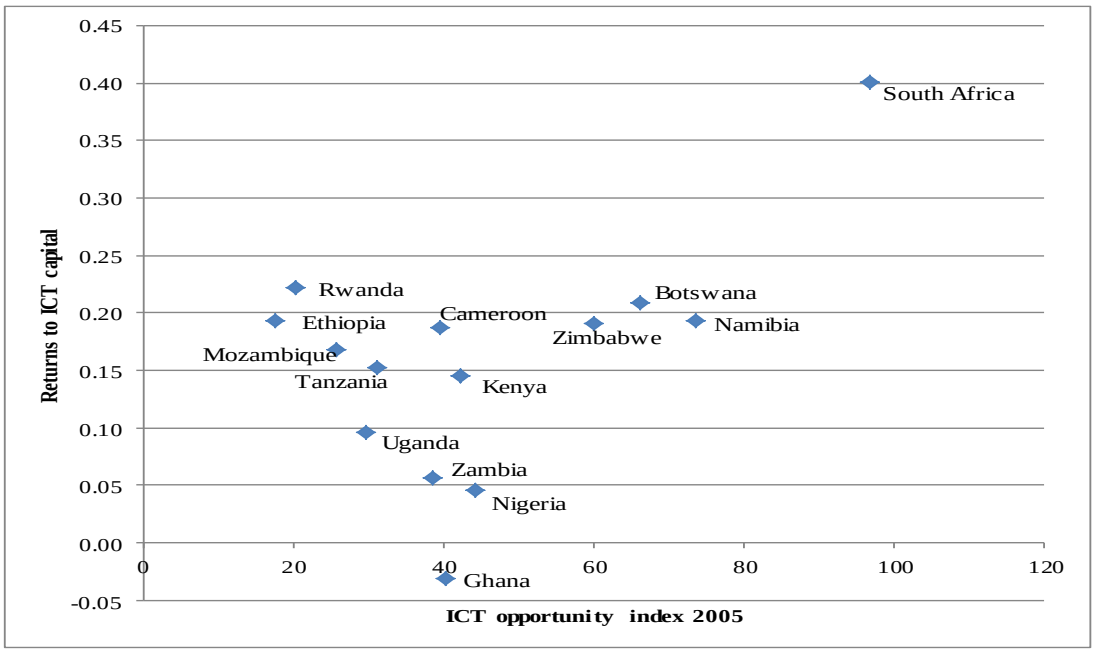


Figure 3. 4: Returns to ICT capital and ICT opportunity index[33], 2007



We also relate return to ICT capital to ICT opportunity index in Figure 3.4. The opportunity index measures the proportion of a country's overall ICT capital and ICT

[33] ICT opportunity index tracks the digital divide by estimating relative disparity in ICT Opportunity levels across various countries and over time. It simply measures the gaps between ICT "haves" and "have-nots". The index is a merger of two well-known initiatives, ITU's Digital Access Index (DAI) and Orbicom's Monitoring the Digital Divide/ Infostate conceptual framework and model. The conceptual framework of the index introduces the notions of a country's infodensity and info-use. Infodensity refers to the slice of a country's overall capital and labour stocks, which are ICT capital and ICT labour stocks and indicative of productive capacity. Info-use refers to the consumption flows of ICTs (ITU, 2007). ICT diffusion index was abandoned in 2007 in favour of ICT opportunity index.

labour stock, which indicate the country's productive capacity. It also takes into account the consumption flow of ICT facilities in a country. The index therefore measures the overall ability of individuals in a country to access and use ICTs, as well as the potential benefits accrued from the use of ICT. The opportunity index is based on ICT opportunity, ICT infrastructure and utilization of ICT. *Figure 3.4* shows the relationship between return to ICT and the opportunity index. A look at the figure shows that the relationship between returns to ICT capital and the opportunity index is similar the relationship between returns to ICT capital and diffusion index.

The chapter also estimates a second Cobb-Douglas production specification and employs other measures of ICT use; the results are presented in Table 3.2. In addition to the log values of ICT capital stock we include an ICT possession index, which measures the number of ICT equipment/facilities the firm adopts. This is aimed at capturing the relationship of the number of ICT equipment the firm adopts and turnover, given the level of ICT capital. The index ranges from 0 to 9 depending on the number of ICT equipment the firm adopts. If a firm adopt no ICT equipment, the index takes the value zero and if the firm has one (1) ICT equipment it takes the value one (1). The highest value for the index is nine (9) when the firm adopts all nine (9) ICT equipment captured in the dataset. Table 3.2 provides descriptive statistic of the ICT possession index. Firms in South Africa and Zimbabwe employ average a higher number of ICT equipment/facilities compared to firms operating in other countries.

Table 3. 2: Descriptive statistics of ICT possession index by country

Country	Mean	Median	Standard deviation	Minimum	Maximum	Observation
Botswana	3.51	4.0	1.89	0	9	255
Cameroon	2.10	1.0	1.76	0	9	280
Ethiopia	2.74	2.0	2.11	0	9	281
Ghana	2.88	2.0	2.13	0	9	280
Kenya	2.70	2.0	1.92	0	8	277
Mozambique	2.88	2.0	2.51	0	9	280
Namibia	2.56	2.0	2.48	0	9	307
Nigeria	2.23	2.0	1.72	0	8	265
Rwanda	2.24	2.0	1.78	0	8	278
South Africa	4.06	4.0	2.58	0	9	290
Tanzania	1.92	1.0	1.82	0	9	263
Uganda	2.46	2.0	1.76	0	8	351
Zambia	3.05	2.0	2.18	0	9	276
Zimbabwe	4.27	4.0	2.04	0	9	281

Table 3.3 presents result of the estimation of the Cobb-Douglas function with the number of ICT equipment the firm possesses as discrete variable taking the values 0, 1, 2,...,9. This variable measures the number of ICT equipment in working condition and in use within the organisation. The ICT possession variable takes a particular value if the firm possesses that particular number of ICT equipment, and it takes the value zero if the firm possesses no ICT equipment. We present the detailed results in Table A-3.2 of the appendices. The R^2 value suggests that in all the countries the turnover of the firm is well explained by the independent variables, with all the Adjusted R-squares for the all the countries estimations shown to be above the 50 per cent mark. Also the F-statistic probability value of zero indicates that independently the variables jointly explain firm's turnover in the sampled countries. Controlling for the number of ICT equipment the results suggest that ICT capital has no significant association with firm's turnover in Cameroon, Ghana, Nigeria and Zambia.

ICT capital has a significant association with turnover after controlling for the number of ICT equipment owned by firms in Mozambique, Namibia and Tanzania, the level of significance was very low at 10 per cent. ICT capital, however, is highly significant and has a positive association with firm's turnover in Botswana, Ethiopia, Kenya, Rwanda, South Africa, Uganda and Zimbabwe. Overall, the results suggest that in Botswana, Ghana, Mozambique, Nigeria, South Africa and Zambia ICT possession index (measuring the number of ICT equipment owned by the firm) has a positive association with turnover if the firm. Indicating that firms with more ICT equipment in these countries is associated with higher levels of turnover. The evidence also suggests lack of significant association between number of ICT equipment or facilities owned by the firm and turnover in Cameroon, Ethiopia, Kenya, Namibia, Rwanda, Tanzania, Uganda and Zimbabwe. After controlling for the number of ICT equipment possessed by the firm, all other variables had the expected sign and were all significant in all the countries.

Table 3. 3: Cobb-Douglas production with ICT possession index and ICT capital

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
log of employment	0.384***	0.307***	0.410***	0.485***	0.366***	0.436***	0.495***
	(0.096)	(0.112)	(0.084)	(0.081)	(0.083)	(0.070)	(0.132)
log of ICT capital	**0.112*** **	**0.096**	**0.100** **	**-0.042**	**0.073** **	**0.040***	**0.061***
	(0.036)	**(0.072)**	**(0.049)**	**(0.030)**	**(0.033)**	**(0.022)**	**(0.032)**
log of capital	0.058**	0.130**	0.131***	0.143***	0.171***	0.046**	0.065*
	(0.025)	(0.062)	(0.048)	(0.031)	(0.046)	(0.019)	(0.034)
log of raw materials	0.149***	0.247***	0.322***	0.289***	0.327***	0.150***	0.198***
	(0.037)	(0.051)	(0.059)	(0.042)	(0.070)	(0.022)	(0.056)
ICT possession	**0.063***	**0.045**	**0.042**	**0.087** **	**0.014**	**0.165*** **	**0.073**
	(0.036)	(0.106)	(0.052)	(0.044)	(0.028)	(0.031)	(0.052)
Constant	7.636***	5.144***	5.837***	6.610***	5.331***	7.549***	7.589***
	(0.322)	(0.896)	(0.894)	(0.438)	(0.712)	(0.324)	(0.443)
Observations	255	280	282	280	277	280	307
R-squared	0.731	0.584	0.714	0.690	0.794	0.739	0.574

Variables	Nigeria	Rwanda	S. Africa	Tanzania	Uganda	Zambia	Zimbabwe
log of employment	0.196**	0.194***	0.580***	0.394***	0.366***	0.368***	0.488***
	(0.091)	(0.066)	(0.183)	(0.085)	(0.057)	(0.062)	(0.145)
log of ICT capital	**-0.022**	**0.146*** **	**0.231*** **	**0.059***	**0.055** **	**0.011**	**0.147*** **
	(0.047)	**(0.046)**	**(0.078)**	**(0.032)**	**(0.024)**	**(0.024)**	**(0.033)**
log of capital	0.118***	0.117***	0.148**	0.145***	0.069***	0.065**	0.236***
	(0.042)	(0.031)	(0.072)	(0.054)	(0.023)	(0.027)	(0.082)
log of raw materials	0.249***	0.154***	0.147***	0.170***	0.343***	0.397***	0.114***
	(0.036)	(0.025)	(0.033)	(0.048)	(0.054)	(0.044)	(0.029)
ICT possession	**0.157*** **	**-0.027**	**0.105***	**0.072**	**0.012**	**0.059** **	**-0.060**
	(0.056)	**(0.046)**	**(0.061)**	**(0.046)**	**(0.028)**	**(0.025)**	**(0.045)**
Constant	6.815***	7.283***	6.089***	6.295***	6.254***	5.247***	7.737***
	(0.416)	(0.337)	(0.738)	(0.360)	(0.486)	(0.426)	(1.091)
Observations	265	279	290	263	352	276	281
R-squared	0.731	0.677	0.534	0.723	0.769	0.867	0.623

Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1. Note: All specifications include firm and industry specific characteristics (sole proprietorship, secondary, vocational and tertiary educational levels, manufacturing and construction industrial sector, formal and semi-formal sectors and lastly managerial skills) but exclude ICT-control variables interaction terms. Primary to no education, services industrial sector and informal sector are used are default variables. Detailed table is provided in Table A-3.2 appendix.

To examine complementarities of ICT capital and how it is associated with firm's turnover, ICT capital is interacted with the control variables. The results are presented in Table 3.4. All variables have the expected signs in all the country estimations and in all countries an adjusted R^2 of more than 0.60 was obtained. The results show significant changes in the impact of ICT on turnover in some of the countries. For instance in Zimbabwe, the ICT possession index has a negative relationship with turnover after accounting for complementarity effects of ICT among firms in these countries. The results after controlling for interaction between ICT capital stock and the control variables provide evidence which suggests that ICT possession index has a significant association with turnover of firms in six (6) countries. This confirms the earlier finding that higher number of ICT equipment is positively associated with turnover.

Table 3. 4: Cobb-Douglas production function with interaction terms and ICT possession

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
log of employment	0.384***	0.288**	0.436***	0.490***	0.364***	0.408***	0.554***
	(0.099)	(0.112)	(0.068)	(0.082)	(0.085)	(0.067)	(0.102)
log of ICT capital	**0.101**	**0.471****	**0.150***	**0.158**	**0.179**	**0.117***	**0.000**
	(0.088)	**(0.232)**	**(0.090)**	**(0.113)**	**(0.141)**	**(0.069)**	**(0.080)**
ICT possession	**0.039**	**0.045**	**-0.005**	**0.077***	**0.011**	**0.179*****	**0.043**
	(0.038)	**(0.089)**	**(0.066)**	**(0.044)**	**(0.037)**	**(0.030)**	**(0.060)**
log of capital	0.049*	0.089*	0.098***	0.126***	0.168***	0.046**	0.058**
	(0.027)	(0.050)	(0.025)	(0.030)	(0.041)	(0.019)	(0.028)
log of raw materials	0.140***	0.238***	0.307***	0.267***	0.319***	0.153***	0.225***
	(0.039)	(0.049)	(0.055)	(0.042)	(0.066)	(0.023)	(0.051)
Constant	7.784***	2.942*	5.909***	5.456***	4.698***	7.648***	7.883***
	(0.757)	(1.716)	(0.785)	(0.862)	(1.128)	(0.520)	(0.536)
Observations	255	280	282	280	277	280	307
R-squared	0.745	0.623	0.749	0.718	0.804	0.757	0.640

Variables	Nigeria	Rwanda	S. Africa	Tanzania	Uganda	Zambia	Zimbabwe
log of employment	0.203**	0.202***	0.618***	0.399***	0.362***	0.358***	0.393***
	(0.098)	(0.068)	(0.160)	(0.083)	(0.058)	(0.065)	(0.146)
log of ICT capital	**0.022**	**0.103***	**-0.168**	**0.040**	**0.114***	**0.214****	**0.268**
	(0.085)	**(0.057)**	**(0.203)**	**(0.081)**	**(0.066)**	**(0.100)**	**(0.218)**
ICT possession	**0.186*****	**0.005**	**0.108****	**0.031**	**0.003**	**0.060****	**-0.083***
	(0.058)	(0.056)	(0.053)	(0.053)	(0.033)	(0.027)	(0.045)
log of capital	0.096**	0.120***	0.168**	0.154***	0.068***	0.061**	0.199***
	(0.042)	(0.030)	(0.070)	(0.048)	(0.024)	(0.027)	(0.064)
log of raw materials	0.253***	0.151***	0.130***	0.167***	0.339***	0.402***	0.119***
	(0.035)	(0.025)	(0.026)	(0.048)	(0.055)	(0.041)	(0.028)
Constant	6.360***	7.619***	8.217***	6.292***	5.840***	4.181***	6.841***
	(0.599)	(0.427)	(1.529)	(0.468)	(0.614)	(0.605)	(2.048)
Observations	265	279	290	263	352	276	281
R-squared	0.761	0.697	0.601	0.732	0.771	0.876	0.660

Robust standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1. Note: All specifications include firm and industry specific characteristics (sole proprietorship, secondary, vocational and tertiary educational levels, manufacturing and construction industrial sector, formal and semi-formal sectors and lastly managerial skills).All estimations include ICT capital – control variables interaction terms (ICT – sole proprietorship; ICT – secondary education; ICT – vocational education; ICT – tertiary education; ICT – manufacturing sector; ICT – construction sector; ICT – formal sector; ICT – semi formal sector; ICT – managerial skills). Detailed table is provided in appendix Table A-3.3.

4.1.3 Meta-analysis results

We present the results from the meta-regression analysis in this section. We estimate the combined effect size of ICT coefficient of elasticity pooling all the countries together and proceed to examine the validity or authenticity of the estimated effect size. The purpose of the meta-analysis is to pool together the available empirical evidence obtained from the country level estimations in order to ascertain whether the impact of ICT capital is different from zero or not across the various countries. Table 3.5 presents results from the combined (pooled) estimates of the impact of ICT capital on firm's turnover and the associated confidence intervals from fixed and random effects meta-analysis. The fixed and random effects methods all provide evidence of a positive and significant effect of ICT capital on SME's turnover across African countries. The effect sizes estimated from the two approaches when all 14

countries empirical evidence is combined into one study is 0.076 and 0.083 for the fixed and random effects respectively.

Table 3.5: Fixed and random effects meta-analysis of ICT capital

Study	Effect Size (ES)		[95% Confidence Interval]				% Weight	
	Fixed effect	Random effect	Fixed effect		Random effect		Fixed effect	Random effect
Botswana	0.135	0.135	0.062	0.208	0.062	0.208	4.38	6.34
Cameroon	0.111	0.111	0.023	0.199	0.023	0.199	2.96	5.09
Ethiopia	0.117	0.117	0.043	0.191	0.043	0.191	4.15	6.16
Ghana	-0.019	-0.019	-0.08	0.038	-0.08	0.038	7.12	7.89
Kenya	0.08	0.08	0.023	0.137	0.023	0.137	7.12	7.89
Mozambique	0.094	0.094	0.053	0.135	0.053	0.135	13.59	9.7
Namibia	0.082	0.082	0.037	0.127	0.037	0.127	11.33	9.23
Nigeria	0.029	0.029	-0.05	0.107	-0.05	0.107	3.74	5.83
Rwanda	0.136	0.136	0.052	0.22	0.052	0.22	3.24	5.37
South Africa	0.246	0.246	0.099	0.393	0.099	0.393	1.07	2.45
Tanzania	0.085	0.085	0.016	0.154	0.016	0.154	4.89	6.7
Uganda	0.061	0.061	0.024	0.098	0.024	0.098	16.6	10.16
Zambia	0.034	0.034	-0.01	0.075	-0.01	0.075	13.59	9.7
Zimbabwe	0.135	0.135	0.074	0.196	0.074	0.196	6.23	7.48
I-V/D+L pooled ES	**0.076**	**0.083**	**0.06**	**0.091**	**0.06**	**0.11**	**100**	**100**

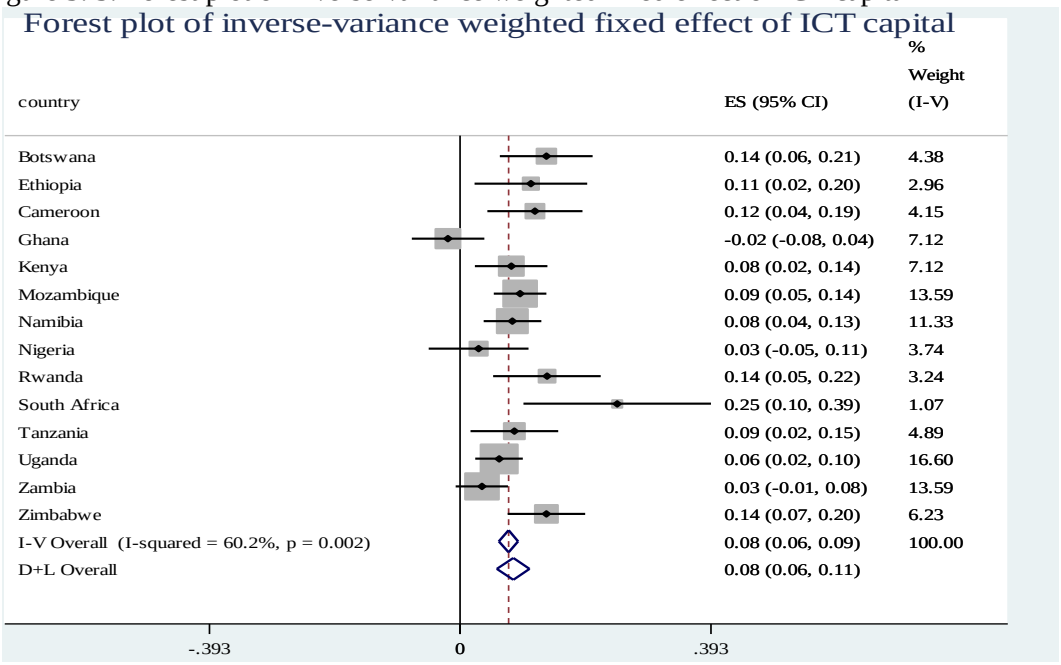
Note: The Q test for heterogeneity (fixed effect) - chi-squared = 32.64 (d.f. = 13), p = 0.002. I-squared (variation in ES attributable to heterogeneity) = 60.2%. Test of Effect size=0: z= 9.80; p = 0.000. Estimate of between-study variance Tau-squared = 0.0013. Test of ES=0: z= 6.39; p = 0.000

The fixed effect estimation of meta-analysis is based on the assumption that there is homogeneity among all the countries and that as stated above in the methodology a single true effect size is built in all country estimations thus the absence of heterogeneity between the studies is assumed. This assumption underlying the fixed effect method can be empirically tested to ascertain the presence of heterogeneity or otherwise. Heterogeneity is measured by Cochran's Q, which is estimated as the weighted sum of squared differences between the individual country study effects and the pooled effect across country studies, with the weights being those used in the pooling method. The Q-test has a chi-squared distribution with *k-1* degrees of freedom and tests for an indication of the extent of between-study variability impact on the meta-analysis.

Another test to validate the presence of heterogeneity or otherwise is the I-squared statistic, which gives an indication of the percentage of variation across the various studies that is explained by heterogeneity and not due to sampling errors. In contrast to the Q statistics, I-squared does not inherently depend upon the number of studies considered. The result for the heterogeneity test is reported in Table 3.4 alongside the I-squared statistic. Cochran's Q test for heterogeneity is significant at the 1 per cent

level, while the I-squared statistic further shows that 60.2 percent of the variation in the effect size is as result of heterogeneity in our country estimations. However, a visual inspection of the Forest plot is more appropriate in determining heterogeneity. If the confidence intervals lines overlap it implies the studies are homogeneous. The visual inspection of the plot, in Figure 3.5, indicates that the confidence intervals of all countries overlap, except Ghana. This indicates the homogeneity in the effect of ICT capital stock on turnover across the countries. Thus, in summary the fixed effects model of meta-analysis, which is based on homogeneity of effects sizes, is more appropriate compared to the random effect model and it is supported by the evidence inherent in the data.

Figure 3. 5: Forest plot of inverse-variance weighted fixed effect of ICT capital



In summing up, when we combine the evidence obtained from the 14 countries and applying the appropriate meta-analysis, the evidence suggests a positive and significant relationship between ICT capital stock and the turnover among SMEs in the 14 sampled African countries. More specifically, the average weighted coefficient of ICT capital stock elasticity is 0.076 and statistically significantly different from zero.

4.2 Translog production estimation

Unlike the Cobb-Douglas production function, the Translog production functional form imposes no restrictions other than that of symmetry as indicated under the methodology in the previous section. The marginal rate of technical substitution is homogenous of zero degree in factors of production. We present results for a four-input Translog production function in Table 3.6.

The results in Table 3.6 suggest a positive and statistically significant relationship between the ICT capital stock and turnover of firms in 8 of the countries.[34] However, it has no impact on turnover in Botswana, Ghana, Namibia, Nigeria, Tanzania and Zambia. The positive impact of ICT capital implies that turnover across these countries would increase with an increase in ICT capital. The Translog functional framework results support our earlier results from the Cobb-Douglas functional framework. The results show that ICT capital stock has a greater impact on turnover in South Africa compared to the other countries surveyed, while Ugandan firms have the lowest ICT capital impact.

We now turn our focus to the interaction of the variable of interest, ICT capital, with the other factors of production. The ICT capital and non-ICT capital interaction terms produce interesting results. This interaction term is significant in Cameroon, Kenya, Tanzania and Zimbabwe. In Cameroon, Kenya and Zimbabwe ICT capital and non-ICT capital interaction terms are negative while the levels of both capital variables have a positive and significant effect on turnover. This suggests that the cross elasticities of ICT capital and non-ICT capital in these countries are negative, implying a substitution effect between the inputs. This result indicates that SMEs in these countries substitute one of the inputs for the other. By contrast, in Tanzania the results suggest a complementarity effect of the two inputs in the production process, reflected in the positive and significant coefficient of the interaction term involving ICT capital and non-ICT capital. This would suggest that the joint effect of ICT and non-ICT capital contributes significantly to turnover of SMEs and the two inputs complement each other in the production.

[34] ICT capital stock is statistically significant in Cameroon, Ethiopia, Kenya, Mozambique, Rwanda, South Africa Uganda and Zimbabwe

Table 3. 6: Results of Translog production function

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia	Nigeria	Rwanda	S. Africa	Tanzania	Uganda	Zambia	Zimbabwe
log of employment	1.012***	-1.23**	-0.286	0.718**	0.617*	1.039***	1.041*	0.364	0.714***	-0.109	0.504**	1.305***	0.632***	-1.445**
	(0.283)	(0.594)	(0.605)	(0.310)	(0.347)	(0.204)	(0.576)	(0.304)	(0.229)	(0.623)	(0.224)	(0.239)	(0.217)	(0.662)
log of ICT capital	**0.042**	**0.397****	**0.359*****	**-0.019**	**0.403****	**0.148*****	**0.102**	**0.040**	**0.250*****	**0.401*****	**0.065**	**0.142***	**-0.0001**	**0.446****
	(0.101)	**(0.200)**	**(0.098)**	**(0.096)**	**(0.164)**	**(0.053)**	**(0.084)**	**(0.087)**	**(0.055)**	**(0.138)**	**(0.086)**	**(0.082)**	**(0.073)**	**(0.206)**
log of capital	-0.058	0.282	0.490***	0.215**	0.424**	0.025	0.094	0.008	0.247***	0.288*	0.160*	-0.120	0.250**	0.470*
	(0.061)	(0.226)	(0.111)	(0.096)	(0.181)	(0.043)	(0.109)	(0.092)	(0.083)	(0.164)	(0.093)	(0.109)	(0.103)	(0.277)
log of raw materials	-0.066	-0.141	0.533**	0.030	0.454**	-0.076	-0.028	-0.30***	-0.145**	-0.002	-0.042	-0.259***	0.122	-0.156
	(0.097)	(0.135)	(0.228)	(0.138)	(0.218)	(0.061)	(0.121)	(0.076)	(0.060)	(0.107)	(0.067)	(0.075)	(0.088)	(0.164)
labour square	0.205**	0.260	-0.122	0.086	0.236**	0.300***	-0.078	-0.201*	-0.046	-0.193	0.004	0.019	-0.094	0.023
	(0.100)	(0.204)	(0.129)	(0.115)	(0.102)	(0.097)	(0.240)	(0.112)	(0.080)	(0.192)	(0.077)	(0.077)	(0.089)	(0.213)
capital square	0.021***	0.005	-0.002	0.011**	0.043***	0.010**	0.023***	0.029	0.007	0.015	0.018**	0.012	0.013	0.001
	(0.007)	(0.017)	(0.010)	(0.005)	(0.014)	(0.005)	(0.009)	(0.023)	(0.010)	(0.016)	(0.008)	(0.012)	(0.010)	(0.012)
ICT square	0.014	0.030	-0.004	0.015	0.032***	0.010	0.042***	0.005	-0.002	0.025	0.005	0.024***	0.041***	0.024*
	(0.017)	(0.019)	(0.010)	(0.011)	(0.011)	(0.008)	(0.014)	(0.012)	(0.007)	(0.019)	(0.010)	(0.006)	(0.010)	(0.012)
raw material square	0.074***	0.047	0.069***	0.084***	0.087***	0.092***	0.068***	0.090***	0.096***	0.087***	0.104***	0.097***	0.095***	0.085***
	(0.007)	(0.029)	(0.009)	(0.008)	(0.010)	(0.009)	(0.009)	(0.008)	(0.005)	(0.014)	(0.008)	(0.005)	(0.010)	(0.009)
labour *x* capital	-0.045**	0.068	0.035	-0.009	-0.019	-0.015	-0.005	0.015	0.008	-0.021	-0.017	-0.011	0.035	0.145***
	(0.018)	(0.044)	(0.035)	(0.018)	(0.037)	(0.016)	(0.030)	(0.028)	(0.023)	(0.058)	(0.020)	(0.028)	(0.024)	(0.054)
labour *x* raw material	-0.09***	-0.020	-0.011	-0.064**	-0.050	-0.12***	-0.034	-0.042**	-0.039**	0.046	-0.025	-0.064***	-0.07***	-0.002
	(0.029)	(0.034)	(0.050)	(0.029)	(0.035)	(0.025)	(0.068)	(0.018)	(0.016)	(0.038)	(0.026)	(0.020)	(0.024)	(0.030)
labour *x* ICT capital	0.027	0.102	0.082***	0.015	-0.001	-0.0002	-0.053*	0.066*	-0.014	0.097*	0.010	-0.033*	0.019	-0.011
	(0.029)	(0.075)	(0.021)	(0.018)	(0.028)	(0.017)	(0.027)	(0.036)	(0.023)	(0.058)	(0.020)	(0.018)	(0.022)	(0.039)
capital *x* raw material	0.0003	0.013	-0.04***	-0.019**	-0.06***	-0.006	-0.015	-0.009	-0.020***	-0.014	-0.027**	0.003	-0.03***	-0.023
	(0.006)	(0.030)	(0.011)	(0.009)	(0.021)	(0.004)	(0.011)	(0.010)	(0.005)	(0.010)	(0.011)	(0.011)	(0.010)	(0.022)
capital *x* ICT capital	0.005	-0.08**	-0.001	0.001	-0.022**	0.004	-0.007	-0.020	-0.005	-0.024	0.014*	0.005	-0.006	-0.04**
	(0.008)	(0.036)	(0.006)	(0.005)	(0.011)	(0.003)	(0.005)	(0.014)	(0.007)	(0.015)	(0.007)	(0.007)	(0.009)	(0.019)
raw material *x* ICT capital	-0.014	0.007	-0.04***	-0.007	-0.036*	-0.02***	-0.009	0.009	-0.01***	-0.04***	-0.023**	-0.02***	-0.015**	-0.007
	(0.010)	(0.016)	(0.008)	(0.009)	(0.019)	(0.006)	(0.008)	(0.012)	(0.005)	(0.014)	(0.009)	(0.008)	(0.007)	(0.013)
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281
R-squared	0.869	0.649	0.842	0.854	0.904	0.845	0.649	0.832	0.874	0.732	0.889	0.885	0.913	0.809

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

The results suggest that raw materials used by firms and ICT capital are substitute in 8 countries: Ethiopia, Kenya, Mozambique, Rwanda South Africa, Tanzania, Uganda and Zambia. However, the results of the interaction term between number of employees and ICT capital is mixed. The results suggest that in Ethiopia, Nigeria and South Africa increase in ICT capital has a greater effect on turnover if labour force is large and vice versa. Conversely, in Namibia and Uganda increasing ICT capital with more labour has a dampening effect on SMEs' turnover.

The estimated parameters of the Translog production function model are elasticities at the mean levels of output and are defined as functions of the parameters and level of explanatory variables, thus the coefficients cannot be directly interpreted as elasticities. The elasticities of coefficients of the Translog production specification are estimated from equation 3.5 of the previous section. The coefficients of elasticities are in Table 3.7

Table 3. 7: Coefficient of elasticities and returns to scale

Country	log of ICT capital	log of non-ICT capital	employment	raw material	Return to scale
Botswana	0.116	0.097	0.305	0.382	0.900
Cameroon	0.112	0.041	0.058	0.321	0.531
Ethiopia	0.077	0.132	0.300	0.524	1.032
Ghana	0.059	0.130	0.325	0.487	1.001
Kenya	0.054	0.054	0.397	0.452	0.957
Mozambique	0.063	0.056	0.334	0.378	0.830
Namibia	0.092	0.105	0.342	0.351	0.890
Nigeria	0.079	0.079	0.251	0.359	0.768
Rwanda	0.075	0.100	0.252	0.445	0.872
South Africa	0.229	0.109	0.402	0.327	1.067
Tanzania	0.053	0.129	0.213	0.476	0.871
Uganda	0.076	0.043	0.327	0.492	0.938
Zambia	0.103	0.114	0.271	0.503	0.991
Zimbabwe	0.101	0.109	0.221	0.455	0.885

Source: Author's own computation from Translog production framework and returns to scale

The returns to scale of the firms across various countries is also examined and estimated. The returns to scale give a measure of the relative level of economic efficiency of SMEs across the sampled countries. Estimation of the returns to scale for the various countries assist in understanding the relationship that exists between the inputs and turnover, specifically how changes in inputs affect the level of turnover. Decreasing returns to scale implies the use of relatively more inputs to produce the same quantity of product leading to inefficiency and misapplication of

economic resources. Firms that exhibit increasing returns to scale have the ability to charge a mark-up price slightly higher than the average cost compared to a non-increasing returns to scale firm, as the increasing return to scale firm is relatively more efficient. The returns to scale is the sum of the coefficient of elasticities of the factors of production, employment, ICT capital, non-ICT capital and raw materials.

The results for returns to scale are in Table 3.7 indicate that with the exception of SMEs in South Africa, Ghana, Ethiopia, Kenya and Zambia, which exhibited constant returns to scale, SMEs in the remaining countries exhibit decreasing returns to scale. SMEs in Cameroon have the lowest returns to scale (0.5), with South African firms having the highest returns to scale (1.1). This finding is similar to findings from other studies, which find that SMEs tend to experience decreasing or constant returns to scale.

4.3 Quantile regression results

Results from OLS estimates the overall effect of ICT capital on turnover, but this approach fails to capture the distributional effects. We employ quantile regression techniques to address issues of heterogeneity that may exist in firms' turnover and to capture the distributional effect of ICT capital on turnover. The approach evaluates the relative effects of ICT capital and other inputs at different points of the conditional output distribution. The chapter first estimates and presents results for a quantile regression of the turnover function for each of the countries surveyed without controlling for endogeneity of ICT and non-ICT capital. In this regard, we first conduct a normality test on turnover to determine whether the variable is skewed or not. We thus employ the D'Agostino et al. (1990) test for skewness and kurtosis to show that the dependent variable is positively skewed and leptokurtic at the 1% level of significance across all the fourteen countries. This implies that in all the countries a large number of firms have relatively low turnover. We also test for skewness and kurtosis using the natural logarithm of turnover, with the results indicating the lack of normality at the 1 percent level of significance across the countries. The chapter also employs the Jarque-Bera test to confirm that conditional distribution of the residuals obtained from the OLS estimation depart from normality (Jarque and Bera, 1980). The null hypothesis that the conditional distribution of the residual is normal is rejected in all the countries. These tests for normality of the turnover variable

suggest that turnover and the natural logarithm of turnover are not normally distributed, thus justifying the use of quantile regression in this chapter as a robust alternative to least square estimation techniques.

The chapter employs Deaton's (1997) proposed Bootstrap method to determine whether quantile estimation results are sensitive to the country level survey designs. Deaton (1997) indicates that treating a two-stage sample as if it were a simple random sample can have serious implications since the sampling variability of the estimates can be affected by the design. Thus, to solve this problem we resort to bootstrapping, ignoring this leads to obtaining very low standard errors resulting in large t-values, thus overstating the precision of the estimates (Bertrand et al, 2002).

Table 3.9 presents summary results of the quantile regression estimation for all the countries with full results presented in Appendix Table A-3.5, while Figure 3.6 gives a graphical representation of OLS and quantile regression estimates. In Figure 3.6, the shaded grey area indicates a 90 per cent point-wise confidence band for quantile regression estimates after bootstrapping with 200 sample replications. The two dotted parallel lines in each country representation indicate a 90 per cent confidence interval for the quantile estimation, while the dashed line represents the conditional mean effect of ICT capital on turnover obtained from the OLS estimation. For all countries the estimation is conducted at 0.25, 0.5 and 0.75 quantiles.

The results for the effect of ICT capital (see Table 3.9) differ across the conditional distribution of turnover across countries. The results suggest that in some countries, the coefficient of ICT capital exhibits an upward trend along the conditional distribution of a firm's turnover, while in others the ICT capital depicts a downward trend along the conditional distribution. The results for Botswana, for instance, show that ICT capital has greater effect on firms with high turnover compared to firms with lower turnovers. Similar findings are obtained for Ethiopia, Kenya, Tanzania, Uganda and Zimbabwe. The findings suggest that in these countries ICT capital has greater effect on firms at the upper tails of the distribution relative to firms with lower turnover. In Ghana, Nigeria, and South Africa the results indicate a downward trend of ICT capital along the distribution (see Figure 3.6). This implies ICT capital has a stronger effect on firms with low turnover relative to those with high turnover.

Figure 3.6 and Table 3.9 further show a considerable dispersion of ICT capital coefficient at different quantiles of the distribution in all the countries.

The quantile regression results in Table 3.9, show that at the lower tail of the distribution ICT capital has a positive and significant effect on turnover of SMEs in Nigeria but the OLS (estimation at the mean) show no significant effect of ICT on turnover. This indicates that the distribution effect of ICT varies along the distribution. In Zambia the quantile estimation show that at the mid-point of the distribution ICT capital has no significant effect on turnover. At the lower and upper tails of the distribution ICT capital has a positive and significant effect on turnover. The quantile regression estimation also finds that in Cameroon ICT has no effect on low turnover firms but has a significant and positive effect on firms at the upper tail (75 per cent) of the distribution. The reverse is true for Namibia, where the results suggest that ICT capital has no significant effect on turnover of firms at the upper tail of the distribution but a positive and significant effect on turnover for firms at the mid and lower levels of the distribution. In Ghana, the results show that ICT capital has no effect on firm's turnover at all quantiles of the distribution.

The results in Table 3.9 also show that the output elasticity of non-ICT capital is significant along the entire distribution in a few countries: Cameroon, Ethiopia, Ghana, Rwanda and Tanzania. The effect of non-ICT capital input increases as we move from a lower quantile to a higher quantile in all these countries, except Rwanda (the coefficient of decreases from 0.1 to 0.08). This result implies that firms with a high output level are more sensitive to changes in non-ICT capital relative to firms with lower output levels. The reserve is true for Rwanda.

Table 3.9 also indicates that the elasticity of output with respect to raw material input decreases as we move from a lower quantile to a higher quantile in all countries, implying that raw material inputs have a lower output effect at the upper tail of the conditional distribution of output as against the lower tail of the distribution. The findings show that contribution of raw materials to output is smaller at the upper tail of the conditional distribution relative to its effect on output at the lower tail. The results of output elasticity of labour are similar to that of raw materials.

Figure 3. 6: OLS and Quantile regression estimates of effect of ICT capital

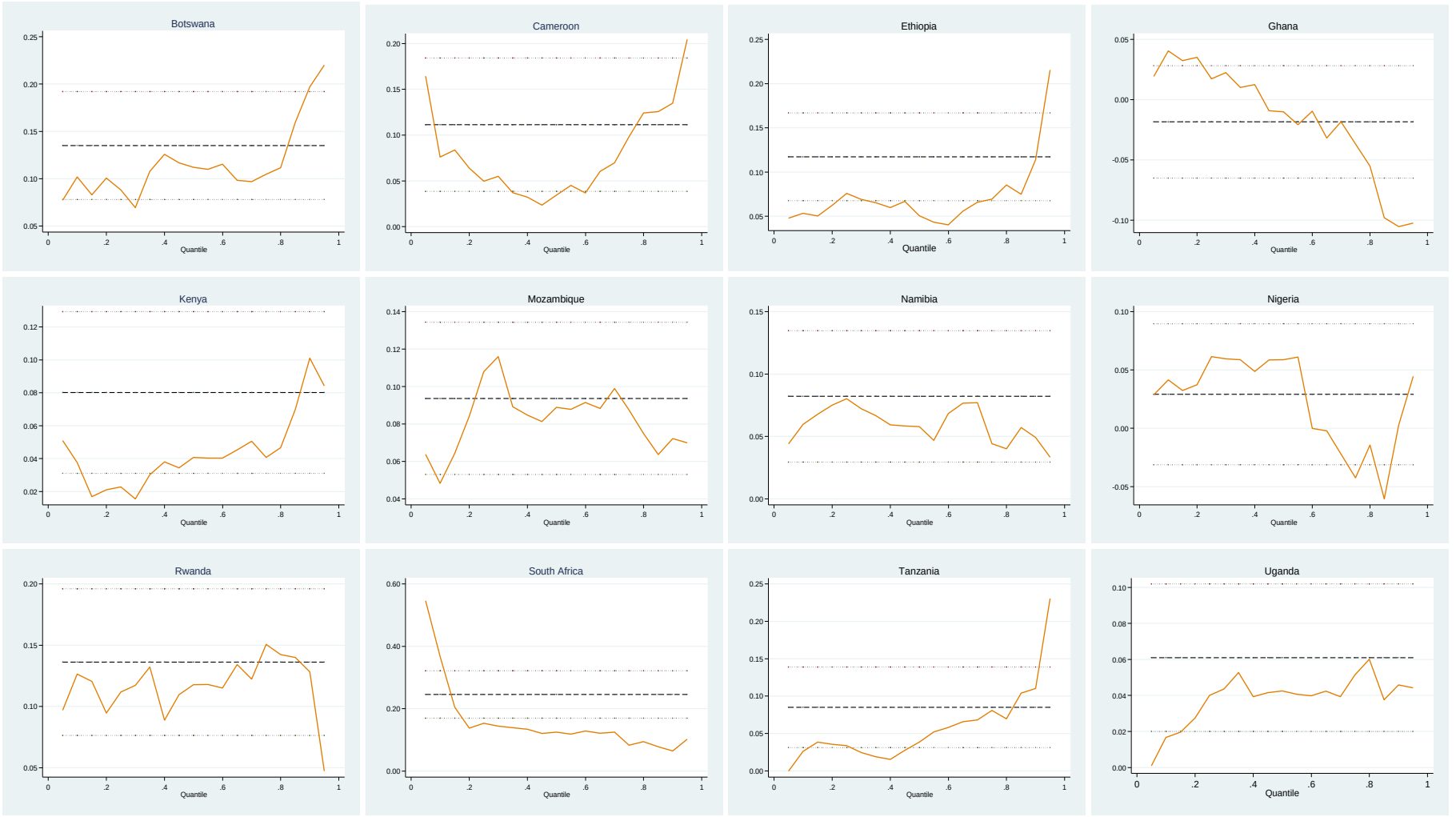


Table 3. 8: Quantile regression estimation

Variables	Botswana			Cameroon			Ethiopia			Ghana		
	0.25	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**
log of employment	0.388***	0.457***	0.395**	0.346***	0.384***	0.442***	0.386***	0.391***	0.438***	0.291***	0.299***	0.456***
	(0.112)	(0.109)	(0.161)	(0.131)	(0.120)	(0.134)	(0.052)	(0.072)	(0.118)	(0.070)	(0.098)	(0.127)
log of ICT capital	**0.088**	**0.112****	**0.105***	**0.050**	**0.035**	**0.098*****	**0.076*****	**0.051***	**0.069*****	**0.017**	**-0.010**	**-0.037**
	(0.056)	**(0.044)**	**(0.053)**	**(0.044)**	**(0.034)**	**(0.036)**	**(0.016)**	**(0.028)**	**(0.025)**	**(0.027)**	**(0.029)**	**(0.048)**
log of capital	0.054	0.073**	0.079	0.094*	0.155***	0.110*	0.066***	0.060*	0.084**	0.061*	0.120***	0.116***
	(0.037)	(0.034)	(0.049)	(0.048)	(0.044)	(0.059)	(0.025)	(0.032)	(0.033)	(0.033)	(0.040)	(0.038)
log of raw materials	0.296***	0.197**	0.117	0.335***	0.209***	0.150***	0.451***	0.366***	0.261***	0.522***	0.438***	0.332***
	(0.084)	(0.084)	(0.078)	(0.078)	(0.034)	(0.033)	(0.049)	(0.059)	(0.067)	(0.044)	(0.079)	(0.067)
Observation	255			280			282			280		

	Kenya			**Mozambique**			**Namibia**			**Nigeria**		
log of employment	0.395***	0.360***	0.296***	0.395***	0.425***	0.548***	0.375***	0.489***	0.626***	0.161	0.169	0.286**
	(0.079)	(0.068)	(0.086)	(0.097)	(0.097)	(0.110)	(0.118)	(0.102)	(0.136)	(0.099)	(0.137)	(0.144)
log of ICT capital	**-0.051**	**0.015**	**-0.036**	**0.108*****	**0.089*****	**0.088****	**0.080*****	**0.058****	**0.044**	**0.061****	**0.059**	**-0.042**
	(0.565)	**(0.392)**	**(0.446)**	**(0.039)**	**(0.029)**	**(0.036)**	**(0.020)**	**(0.023)**	**(0.032)**	**(0.031)**	**(0.050)**	**(0.064)**
log of capital	0.050	0.093***	0.128***	0.068**	0.076**	0.012	0.063**	0.052	0.047	0.045	0.080*	0.185***
	(0.031)	(0.030)	(0.049)	(0.034)	(0.030)	(0.025)	(0.028)	(0.032)	(0.036)	(0.039)	(0.046)	(0.061)
log of raw materials	0.511***	0.453***	0.399***	0.270**	0.175***	0.100***	0.325***	0.226***	0.132***	0.414***	0.311***	0.174***
	(0.052)	(0.041)	(0.072)	(0.110)	(0.063)	(0.036)	(0.082)	(0.060)	(0.048)	(0.073)	(0.055)	(0.044)
observation	277			280			307			265		

	Rwanda			**South Africa**			**Tanzania**			**Uganda**		
log of employment	0.184***	0.130	0.237***	0.697***	0.818***	0.844***	0.254***	0.269***	0.314***	0.261***	0.304***	0.323***
	(0.067)	(0.087)	(0.090)	(0.142)	(0.131)	(0.137)	(0.049)	(0.084)	(0.107)	(0.062)	(0.070)	(0.080)
log of ICT capital	**0.112*****	**0.118*****	**0.151*****	**0.153***	**0.125****	**0.083***	**0.034***	**0.039**	**0.081**	**0.040****	**0.042***	**0.051***
	(0.041)	**(0.044)**	**(0.039)**	**(0.089)**	**(0.054)**	**(0.050)**	**(0.020)**	**(0.031)**	**(0.051)**	**(0.020)**	**(0.026)**	**(0.028)**
log of capital	0.098***	0.111***	0.077*	0.149**	0.070	0.040	0.106***	0.137***	0.189***	0.011	0.033	0.059*
	(0.034)	(0.036)	(0.041)	(0.068)	(0.053)	(0.038)	(0.026)	(0.046)	(0.060)	(0.020)	(0.027)	(0.033)
log of raw materials	0.359***	0.170***	0.109***	0.093***	0.083***	0.071***	0.471***	0.358***	0.144**	0.567***	0.502***	0.405***
	(0.090)	(0.055)	(0.032)	(0.031)	(0.021)	(0.023)	(0.066)	(0.103)	(0.061)	(0.036)	(0.034)	(0.047)
observation	279			290			263			351		

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Note: Adoption 0 is use as the default for extent of ICT adoption indicators. All specifications include firm and industry specific characteristics. Detailed table is provided in appendix Table A-3.5

4.5 ICT and technical inefficiency

The chapter uses a meta-production frontier developed by Sharma and Leung (2000), also referred to as an envelope frontier, which is obtained from pooling the sampled firms across all sectors. The use of this approach is necessary because it is expected that sampled firms drawn from different sectors and industries employ varying technologies in their production processes, this leads to differences in the stochastic production frontier. The sector and industry differences in the stochastic production frontier are accounted for by the introduction of sector and industry specific dummies. The chapter then proceeds to estimate the technical efficiency index for the sampled firms in each country. Maximum likelihood estimation techniques are used to estimate the coefficients of both the stochastic production frontier and technical inefficiencies models in equations 3.10 to 3.12 in the previous section. The section is divided into 3 parts. We first present results and discussion of the stochastic frontier within the Translog functional specification for different ICT adoption measures. This is followed by a discussion on ICT adoption and technical efficiency. Finally, we present results and a discussion of the mean efficiency of SMEs in the selected countries.

Fitness of the model

We examine four null hypotheses to determine the appropriateness of the two production specifications. This is aimed at testing the Cobb–Douglas production functional form against the Translog specification. This is necessary because determining the appropriate functional form increases the accuracy of the estimated technical efficiency. The objective of the likelihood ratio test is to test the null hypothesis that the second-order parameters of the Translog production frontier are simultaneously equal to zero. The likelihood ratio test is computed as $[2(-L_{UR} + L_R)]$ and follows a chi-squared distribution, where L_{UR} is the log likelihood value of the unrestricted model (in our case the Translog model) and L_R represents the log likelihood estimate from the restricted model (the Cobb-Douglas functional framework). The results of the likelihood ratio test reject the null hypothesis at a 1 percent level of significance that the Cobb–Douglas stochastic frontier is an appropriate representation of the data for the various countries. This implies that the Translog functional form is a better fit of the data for all the surveyed countries and for estimating the technical efficiency of the three ICT adoption measures see

Appendix Table. We therefore present results for Translog production specifications, using ICT capital as a measure of ICT adoption. The results of the Cobb-Douglas production functional specification are also in Appendix Table A-3.6.

4.5.1 ICT measures and the stochastic frontier

The results of the Translog stochastic frontier in Tables 3.10 to 3.12 are similar to the results of the Cobb-Douglas production function section 4.1 of this chapter. The results of the stochastic frontier are also consistent with similar studies (Castiglione, 2012, Mouelhi, 2009, Admassie and Matambalya, 2002) that have examined technical efficiency among firms. Table 3.10 presents results of Translog specification with ICT capital as a determinant of technical inefficiency. Tables 3.11 and 3.12 also present results of the Translog specification with computer and Internet accessibility as determinants of technical inefficiency, respectively.

The results of the stochastic frontier indicate that most variables are significant in all three models of ICT adoption. Employment is significant and has a positive effect on the turnover frontier in all the specifications (ICT capital, computer and Internet accessibility) for all countries. Table 3.10 suggests that non-ICT capital has a significant and positive effect on turnover in 6 countries and has a negative and significant effect on turnover of SMEs in Nigeria and South Africa. Table 3.10 also indicates that the interaction of non-ICT capital and labour have a negative and significant effect on turnover in countries such as Botswana, Cameroon, Ghana and Namibia. This indicates that increase in non- ICT capital has a less effect on turnover if labour is high and vice versa. These results are similar to the computer and Internet accessibility models (see Appendix Table A-3.6).

We present estimate for coefficient of elasticities, evaluated at the mean of the explanatory variables, and returns to scale in Appendix Table A-3.12. The results are similar to those under section 4.2.

Table 3. 9: Technical inefficiency of log of ICT capital using a Translog production framework

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SAf	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.386 (0.37)***	0.338 (0.294)	0.831 (0.31)***	0.700 (0.304)**	0.358 (0.230)	0.972 (0.22)***	2.189 (0.217)***	0.643 (0.227)***	0.506 (0.262)*	0.827 (0.268)***	0.360 (0.219)	1.259 (0.261)***	0.739 (0.236)***	-0.283 (0.342)
log of non-capital	0.038 (0.092)	-0.144 (0.102)	0.085 (0.117)	0.275 (0.09)***	0.722 (0.05)***	0.083 (0.047)*	-0.016 (0.055)	-0.280 (0.102)***	0.304 (0.103)***	-0.214 (0.074)***	0.289 (0.081)***	-0.017 (0.117)	0.209 (0.118)*	-0.069 (0.097)
log of raw materials	-0.112 (0.070)	-0.204 (0.08)***	-0.205 (0.083)**	-0.006 (0.077)	0.426 (0.05)***	-0.216 (0.05)***	-0.110 (0.062)*	-0.263 (0.080)***	-0.224 (0.050)***	-0.399 (0.053)***	-0.154 (0.060)**	-0.308 (0.073)***	0.053 (0.089)	-0.382 (0.098)***
labour square	0.073 (0.128)	0.336 (0.11)***	0.092 (0.090)	0.176 (0.102)*	0.236 (0.102)**	0.172 (0.096)*	0.064 (0.113)	-0.226 (0.092)**	-0.031 (0.082)	0.010 (0.109)	-0.037 (0.079)	-0.071 (0.081)	0.083 (0.099)	0.059 (0.169)
capital square	0.036 (0.01)***	0.034 (0.01)***	0.015 (0.009)	0.013 (0.005)**	0.030 (0.01)***	0.016 (0.01)***	0.037 (0.008)***	0.042 (0.012)***	0.008 (0.013)	0.040 (0.009)***	0.017 (0.009)**	0.034 (0.010)***	0.025 (0.099)**	0.015 (0.008)**
raw material square	0.077 (0.01)***	0.054 (0.01)***	0.082 (0.01)***	0.089 (0.01)***	0.093 (0.01)***	0.097 (0.01)***	0.079 (0.008)***	0.081 (0.009)***	0.100 (0.006)***	0.096 (0.008)***	0.100 (0.007)***	0.102 (0.007)***	0.097 (0.011)***	0.088 (0.006)***
labour *x* capital	-0.046 (0.023)**	-0.050 (0.03)**	-0.022 (0.029)	-0.002 (0.02)***	-0.002 (0.033)	-0.006 (0.017)	-0.063 (0.017)***	0.028 (0.028)	0.007 (0.026)	0.006 (0.019)**	0.004 (0.020)	-0.014 (0.028)	0.014 (0.024)	0.075 (0.032)**
labour *x* raw material	-0.070 (0.034)**	-0.001 (0.025)	-0.034 (0.023)	-0.065 (0.024)	-0.046 (0.022)**	-0.088 (0.02)***	-0.136 (0.025)***	-0.029 (0.023)	-0.028 (0.018)	-0.037 (0.016)**	-0.017 (0.020)	-0.065 (0.022)***	-0.074 (0.026)***	-0.034 (0.020)*
capital *x* raw material	-0.012 (0.008)	0.012 (0.010)	-0.012 (0.011)	-0.026 (0.01)***	-0.087 (0.01)***	-0.013 (0.004)***	-0.005 (0.004)	-0.004 (0.009)	-0.027 (0.007)***	-0.003 (0.004)	-0.031 (0.006)***	-0.018 (0.011)	-0.035 (0.011)***	-0.010 (0.008)
Technical efficiency														
ICT capital	0.054 (0.172)	-0.135 (0.111)	-0.428 (0.09)***	-0.167 (0.106)	-0.064 (0.152)	-0.307 (0.108)***	-0.387 (0.093)	-0.203 (0.292)	-0.301 (0.120)**	-0.562 (0.090)***	-0.119 (0.174)	-0.079 (0.147)	-0.215 (0.164)	-0.286 (0.068)***
σ_v	0.198	0.439	0.328	0.204	0.134	0.224	0.374	0.225	0.227	0.533	0.145	0.196	0.143	0.399
σ_u	0.652	0.762	0.502	0.613	0.458	0.676	0.613	0.587	0.534	0.776	0.463	0.377	0.499	0.672
σ^2	0.464	0.773	0.360	0.417	0.228	0.507	0.516	0.395	0.337	0.886	0.235	0.181	0.269	0.611
$\lambda = \sigma_u^2 / \sigma_v^2$	0.092	0.332	0.427	0.111	0.086	0.110	0.372	0.147	0.181	0.472	0.098	0.270	0.082	0.353
$\gamma = \sigma_u^2/\sigma^2$	0.084	0.249	0.299	0.100	0.079	0.099	0.271	0.128	0.153	0.321	0.089	0.213	0.076	0.261
Log Likelihood	191.6	355.97	244.59	261.87	189.41	283.83	309.52	241.95	229.29	352.78	178.75	254.63	206.34	325.85
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables in the second stage of estimation. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SAf- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe. See appendix Table A-3.9 for full table

Table 3. 10: Technical inefficiency of computer accessibility using a Translog production framework

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SAf	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.13***	0.429	0.354	0.729**	1.07***	0.78***	2.11***	0.61***	0.457*	0.81***	0.363*	1.21***	0.68***	-0.337
	(0.296)	(0.294)	(0.349)	(0.302)	(0.230)	(0.205)	(0.220)	(0.207)	(0.262)	(0.295)	(0.217)	(0.296)	(0.235)	(0.329)
log of capital	-0.029	-0.184*	0.37***	0.28***	0.203**	0.101**	0.017	-0.092	0.32***	-0.15**	0.30***	0.017	0.211*	0.113
	(0.076)	(0.100)	(0.126)	(0.085)	(0.086)	(0.045)	(0.055)	(0.083)	(0.105)	(0.079)	(0.080)	(0.131)	(0.118)	(0.103)
log of raw materials	-0.071	-0.23***	-0.059	-0.001	-0.094	-0.23***	-0.15**	-0.40***	-0.21***	-0.40***	-0.15**	-0.30***	0.048	-0.21***
	(0.052)	(0.075)	(0.086)	(0.077)	(0.081)	(0.052)	(0.064)	(0.078)	(0.050)	(0.062)	(0.059)	(0.083)	(0.088)	(0.081)
labour square	0.213**	0.335***	0.002	0.177*	0.26***	0.159*	0.053	-0.23**	-0.060	-0.034	-0.035	-0.024	0.086	0.094
	(0.098)	(0.109)	(0.098)	(0.102)	(0.102)	(0.091)	(0.116)	(0.093)	(0.083)	(0.121)	(0.079)	(0.093)	(0.097)	(0.177)
capital square	0.042***	0.038***	0.007	0.012**	0.03***	0.01**	0.03***	0.015	0.009	0.04***	0.016*	0.028**	0.023**	0.02***
	(0.008)	(0.012)	(0.010)	(0.005)	(0.009)	(0.005)	(0.008)	(0.011)	(0.013)	(0.010)	(0.009)	(0.011)	(0.010)	(0.007)
raw material square	0.064***	0.055***	0.09***	0.09***	0.09***	0.09***	0.08***	0.09***	0.10***	0.10***	0.10***	0.10***	0.09***	0.09***
	(0.007)	(0.011)	(0.006)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.006)	(0.009)	(0.007)	(0.008)	(0.010)	(0.009)
labour *x* capital	-0.06***	-0.059**	0.021	-0.002	-0.056*	-0.005	-0.06***	0.035	0.009	0.010	0.005	-0.018	0.009	0.08**
	(0.017)	(0.025)	(0.032)	(0.017)	(0.033)	(0.016)	(0.017)	(0.026)	(0.026)	(0.021)	(0.020)	(0.031)	(0.023)	(0.032)
labour *x* raw	-0.07***	-0.005	-0.014	-0.07***	-0.07***	-0.07***	-0.12***	-0.035	-0.020	-0.026	-0.016	-0.07***	-0.06**	-0.035
material	(0.024)	(0.024)	(0.026)	(0.024)	(0.021)	(0.020)	(0.025)	(0.024)	(0.017)	(0.019)	(0.020)	(0.025)	(0.025)	(0.022)
capital *x* raw	-0.010*	0.015	-0.04***	-0.03***	-0.03***	-0.01***	-0.005	0.004	-0.03***	-0.007	-0.03***	-0.016	-0.03***	-0.03***
material	(0.006)	(0.009)	(0.012)	(0.007)	(0.010)	(0.004)	(0.004)	(0.008)	(0.007)	(0.005)	(0.006)	(0.013)	(0.011)	(0.009)
Technical efficiency														
computer access	0.141	0.528	-0.958	-1.209	-0.620	-4.073**	0.168	0.857	-0.707	-0.705	-1.284	-0.308	-1.450	1.897
	(0.902)	(0.859)	(0.753)	(0.878)	(0.932)	(1.739)	(0.788)	(1.302)	(1.501)	(0.481)	(1.172)	(0.865)	(0.967)	(3.820)
σ_u	0.179	0.463	0.336	0.223	0.183	0.384	0.38	0.195	0.188	0.838	0.198	0.174	0.203	0.337
σ_v	0.431	0.752	0.525	0.610	0.395	0.621	0.645	0.600	0.559	0.768	0.447	0.455	0.482	0.689
σ^2	0.218	0.780	0.389	0.422	0.189	0.533	0.561	0.397	0.348	1.293	0.239	0.237	0.273	0.589
$\lambda = \sigma_u^2 / \sigma_v^2$	0.173	0.379	0.410	0.134	0.214	0.383	0.349	0.105	0.113	1.191	0.197	0.146	0.177	0.240
$\gamma = \sigma_u^2/\sigma^2$	0.148	0.275	0.291	0.118	0.177	0.277	0.259	0.095	0.102	0.544	0.164	0.127	0.150	0.193
Log Likelihood	-155.8	-357.7	-259.4	-262.0	-164.8	-290.8	-324.9	-237.8	-232.4	-397.0	-179.8	-238.1	-206.9	-335.6
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables in the second stage of estimation. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SAf- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe. See appendix Table A-3.10 for full table

Table 3. 11: Technical inefficiency of Internet accessibility using Translog production framework

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SAf	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.087***	0.434	0.541*	0.774***	1.061***	0.838***	2.094***	0.622***	0.477**	0.674***	0.377	1.233***	0.711***	-0.285
	(0.300)	(0.297)	(0.325)	(0.304)	(0.226)	(0.205)	(0.222)	(0.213)	(0.262)	(0.311)	(0.222)	(0.295)	(0.228)	(0.333)
log of capital	-0.019	-0.194	0.263**	0.270***	0.203***	0.096**	0.013	-0.118	0.320***	-0.160**	0.290***	0.025	0.236**	0.098
	(0.081)	(0.103)	(0.123)	(0.085)	(0.085)	(0.045)	(0.056)	(0.090)	(0.104)	(0.081)	(0.082)	(0.129)	(0.115)	(0.097)
log of raw materials	-0.074	-0.265***	-0.136*	0.0001	-0.088	-0.218***	-0.151**	-0.396***	-0.217***	-0.409***	-0.153***	-0.306***	0.060	-0.198***
	(0.051)	(0.076)	(0.087)	(0.077)	(0.080)	(0.053)	(0.065)	(0.080)	(0.051)	(0.061)	(0.061)	(0.082)	(0.086)	(0.089)
labour square	0.226**	0.348***	0.050	0.170	0.264***	0.102	0.056	-0.233***	-0.049	-0.00007	-0.037	-0.024	0.082	0.065
	(0.101)	(0.110)	(0.095)	(0.103)	(0.101)	(0.092)	(0.115)	(0.092)	(0.084)	(0.125)	(0.081)	(0.093)	(0.096)	(0.179)
capital square	0.041***	0.035***	0.010	0.012***	0.032***	0.015***	0.034***	0.019	0.009	0.040***	0.016*	0.026**	0.022**	0.021***
	(0.009)	(0.012)	(0.009)	(0.005)	(0.009)	(0.005)	(0.008)	(0.013)	(0.013)	(0.011)	(0.009)	(0.011)	(0.010)	(0.008)
raw material square	0.064***	0.059***	0.088***	0.088***	0.092***	0.091***	0.085***	0.091***	0.102***	0.101***	0.100***	0.100***	0.093***	0.091***
	(0.006)	(0.012)	(0.006)	(0.006)	(0.006)	(0.008)	(0.008)	(0.009)	(0.006)	(0.009)	(0.007)	(0.008)	(0.010)	(0.006)
labour *x* capital	-0.056***	-0.060***	-0.002	-0.002	-0.058	-0.013	-0.061***	0.033	0.008	0.010	0.005	-0.019	0.008	0.081***
	(0.016)	(0.025)	(0.030)	(0.017)	(0.032)	(0.016)	(0.016)	(0.027)	(0.026)	(0.022)	(0.021)	(0.031)	(0.023)	(0.033)
labour *x* raw material	-0.066***	-0.011	-0.019	-0.071***	-0.070***	-0.058***	-0.126***	-0.034	-0.023	-0.021	-0.019	-0.065***	-0.067***	-0.033
	(0.024)	(0.025)	(0.025)	(0.024)	(0.021)	(0.020)	(0.025)	(0.023)	(0.018)	(0.019)	(0.020)	(0.025)	(0.025)	(0.022)
capital *x* raw material	-0.010*	0.018*	-0.027***	-0.025***	-0.026***	-0.013***	-0.004	0.004	-0.030***	-0.008	-0.030***	-0.014	-0.034***	-0.028***
	(0.006)	(0.010)	(0.011)	(0.007)	(0.010)	(0.004)	(0.004)	(0.008)	(0.007)	(0.005)	(0.006)	(0.013)	(0.011)	(0.008)
Technical efficiency														
internet access	0.621	0.048	-3.201***	-1.565	-0.920	-3.250*	0.739	1.193	-0.353	0.593	-2.141	-1.981	0.711***	0.363
	(1.133)	(0.864)	(1.059)	(1.452)	(1.337)	(1.700)	(0.750)	(1.251)	(1.513)	(0.480)	(2.563)	(1.351)	(0.228)	(0.464)
σ_u	0.183	0.452	0.452	0.232	0.183	0.250	0.384	0.207	0.194	0.836	0.167	0.196	0.183	0.449
σ_v	0.417	0.772	0.772	0.612	0.395	0.656	0.647	0.592	0.556	0.768	0.467	0.449	0.478	0.669
σ^2	0.208	0.800	0.371	0.429	0.190	0.493	0.565	0.393	0.346	1.288	0.245	0.240	0.262	0.650
$\lambda = \sigma_u^2 / \sigma_v^2$	0.192	0.342	0.475	0.143	0.215	0.145	0.352	0.122	0.122	1.185	0.127	0.190	0.147	0.450
$\gamma = \sigma_u^2/\sigma^2$	0.161	0.255	0.322	0.125	0.177	0.127	0.260	0.109	0.109	0.542	0.113	0.160	0.128	0.310
Log Likelihood	-155.57	-359.95	-248.56	-262.52	-164.64	-288.90	-324.54	-237.88	-232.05	-397.34	-178.57	-237.88	-207.55	-338.01
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables in the second stage of estimation. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SAf- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe. See appendix Table 3.11 for full table.

4.5.2 ICT and technical inefficiency

We first examine the presence of technical efficiency among firms by examining the estimates of the variance parameters of the likelihood function (σ^2, γ and λ). The test for technical inefficiency effect rejects the null hypothesis that γ=0 in all 14 countries and for all Translog production specifications. This suggests that technical inefficiency effects determine the levels and variations in turnover of firms. This finding is confirmed by the estimates of λ and σ_u, which are statistically significant and different from zero across all the sampled countries. The null hypothesis which states that there is no technical inefficiency in production was rejected. The test results are similar for all the countries, showing that technical inefficiency affects turnover of firms.

The results of Translog functional specification suggest that most of the variables captured in the technical inefficiency model do not explain technical inefficiencies among firms in the sampled countries. However, the results reveal that determinants of technical inefficiencies in firms vary from country to country. Firm specific characteristics affect their technical efficiency across the continent (see Appendix Tables A-3.9 to A-3.12). The formality of the firm explains technical efficiencies in most countries. The results suggest that formal and semi-formal sector firms are more technically efficient in comparison to informal sector firms. We also find that compared to firms with a full-time manager, firms that resort to other forms of managerial control are technically inefficient in Cameroon and South Africa. Sole propriety firms located in Cameroon and Kenya are also seen to be technically efficient compared to firms with other forms of ownership. We also find that older firms in Ethiopia are more technically efficient relative to younger firms.

ICT capital has a significant and negative effect on technical inefficiency in eight countries[35]. This finding suggests that in these countries increasing levels of ICT capital stock increases the technical efficiency of firms, and it has the potential to increase turnover of firms across these countries. This is consistent with previous studies which find ICT investment to have a positive effect on the technical efficiency of firms (Gholami et al, 2004). In the remaining six countries, ICT capital

[35] These countries include Botswana, Ethiopia, Kenya and Mozambique, Namibia, Rwanda, South Africa and Zimbabwe.

does not explain the level and variation of technical inefficiency. However, the story is different with computer and Internet accessibility as determinants of technical inefficiency. We find that firms with access to computer and Internet are more likely to improve technical efficiency relative to firms with no access to the technologies in Mozambique (see Tables 3.11 and 3.12), which can lead to increases in turnover. In comparison to firms with no access to computers, the results in Table 3.10 suggest that firms with computer access are technically efficient. While in Ethiopia the results in Table 3.12 suggest that access to Internet improves the technical efficiency of firms. By contrast, in Zambia SMEs with no access to Internet are more like to improve technically efficient relative to those with Internet access. The use of computer and Internet do not have a significant effect on technical efficiency of firms in the remaining countries.

4.5.3 ICT and mean efficiency

If firms in Africa are to be competitive in the global market it is imperative for these firms to increase their level of efficiency as this leads to high growth and productivity which from the view point of the structural approach tends to increase competitiveness of firms in the long-run. The potential of increasing technical efficiency levels in the various countries can be ascertained by analysing the technical efficiency scores presented in Table 3.13. The efficiency scores suggest that firms across the continent operate at varying technical efficiency levels with firms in most of the countries operating at very low technical efficiency levels. This confirms our earlier results which show that technical inefficiency is high among SMEs in Africa relative to their potential, given their respective technologies. The results paint a gloomy picture of SMEs across the sampled countries.

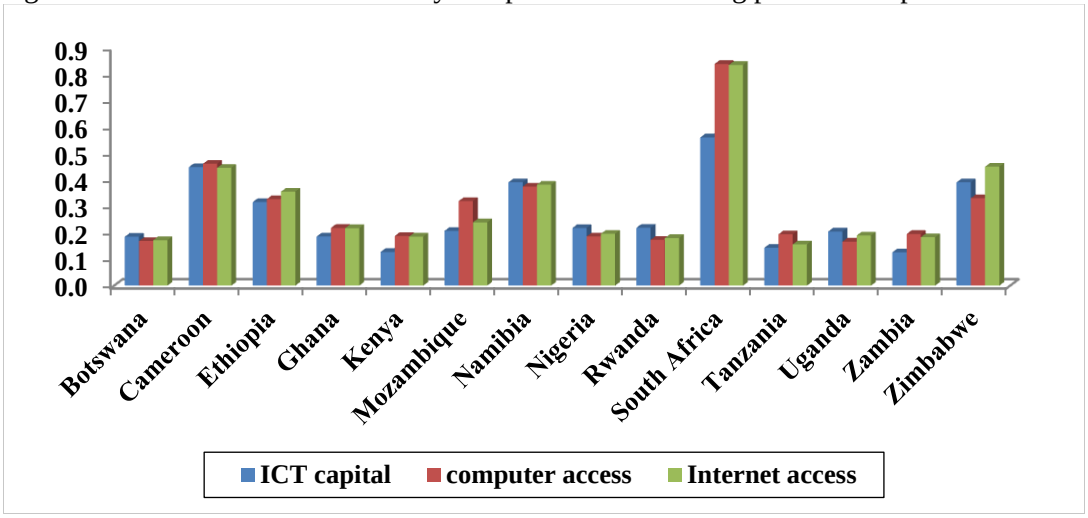
Table 3.13 presents estimates of mean technical efficiency of firms across the countries. The results show that with the exception of SMEs in South Africa, SMEs in the remaining countries operate below the 50 percent level of technical efficiency. The low mean technical efficiencies across the countries indicate that firms have the potential to increase turnover by improving technical efficiency levels using their existing resources and technologies in the short run. The low mean technical efficiencies across the countries may be attributed to the low level of ICT capital as a share of total capital.

Table 3. 12: Mean technical efficiency of firms

Country	Log of ICT capital	Computer access	Internet access
Botswana	0.185	0.169	0.172
Cameroon	0.448	0.461	0.446
Ethiopia	0.316	0.328	0.356
Ghana	0.186	0.218	0.218
Kenya	0.127	0.188	0.186
Mozambique	0.207	0.320	0.240
Namibia	0.391	0.375	0.382
Nigeria	0.218	0.186	0.196
Rwanda	0.219	0.173	0.180
South Africa	0.561	0.839	0.835
Tanzania	0.143	0.194	0.156
Uganda	0.205	0.167	0.190
Zambia	0.126	0.196	0.183
Zimbabwe	0.391	0.331	0.450

Source: Own estimates, obtained from estimation of Translog production for various countries.

Figure 3. 7: Mean technical efficiency computed from Translog production specification



The findings suggest firms located in South Africa are more technically efficient relative to firms in other parts of sub-Sahara Africa. Technical efficiency among South African firms ranges between 56 percent and 83 percent. The results indicate that South African firms experience a short fall in turnover ranging between 0.44 percent and 0.17 percent, implying that these firms are more likely to increase turnover up to 44 percent on average if technical efficiency improves. The high technical efficiency level of firms in South Africa maybe attributed to the high return to ICT capital. Botswana, Kenya Tanzania, Uganda and Zambia in most cases register a mean technical efficiency of less than 25 percent. The results of the mean efficiency from the Translog specification are similar to that of the Cobb-Douglas functional form.

5 Conclusion

This chapter investigates the effect of ICT usage on the turnover of SMEs based on a cross-section dataset cutting across fourteen countries in 2006. The information collected by the survey is comprehensive with regards to a firm's turnover, raw material usage, the disaggregation of capital into ICT and non-ICT capital, the characteristics of SMEs, the employees used by the SMEs and also the disaggregation of technology. The chapter contributes the empirical literature on ICT adoption among firms by providing cross-country evidence on the effect of ICT on turnover. Studies that examine the effect of ICT on firm are mainly based on a single country, but this chapter provides evidence across 14 countries. The chapter also contribute to the existing literature by accessing the effect on ICT adoption on technical efficiency in developing countries.

The chapter employs both Cobb-Douglas and Translog production functional specifications to examine the effect of ICT capital on turnover of firms in Africa. However, unlike other studies that imposes the production functional form on the data this chapter uses a likelihood ratio test to determine which production functional specification best fits the data. To account for heterogeneity that may arise, the chapter uses quantile regression technique and estimates the distributional effect of ICT capital. This is because ICT capital is likely to have varying effects at different points of turnover distribution. The chapter also uses a stochastic frontier approach to investigate the effect of ICT capital, computers and the Internet access on technical efficiency of SMEs in the selected countries.

The findings of the chapter indicate positive and significant correlations between ICT capital and SMEs' turnover across most of the selected countries, with the exception of Ghana, Nigeria and Zambia. The chapter also finds that in eight of the countries the return to ICT capital is greater than return to non-ICT capital, with South Africa having the highest return to ICT capital. This finding gives an indication of the potential of ICT capital in SSA. The effect of ICT capital on turnover differs across countries and there is a lack of consistency across SSA region. To obtain a summary measure of the effect of ICT on turnover we apply meta-analysis techniques. The finding of the meta-analysis shows that ICT capital has a positive and significant effect on SMEs' turnover in selected SSA countries.

Dealing with the possible problem of heterogeneity the chapter estimates a quantile regression and finds that the effect of ICT capital on turnover varies along the distribution. Contrary to the findings of the OLS we find that ICT has a positive and significant relationship with turnover along different points of the distribution in Zambia and Nigeria. Although ICT capital has no effect on turnover at the mean of the distribution, ICT capital impacts positively on SMEs with low turnover in Nigeria. In Zambia, ICT has a significant and positive effect on SMEs with low turnover and those with relatively high turnover. This finding requires the development of ICT policies and strategies that will take into account varying effects of ICT capital on SMEs with different levels of turnover.

The chapter also finds the presence of a substitution effect between ICT and non-ICT capital in Cameroon, Kenya and Zimbabwe. On the contrary, Tanzania shows a complementary effect between ICT capital and non-ICT capital. Overall findings of the positive and significant effect of ICT on firm output are confirmed in most of the sampled countries. As such, there does not appear to be an ICT productivity paradox among SMEs in Africa.

Using two different functional production specifications, we examine effect of ICT adoption on technical efficiency of SMEs in Africa. However, we base the discussion mainly on the Translog functional framework as it is more flexible than the Cobb-Douglas and second, the likelihood ratio test indicates that Translog functional specification best fits the data. The results show that ICT capital has significant and positive effect on technical efficiency in 8 of the countries. We further find that firms with access to computer and Internet are more likely to improve technical efficiency relative to firms with no access to the technologies in Mozambique. However, our findings show that SMEs in all the countries, except South Africa, operate below a technical efficiency level of 50 percent. While this situation looks gloomy, it may also be an indication of potential gains if the right policies are put in place to support SMEs in these countries to be more efficient.

CHAPTER 4 – VARIATION IN RETURNS TO INFORMATION AND COMMUNICATION TECHNOLOGY: A DECOMPOSITION ANALYSIS

1 Introduction

In recent times several studies have resorted to the use of firm-level data to examine output and productivity growth among SMEs (hereafter we refer to SMEs as firms). This is largely due to the belief that firm growth translates into industrial growth, which arguably drives economic growth (Trimmer and Van Ark, 2005). The adoption and usage of new technology has been an important contributing factor to increasing output and productivity and by extension higher economic growth rates. The World Bank (2006) indicates that firms with access to ICT grow faster, invest more, and tend to be more productive and profitable than those with no access to ICT. There is a consensus among many economists on the positive impact of ICT adoption and usage on firms' output and productivity in recent times, at least in developed countries. The previous chapter of this thesis also finds a significant and positive effect of ICT capital on a firm's turnover in selected SSA countries. However, significant differences exist regarding the contribution of ICT to output and productivity growth across key firm level characteristics, such as firm size, access to computers and Internet, and the managerial control type employed by the firm. For instance, evidence suggests that large firms have higher turnover and also are more likely to adopt new technologies as they have the financial capabilities to install and use these new technologies.

There are also significant differences in turnover of firms in rich and poorer countries and thus difference in their usage and return to ICT adoption. The OECD (2007) asserts that the impact of the Internet on firm output and productivity has a far wider reach than just information and technology industries. The efficiency level of firms with access to computer and internet tend to increase relative to firms with no access to these technologies, as it allows for connectivity and interaction among market participants Avgerou (2003). Furthermore, the use of these technologies creates an easy flow of information, leading to faster and better matching processing resulting in high returns in output and productivity (Grimes et al., 2012; OECD, 2010; Forman and van Zeebroeck, 2010; Bertschek et al., 2011). With higher levels of efficiency,

firms with computer and internet access are likely to have higher turnover compared to their counterparts with no access to ICT.

The literature (see, for example Caselli, 2005; Hall and Jones, 1999) shows significant differences in output and productivity of firms in relatively high income countries compared to those in LIC. Tybout (2000) and World Bank (2004) examine why firms in LIC tend to have low output and productivity. These studies show that the lack of adequate infrastructure, dominance of the informal sector, poor regulations and slow judicial system, poor trade policies, and a lack of highly skilled human capital together work to inhibit the productivity of firms. This in turn contributes to the low output levels in poorer countries. Bloom et al. (2010) also find evidence to suggest that financial constraints in LIC, especially among smaller firms, hinder productivity and output growth. In this regard, firms in high income countries are expected to have relatively high turnover compared to firms in lower income countries.

Several studies find firm level characteristics have an impact on the performance of firms in both developed and developing countries. Harvie et al. (2010) for instance find that firm characteristics are an important determinant of firm's participation in production networks and by extension high performance. Shiels et al. (2003) also points out that firm and industry level characteristics affect the adoption and usage of ICT among firms. Most firms in Africa are poorly managed (Rogerson, 2008; Abor and Quartey, 2010; Smit and Watkins, 2012) and in many of these firms the owners tend to make all major decisions even when they lack the expertise, thus there is a lack of delegation of decision making to experts. This practice is largely due to apprehension on the part of owners of expropriation by managers employed to run the daily activities of these firms. However, many of these SME owners lack the time and capacity to make expert decisions hence resulting in low productivity as well as low output growth. Several studies have suggested that firms have increased their productivity levels largely as a result of better management practices. Chandler et al (2009) for instance posits that in the early 1990s the United States and Germany experienced high productivity growth partly due to superior management practices. Thus managerial control type among firms is important in assessing differences in firms' turnovers.

This chapter is an extension of the preceding chapter, and aims at analysing variations in turnover across various groups of firms. The chapter focuses on the contribution of ICT capital stock to turnover differentials among the different groups of firms. It examines the possible sources of this turnover gap within countries and across various income groupings (low, low-middle and upper-middle income countries), paying particular attention to ICT capital stock. It also assesses the contribution of the traditional factors of production in each country and across the income groups. In relation to the above discussion, there is a possibility of differences in turnover based on the characteristics of firms in the various countries. Turnover differentials are estimated over the following variables:

- Firm's computer accessibility (firms with computer access as against those with no access)
- Internet accessibility of the firm (firms with Internet access as against those with no access)
- Firm's managerial control type (firms with a full time manager against other forms of managerial control types)
- The size of the firm (micro sized firms against small to medium sized firms)

The contribution of covariates (the factors of production and firm-level characteristics) to differentials in an outcome (turnover) can be investigated by using decomposition analysis. The technique decomposes the overall differential between the outcome of two groups into two broad components – endowment and returns to endowment. It also enables the determination of contribution of each covariate to the two components and the overall differential. Originally used by Oaxaca (1973) and Blinder (1973) to decompose the gender wage gap and the racial wage gap, the technique has been extended to analysis of differences in several outcomes, such wealth, gender cognitive performance, inequality in living standards and more. In recent times the technique has been extended to decompose total factor productivity. Mean decomposition is simple to perform using Oaxaca-Blinder approach. However, differences in turnover at both ends of the distribution make decomposition at the mean an inappropriate representation of the entire distribution.

The chapter's contribution to the existing literature on ICT and firm level performance is twofold. To the best of our knowledge this is the first study that attempts to investigate and determine the contributing factors to turnover differentials emphasising the contribution of ICT capital across sub-Saharan Africa. Second, the chapter employs a recent decomposition technique, based on the creation of a counterfactual argument, to determine the contribution of the factors of production at both the mean and at various points along the distribution, focusing on the contribution of ICT capital as an additional input besides the traditional factors of production. Using the quantile decomposition technique we also determine the contribution of ICT capital to the turnover differentials at different points along the distribution. The remainder of the chapter is set out as follows. Section 2 provides a detailed discussion of Fortin et al. (2010) decomposition techniques, and Section 3 presents the results of the decomposition analysis with a discussion of the results. The conclusion and policy implications are provided in Section 4.

2 Empirical methodology

This section outlines the mean and quantile decomposition techniques to be employed in the chapter The Oaxaca-Blinder decomposition has been used extensively in the labour market and discrimination literature to study wage differentials and discrimination between different groups of workers and race (Oaxaca, 1973; Blinder, 1973). The method has seen numerous extensions since its introduction which go beyond conducting decompositions at the mean, and one such extension has been the more recent quantile-based decomposition methods. The chapter relies heavily on the approach adopted in Fortin, Lemieux, and Firpo (2011), especially for the quantile decompositions and empirical approach.

2.1 Mean Oaxaca-Blinder decomposition

The main aim of the Oaxaca-Blinder (OB) approach to decomposition is to determine the sources of differences at the mean of a distribution between two different groups. The OB technique has been widely used in the labour economics literature to decompose changes or differentials in mean wages into a wage structure effect and a composition effect, and furthermore determines the contribution of each covariate to these two effects and to the overall differential. In this chapter, the method is used to decompose firm turnover into two components. The first

component attributes the overall turnover differential to differences in observable characteristics (resources), while the second component is attributed to differences in returns to these characteristics under the hypothesis that the two groups of firms have the same characteristics. To perform the mean Oaxaca decomposition we first estimate a production function, with turnover as the dependent variable, for both groups of firms.

The Oaxaca decomposition technique compares the turnover distributions under two mutually exclusive events. That is being a firm in group "A" or "B". We split the sampled firms into two broad groups based on firm level characteristics. To perform the decomposition analysis, we split the firms in each of the country into two groups – firms with access to computer and those with no computer access (decomposition by computer accessibility). The second set of decomposition also splits firms in each country into two groups – firms with internet access and those with no internet access (decomposition by internet accessibility). The study also performs decomposition by managerial control type as well decomposition by firm size and the same technique is used as in decomposition by computer and internet accessibility. In this respect, we perform five set of decomposition analysis based on four groupings:

- Decomposition by computer accessibility
- Decomposition by internet accessibility
- Decomposition by firm size
- Decomposition by managerial control type

The mean-based Oaxaca decomposition technique is critically dependent on the creation of a counterfactual distribution of turnover. The method addresses questions such as if firms in a particular group "A" have the same resources and similar individual firm level characteristics as firms in group "B", will there be differences in their turnover? That is to say what would be the distribution of turnover for group "A" if they are assigned the characteristics of group "B" firms? The Oaxaca-Blinder decomposition technique is based on the assumption that the relationship between turnover and the set of explanatory variables is linear and additive. Thus the relationship is represented below as:

$$Y_{Hi} = X_{Hi}\beta_{Hi} + \vartheta_{Hi} \ , \ E(\vartheta_{Hi}|X) = 0; \quad H \in (A, B); \quad i = 1,2\ 3, \ldots . N \qquad (4.1)$$

X represents the vector of observable characteristics (log of employees for firm *i* in group H; log values of ICT and conventional (non-ICT) capital; log of raw materials; and a vector of firm level characteristics). β is a vector of the slope parameters including the intercept, and ϑ is the error term. The *i* subscript represent firm *i*. If we let *H* represent the group firm *i* belongs to, then the unconditional counterfactual turnover distribution for firms belonging to group "B" is given as $Y_{A|H=B}$, and $Y_{B|H=A}$ represents the counterfactual distribution for firms in group "A". Let $F_{Y_A|H=A}$ indicate the distribution of the (potential) turnover outcome (Y_A) for firms in group "A" and $F_{Y_B|H=B}$ denote the distribution of the (potential) outcome Y_B of group "B" firms. Fortin et al (2011) assert that if the mean and quantile of the statistical distribution are considered as a real-valued functional of the relevant distributions then we can express the turnover distributional statistics as $\theta(F_{Y_A|H=A})$, where θ is the functional form of the turnover equation. Thus the overall difference in turnover between two groups of firms as measured in terms of the distributional statistic θ is given as:

$$\Delta_Y^{\theta} = \left[\theta(F_{Y_A|H_A}) - \theta(F_{Y_B|H_B})\right] \qquad (4.2)$$

where, $\boldsymbol{\theta}$ is the functional form of the turnover equation. Δ_Y^{θ} indicates the overall turnover gap and can be divided into two main components: characteristic effects and the return to characteristics. Decomposing the over gap allows for a comparison of the actual distribution of turnover with its counterfactual, hence it is imperative to construct a meaningful counterfactual distribution for effective comparison. Introducing the counterfactual into the overall differential equation under the common assumptions of mutually exclusive groups, ignorability and overlapping support[36] we can present the turnover gap in equation 4.2 as follows:

$$\Delta_Y^{\theta} = \left[\theta(F_{Y_A|H=A}) - \theta(F_{Y_B|H=A})\right] + \left[\theta(F_{Y_B|H=A}) - \theta(F_{Y_B|H=B})\right] \qquad (4.3)$$

[36] The assumption of ignorability is widely used in the program evaluation literature and allows ruling out the selection into a particular group based on unobservables. This assumption makes unobservable covariates identical across groups once we condition on a vector of observed component. The overlapping support assumption requires overlap of observable characteristics of groups that is to say no single value of X = x or ε = e can serve to identify membership into one of the groups (Fortin e al, 2010).

Replacing the distributional function by the sample averages and the estimated Ordinary Least Square (OLS) coefficients, we can rewrite the overall gap as:

$$\Delta_Y^{\theta} = \left[\bar{X}_A\hat{\beta}_A - \bar{X}_B\hat{\beta}_A\right] + \left[\bar{X}_B\hat{\beta}_A - \bar{X}_B\hat{\beta}_B\right] \quad (4.4)$$

$\bar{X}_B\hat{\beta}_A$ is the unconditional counterfactual distribution of SME's turnover at the mean. Rearranging equation 4.5, we obtain:

$$\Delta_Y^{\theta} = (\underbrace{[\bar{X}_A - \bar{X}_B]\hat{\beta}_A}_{endowment}) + \underbrace{(\bar{X}_B[\hat{\beta}_A - \hat{\beta}_B])}_{returns} \quad (4.5)$$

Equation 4.5 shows that the overall difference can be decomposed into two main components. The first component is the endowment effect[37]. This represents the explained portion of the difference in the distribution of turnover due to difference in the endowment of firms. It refers to the expected changes in the mean turnover of firms in group "B" if these firms had similar resources/endowment as those firms in group "A". The second component is the returns effect, and it measures the overall differential that is related to varying returns to the endowment of firms, that is it is the part of the gap that cannot be explained by group differences. In this chapter the coefficient is interpreted as the effect on the mean turnover of group "B" firms if they are assigned the coefficients of group "A" firms (Jann, 2008). The two components can further be split up into the contribution of each covariate to both the endowments and returns to endowments.

Equation 4.5 can be extended further, as in Jones and Kelley (1984), and Daymont and Andrisani (1984), into three components (known commonly in the literature as the three-fold decomposition). The approach adds a third term to the characteristics and returns effects. Rearranging equation 4.5 we obtain:

$$\Delta_Y^{\theta} = \underbrace{([\bar{X}_A - \bar{X}_B]\hat{\beta}_B)}_{\Delta_X^{\theta}} + \underbrace{(\bar{X}_B[\hat{\beta}_A - \hat{\beta}_B])}_{\Delta_R^{\theta}} + \underbrace{(\bar{X}_A - \bar{X}_B)(\hat{\beta}_A - \hat{\beta}_B)}_{\Delta_I^{\theta}} \quad (4.6)$$

The first term Δ_X^{θ} in equation 4.6, captures the contribution to the total differential in turnover between firms in group "A" and those of group "B" attributed to difference in firms' average endowment across the two groups of firms. The second term Δ_R^{θ}, is

[37] Endowment effect is also referred to as the characteristics effect or explained component in labour economic literature. Return effect is also referred to as unexplained component or coefficient effect.

the returns effect and represents the differential in the mean turnover of firms in group "A" and "B" due to differences in returns to endowments in addition to the intercept. The third component is the interaction term which measures the simultaneous effect of differences in endowments and coefficients. That is, it shows the interaction of the differences in endowments and returns to endowments of the two groups of firms, accounting for the fact that differences in endowments and coefficients exist simultaneously between the two groups (Jann, 2008).

The Oaxaca-Blinder decomposition method is easy to implement mainly due to the assumption of linearity between the covariates and the dependent variable. However, there are some underlying limitations of the technique, especially when estimating the detailed decomposition. In the presence of categorical variables the result of the detailed decomposition is invariant to the choice of the omitted category. That is to say, the contribution of the covariates to returns to endowment is highly sensitive to the choice of different omitted groups, a problem well documented as the identification problem in Oaxaca and Ransom (1999) [38].

2.2 Quantile Oaxaca Decomposition Method

Prior to the early 2000s it was extremely challenging to estimate decomposition along the entire distribution of a variable as the OB decomposition method only applied to the mean. However, interest of researchers into quantile decomposition heightened as the United States recorded dramatic growth in earnings inequality. In recent times, several methods have been developed that allow for decomposition beyond the mean of a distribution. These methods are based on techniques used in the program evaluation literature. The technique has been extended to estimate quantile decompositions as seen in Firpo et al. (2007). Several approaches have been proposed to estimate decomposition along the entire distribution of a variable, see for example, Juhn, Murphy and Pierce (1993), DiNardo, Fortin, Lemieux (1996), Donald

[38] Yun (2005) provides a solution to problem of using categorical variables by limiting the sum of the coefficients for a set of category variables by imposing normalisations on coefficient to purge the intercept from the effect of the omitted category – Fortin et al. (2011). It then expresses the coefficient of the transformed equation to reflect a deviation from the estimated parameters instead of deviations from the base category. Fortin et al (2011) show that some degree of arbitrariness is used to derive the normalised equation and implementing this solution is at the cost of interpretational challenges. Thus, we do not apply Yun's (2005) solution to normalise the categorical variables in order to maintain their economic significance.

et al. (2000), Machado and Mata (2005) and Melly (2006), which are based on conditional quantile estimations.

These approaches have a number of limitations (see Fortin et al., 2011). We therefore employ the novel technique proposed by Fortin et al. (2011), which provides a more consistent technique of estimating both detailed and aggregate quantile decompositions. It further addresses the limitations association with Oaxaca decomposition methods which are based on conditional quantile regression.

2.2.1 Recentred Influence Function (RIF) Regression

Firpo et al (2009) defined Recentred Influence Function (RIF) as indicating a linear approximation of a non-linear functional distribution of turnover which enables the computation of partial effects for the explanatory variables. The technique, proposed by Firpo et al (2009), is a two stage approach and provides a more convenient approach to performing Oaxaca-Blinder type of decomposition of any other distributional statistics besides the mean. The underlying principle of the approach is to estimate a RIF of the variable of interest (firm's turnover) on the covariates by estimating the partial effects of changes in the distribution of the covariates on the unconditional quantiles of turnover. The technique then replaces turnover with the estimated RIF and this is regressed on the set of covariates to generate Oaxaca-Blinder decomposition for various quantiles along the distribution of turnover.

Following Firpo (2009), we first compute the sample quantiles of interest $\boldsymbol{q}$ and estimate the RIF of turnover for each quantile and proceed with an estimation of densities corresponding to each quantile using the kernel density method. The estimation of RIF for the $\boldsymbol{\tau th}$ quantile of interest is expressed below as:

$$RIF(y; q_\tau) = q_\tau + IF(y; q_\tau) = \frac{\tau - \mathbb{I}\{y \leq q_\tau\}}{f_y(q_\tau)} \qquad (4.7)$$

where, q_τ is the τth quantile of firm's turnover, $f_y(q_\tau)$ captures the unconditional density function of turnover evaluated at the τth quantile, estimated using kernel density methods; $\mathbb{I}\{y \leq q_\tau\}$ is an indicator function determining whether the outcome variable is smaller or equal to the τth quantile. $IF(y; q_\tau)$ is the influence function for the τth quantile. Firpo et al (2009) assert that the population of the τth

quantile of the unconditional distribution of turnover plus the corresponding influence function is equivalent to the estimated RIF as stated in equation 4.7. In Firpo et al's (2009) assessment the dependent transformed variable (turnover) can be regressed on the set of explanatory variables using OLS. The expected value of the influence function in equation 4.7 is equal to zero, implying that the corresponding distributional statistics is equal to the expected value of the RIF for the *τth* quantile:

$$q_\tau = E[RIF(y; q_\tau)] \quad (4.8)$$

We can represent the distributional statistics of turnover as the conditional expectation of the RIF given the set covariates and this is given as follows:

$$q_\tau = E[RIF(y; q_\tau)|X] \quad (4.9)$$

Applying the law of iterated expectations[39] the distributional statistics of turnover can be defined in terms of the conditional expectation and written as:

$$q_\tau = \int E[RIF(y; q_\tau)|X]\, dF(X) \quad (4.10)$$

Thus, the impact of covariates on the distributional statistics of turnover can be obtained by integration of the conditional expectation of the distributional statistics through the use of regression techniques. We can represent the conditional expectation as a linear function of observable independent variables, $E[RIF(y_a; q_\tau)|X] = X\beta + \varepsilon$, however the expected value of the error term is approximated to zero. This equates the expected value of the true conditional expectation to the linear function of the RIF regression of the distributional statistics. This makes it easier to employ OLS techniques in estimating the RIF and makes it simple and meaningful. Imposing the assumptions of ignorability and overlapping support and applying the Oaxaca-Blinder decomposition to the RIF regression, the total turnover differential between groups of firms at the *τth* quantile can be presented below as:

$$\Delta_Y^\tau = E\left[RIF\left(y_a; q_{a,\tau}\right)\right] - E[RIF\left(y_b; q_{b,\tau}\right)] \quad (4.11)$$

We can rewrite equation 4.11 in terms of the returns effect and endowment effects as:

[39] The law states that the expectation of the conditional expectation is the unconditional expectation. That is the average of the conditional averages is the unconditional average.

$$\Delta_Y^{\tau} = \underbrace{\left[\bar{X}_a\hat{\beta}_{a,\tau} - \bar{X}_b\hat{\beta}_{a,\tau}\right]}_{\Delta_X^{\tau}} + \underbrace{\left[\bar{X}_b\hat{\beta}_{a,\tau} - \bar{X}_b\hat{\beta}_{b,\tau}\right]}_{\Delta_R^{\tau}} \quad (4.12)$$

Equation 4.12 can be rearranged as:

$$\Delta_Y^{\tau} = \underbrace{\left([\bar{X}_a - \bar{X}_b]\hat{\beta}_{a,\tau}\right)}_{\Delta_X^{\tau}} + \underbrace{\left(\left[\hat{\beta}_{a,\tau} - \hat{\beta}_{b,\tau}\right]\bar{X}_b\right)}_{\Delta_R^{\tau}} \quad (4.13)$$

where Δ_X^{τ}, measures the endowment effect at the *τth* quantile and Δ_R^{τ} represents the differences in returns to the endowment. What makes this method more appealing is the fact that it can be used to determine the contribution of each covariate to both endowments and returns effects at the *τth* quantile. Unlike other methods of decomposition beyond the mean this techniques allows for detailed decomposition. This is made possible by the use of the linear approximation technique. The contribution of the covariates to both endowments and returns effect is written as follows:

$$\Delta_X^{\tau} = \sum_{k=1}^{K}(\bar{X}_{bk} - \bar{X}_{ak})\delta_{bk,\tau} \quad (4.14a)$$

$$\Delta_R^{\tau} = \sum_{k=2}^{K}\bar{X}_{bk}\left(\delta_{bk,\tau} - \delta_{ak,\tau}\right) \quad (4.14b)$$

The RIF regression technique is more advantageous due to the linearity of the technique as it makes it easier to invert the proportion of interest by dividing by the density (Fortin et al, 2011). Further we perform this inversion locally hence the impact evaluation need not be at all points along the distribution, which leads to the problem of monotonicity associated with the Machado and Mata (2005) technique. However, this inversion of the proportions draws similarities with the approach proposed by Chernozkukov, Fernandez-Val and Melly (2009). Another advantage from the linearity nature of RIF is that it generates a simple regression which is easy to interpret. Unlike other decomposition methods, the RIF regression provides results that are path independent, that is the results are insensitive to the order of the decomposition.

Firpo et al (2009) technique is dependent on the transformation of a non-linear distributional function into a linear approximation, which is not precise leading to approximation errors hence estimation of inconsistency results. RIF-regression is based on invariance of the conditional distribution like other techniques which attempt to perform decomposition beyond the mean. Firpo et al (2009) assert that the

approach does not account for the presence of endogeneity. A major limitation of the technique is that if the distribution is heaped towards the right-hand tail, the kernel density estimation may under-smooth the tail density estimates, leading to unreliable inference for the upper quantile regression coefficients (Lubrano et al, 2014). However, Fortin et al (2011) propose the use of a reweighting technique to solve this problem and also in the absence of linearity of the conditional expectation of the distribution, that is, turnover.

2.2.2 Reweighting approach and RIF regression

The classical Oaxaca-Blinder decomposition assumes the linearity of the conditional mean, which may not hold (Barsky et al., 2002). However, Fortin et al. (2011) propose the application of reweighting technique to deal with the possibility of the linearity assumption breaking down. This according to Barsky et al. (2002) prevents the estimates of consistent endowment and return effects. However, Barsky et al (2002) argue that in the presence of non-linearity, as in the case of wealth-earnings relationship, Oaxaca-Blinder decomposition is likely to produce inconsistent estimates. The literature suggests two approaches to deal with this problem. The first is the use of a non-parametric approach to estimate the conditional expectation. Barsky et al (2002) however proposed the use of a non-parametric method by adopting the reweighting approach put forward by DiNardo et al (1996). Though their paper concentrated on estimation of counterfactual densities, the approach is applicable to any statistical distribution. We follow this approach of using the reweighting technique as in Fortin et al (2011). The technique uses a reweighting function to estimate counterfactual densities.

The underlying principle of the reweighting technique is to make the characteristics of firms in group "A" similar to firms in group "B" and perform decomposition using RIF regression technique. The reweighting technique allows us to superimpose the characteristics of firms in group "A" on firms in group "B". To obtain the counterfactual densities we reweight group "A" firms with weights $\psi(X)$, which depends on the values of the covariates. Baye's rule is used to determine these weights. The reweighting factor is given below as:

$$\Psi(X) = \frac{\Pr(X|H_A=1)}{\Pr(X|H_A=0)} = \frac{\Pr(H_A=1|X)/\Pr(H_A=1)}{\Pr(H_A=0|X)/\Pr(H_A=0)} \quad (4.15)$$

where $\Pr(H_A = 1|X)$ is the probability of a firm belonging to group "A". $\Pr(H_A = 1)$ and $\Pr(H_A = 0)$ are the samples proportions for group "A" and "B" respectively. The reweighting factor given in equation 4.15 indicates that weights are calculated from the probabilities of belonging to a particular group, say "A", conditional on the covariates (X). In this regard, the reweighting factor is obtained by estimating a probability model of a firms belonging to group "A". Empirically, we estimate either a probit or logit model for the probability of belonging to group "A" and "B" using the pool data for the two groups. The estimated probabilities are then used to compute the reweighting factor for each firm in group "B". We proceed by calculating the counterfactual statistics of interest using observations from group "B" reweighted using the computed reweighting factors. Next, we perform decomposition similar to the Oaxaca-Blinder approach using the reweighting factor, the RIF regression and also the counterfactual distribution of turnover for any unconditional quantile (τ). The total turnover gap at the τthe quantile is then given as the difference between actual averages and the reweighted counterfactual average of both endowment and returns components. It is written as:

$$\Delta_Y^\tau = \underbrace{(\bar{X}_A\hat{\delta}_{A,\tau} - \bar{X}_A^C\hat{\delta}_{A,\tau}^C)}_{\Delta_X^\tau} + \underbrace{(\bar{X}_B\hat{\delta}_{B,\tau} - \bar{X}_{B,\tau}^C\hat{\delta}_{B\tau}^C)}_{\Delta_R^\tau} \quad (4.16)$$

Where, superscript C represents the reweighted sample estimates of the counterfactual distribution. The turnover gap can be decomposed further into a true endowments and returns effects and error terms which are given by:

$$\Delta_X^\tau = \underbrace{(\bar{X}_A - \bar{X}_A^C)\hat{\delta}_{A,\tau}}_{\Delta_{X,p}^\tau} + \underbrace{(\hat{\delta}_{A,\tau} - \hat{\delta}_{A,\tau}^C)\bar{X}_{A,\tau}^C}_{\Delta_{X,e}^\tau} \quad (4.17)$$

$$\Delta_R^\tau = \underbrace{\bar{X}_B(\hat{\delta}_{A,\tau}^C - \hat{\delta}_{B,\tau})}_{\Delta_{R,p}^\tau} + \underbrace{(\bar{X}_B - \bar{X}_A^C)\hat{\delta}_{A,\tau}^C}_{\Delta_{R,e}^\tau} \quad (4.18)$$

The terms $\Delta_{X,p}^\tau$ and $\Delta_{R,p}^\tau$ represent respectively the pure endowment (pure composition) and pure return (pure structure) effects. The second term ($\Delta_{X,e}^\tau$) in equation 4.17 captures the specification (approximation) error, it captures errors in estimation resulting from the RIF being non-linear, thus measures error due to the fact that the RIF regression procedure is based on the local approximation of the unconditional distribution of interest (turnover). The smaller the specification the

more robust the RIF estimation is and vice versa. In equation 4.18 the second term, $\Delta_{R,e}^{\tau}$, is the reweighting error capturing the fact that the endowment effect obtained from the reweighted RIF regression decomposition differs from that obtained from the standard Oaxaca-Blinder decomposition when the reweighted mean is different from the non-reweighted mean. The reweighting error turns to zero if the reweighting factor is consistently estimated especially when large samples are employed. The reweighting-RIF regression technique like the RIF regression provides results that are path independent. However the sum of the share of each covariate is not equal to the total contribution of covariates. This difference is an interaction effect between the different covariates which is difficult to interpret (Fortin et al, 2011).

The chapter examines the contribution of individual covariates to turnover differentials, as it enables an assessment of the contribution of ICT capital to turnover differentials in each country. This is a major contribution of this chapter to the empirical literature. Each decomposition analysis is conducted at the country level. Specifically, the chapter assesses differentials in turnover of firms with access technology type, ***j***, relative to those with no access to technology[40] ***j***. The chapter also analyses the gaps in turnover of micro sized firms against small-medium sized firms. Decomposition by managerial control type is also estimated to assess the differential (gap) in turnover, and the contribution of endowment and returns to this gap, focusing on the contribution of ICT capital.

3 Empirical results

Having outlined the relevant methods in the previous section, we present the results of decomposition analyses evaluated at the mean and at different quantiles (mean and quantile decompositions). For the mean decomposition analysis, we present 4 decomposition[41] results specified in the previous section. With respect to quantile decomposition, we present results of 2 decomposition analyses. For easy of

[40] The study uses two technology types, which are internet and computer accessibility. Here decomposition is undertaken by these two types of technology.

[41] The study also performed decomposition by SME's age, industrial sector and by formality index of the SME. In all these decomposition analysis the study found no significant differences across the various groupings. In the case of quantile decomposition we drop firm size decomposition since we find no significant differences between small and micro firms.

discussion, we grouped these 2 sets of decomposition results into one broad heading: decomposition by technology type. As discussed in the previous section detailed decomposition of turnover by these groupings allows us to assess the relative contribution of firms' endowment of ICT capital, and the return to these endowments to turnover differentials.

The return effect captures the variation in the returns to the characteristics between groups of firms. The third component of the threefold decomposition is the interaction term which estimates the simultaneous effect of differences in endowments and returns. That is, it accounts for the fact that differences in endowments and returns exist simultaneously between two groups. In addition to the mean decomposition, we also decompose the individual effect of the explanatory variables along different quantiles rather than only at the mean of the distribution. Decomposing at the mean does not allow for assessment of differences in turnover among the various groupings at various quantiles of the distribution, as differences may differ along the distribution. We therefore apply an unconditional quantile decomposition to assess the contribution of both endowments and its returns to turnover gaps of firms along the distribution laying emphasis on contribution of ICT capital. We present two sets of quantile decomposition results: the RIF regressions results and the reweighting RIF results. We base the discussion of the quantile decomposition results on the latter.

3.1 Results of mean decomposition

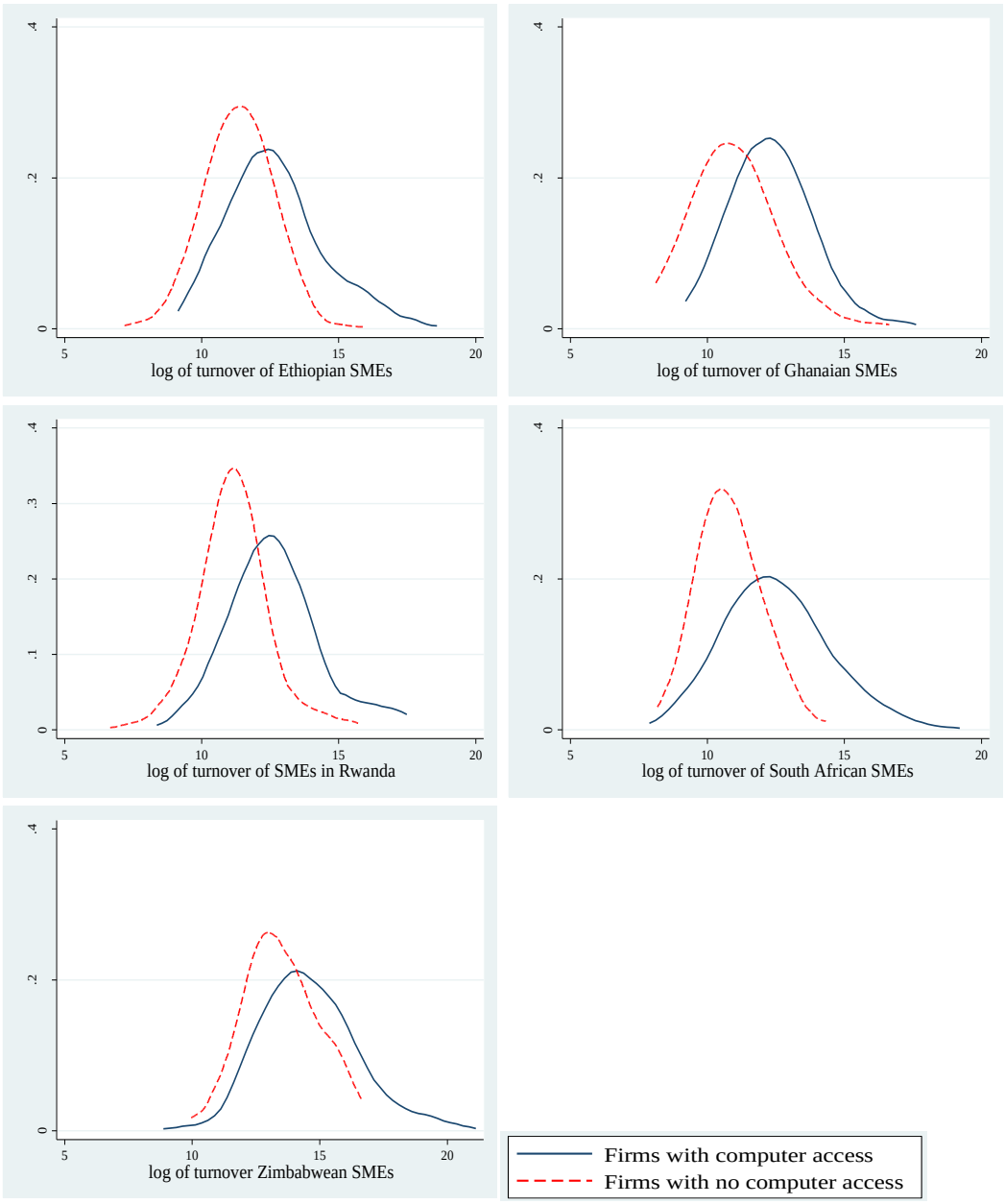
The section presents results from Oaxaca-Blinder decomposition at the mean for 4 different sets of decompositions grouped under two broad headings: decomposition by technological type (access to internet and access to computer) and decomposition by firm type (firm size and managerial control type).

3.1.1 Results of mean decomposition by type of technology

In this subsection, we present results for the threefold Oaxaca-Blinder decomposition by computer and internet accessibility. A positive gap implies that firms with access to technology *j* have relatively high turnover compare to firms with no access to the technology. Conversely, a negative gap indicates that firms with no access to technology *j* have a higher turnover compare to firms with access to the technology.

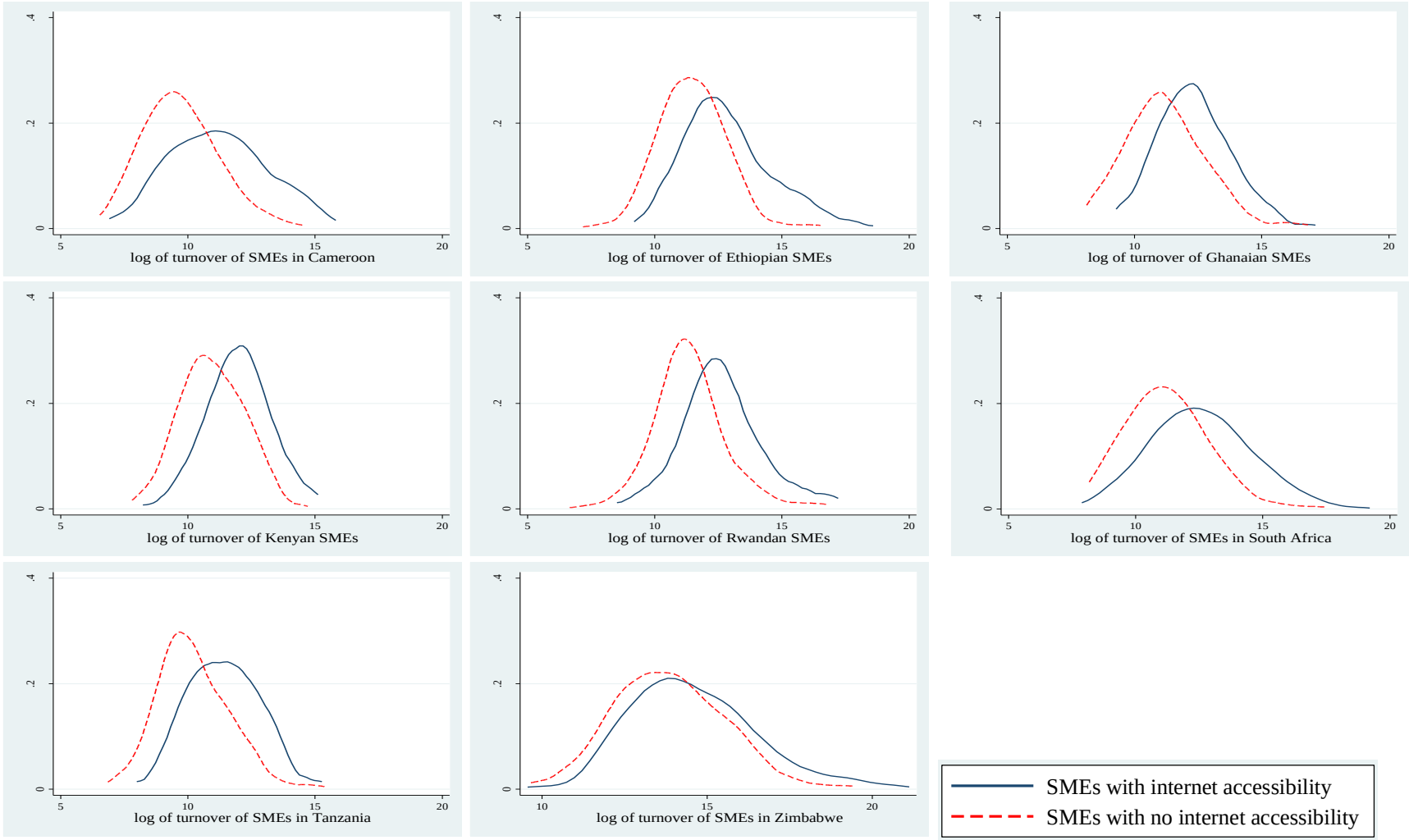
Figures 4.1 and 4.2 illustrate the existence of differences in turnover across firms with access to technology (computer and internet access, respectively) and those with no access to these technologies.

Figure 4. 1: Distribution of firms' turnover by computer accessibility



Figures 4.1 and 4.2 also depict the turnover distribution by computer and internet accessibility respectively for some selected countries (the remaining countries' distributions are shown in the Appendix 4 due to the lack of space). The figures illustrate that across all the countries, firms with access to these technologies, on average have higher turnover than those with no access to these technologies.

Figure 4. 2: Distribution of firms' turnover by internet accessibility



Note: Turnover distribution of the remaining countries are presented in Appendix Figure A-4.2 of the paper.

Contribution of endowments and returns to endowment

Tables 4.1 and 4.2 report the threefold mean decomposition results and the contribution of the key variable of interest (ICT capital stock) to computer and internet accessibility turnover gaps respectively. The full tables containing all covariates are presented in Appendix A1. Figure 4.3 and Figure 4.4 graphically illustrate the contribution of endowment and returns to endowment to both computer and internet accessibility turnover gaps. The results presented in Tables 4.1 and 4.2 confirm high mean turnover in favour of firms with access to computers or internet across the continent. This is shown by the positive and highly statistically significant turnover gaps for both computer and internet accessibility for almost all the countries. The descriptive statistics indicates that Mozambique has the highest turnover gap for both computer and internet accessibility, with both showing an average of over 500 per cent difference in turnover favouring firms with access to these technologies.

Figure 4. 3: Contribution of endowments and returns to computer accessibility turnover gap

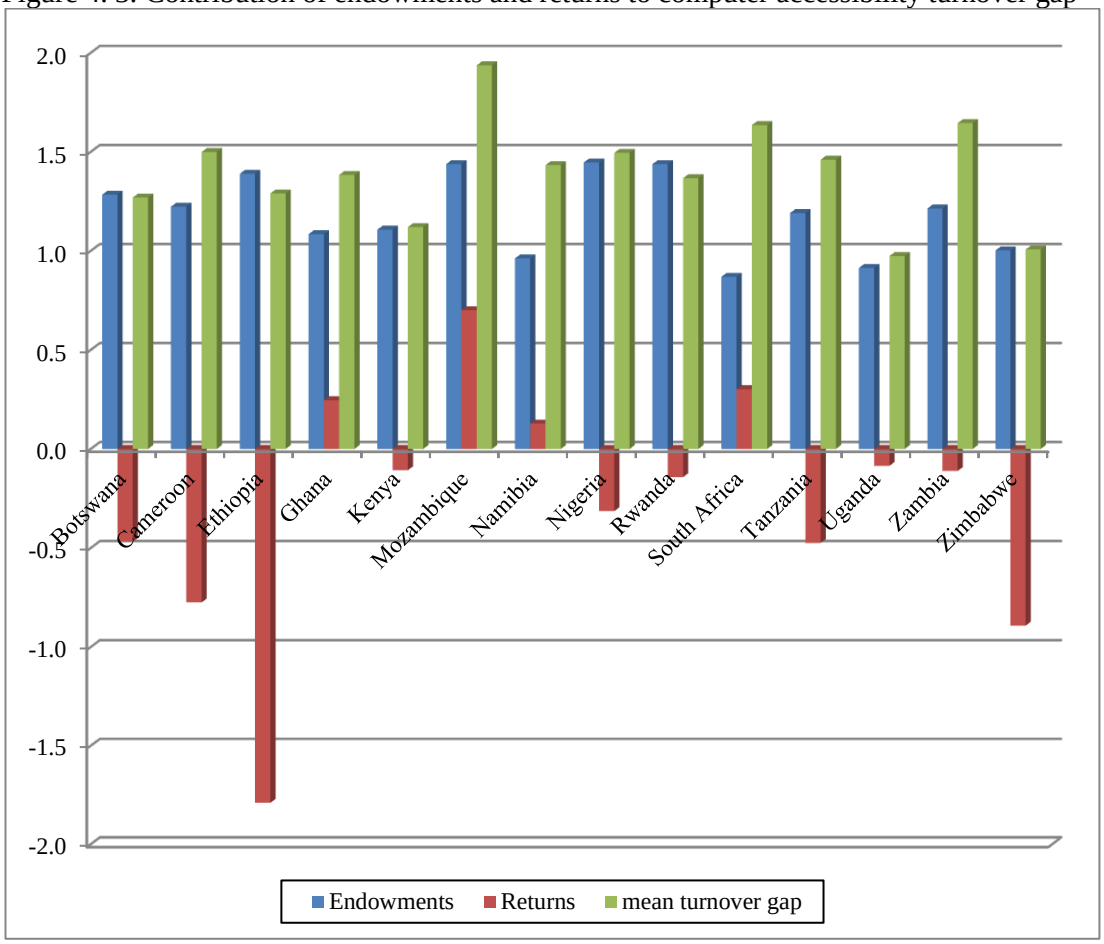
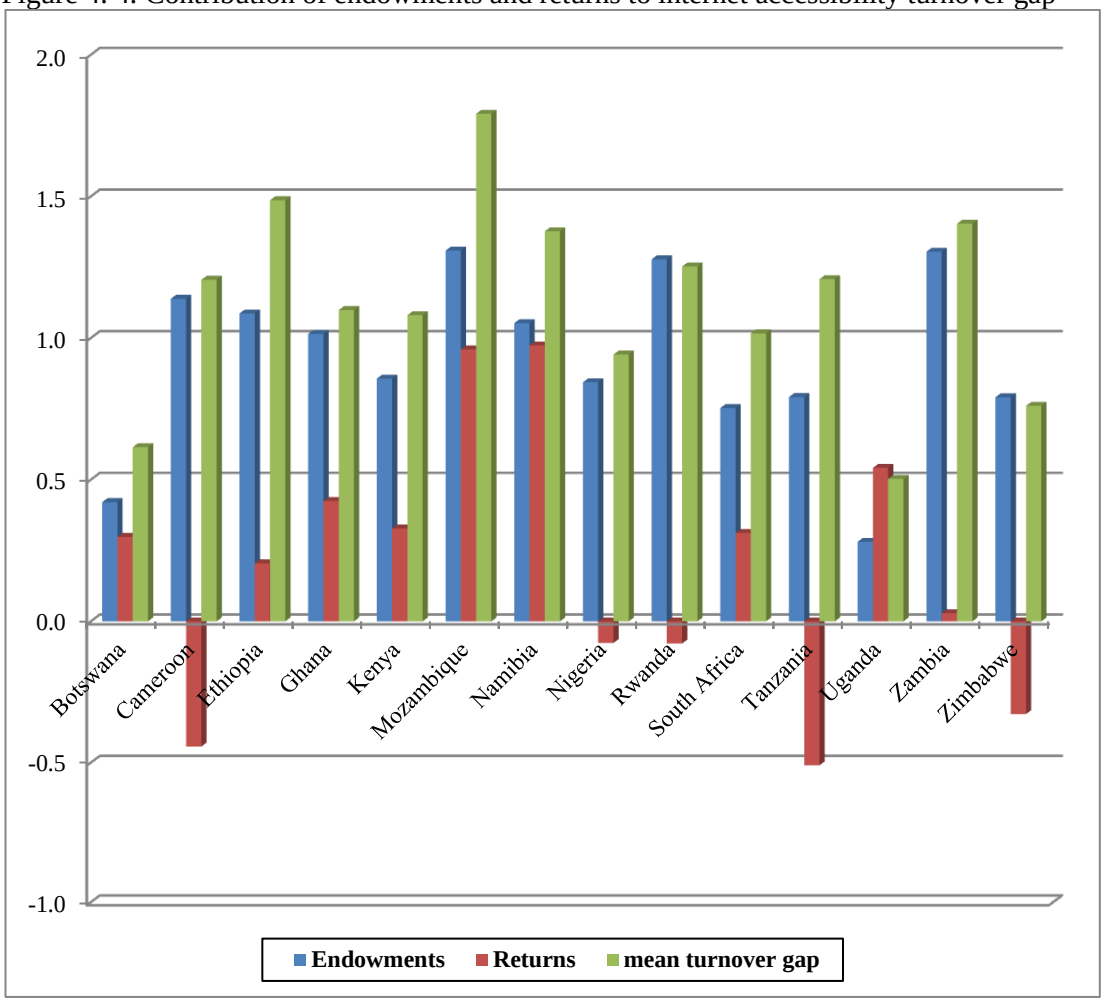


Figure 4. 4: Contribution of endowments and returns to internet accessibility turnover gap



For computer accessibility turnover gap firms with computers in South Africa and Zambia have a relative high turnover of over 400 per cent relative to firms with no computer access. Also, firms using internet have an average turnover of over 300 per cent relative to firms with not internet access. Uganda has the lowest difference in turnover for computer and internet accessibility, 165 percent and 65 percent on average respectively in favour of firms with access to the technologies. In all the countries firms with access to computer or internet register on average a higher turnover relative to firms with no computers or internet access.

Table 4. 1: Oaxaca mean decomposition of turnover by computer accessibility

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
access to computer	12.325*** (0.070)	10.897*** (0.286)	12.548*** (0.209)	12.322*** (0.139)	11.841*** (0.122)	12.619*** (0.094)	12.175*** (0.245)
no access to computer	11.056*** (0.163)	9.398*** (0.098)	11.258*** (0.125)	10.939*** (0.115)	10.720*** (0.117)	10.682*** (0.110)	10.743*** (0.097)
total gap	1.269*** (0.166)	1.499*** (0.322)	1.290*** (0.265)	1.383*** (0.203)	1.120*** (0.172)	1.937*** (0.153)	1.433*** (0.255)
endowments	1.284*** (0.277)	1.223*** (0.237)	1.389*** (0.295)	1.084*** (0.310)	1.107*** (0.188)	1.438*** (0.209)	0.962*** (0.205)
log of ICT capital	0.358* (0.198)	0.042 (0.099)	0.341*** (0.096)	-0.081 (0.090)	0.212** (0.090)	0.236** (0.116)	0.223*** (0.072)
coefficients	-0.468 (0.325)	-0.775 (0.819)	-1.790* (0.934)	0.246 (0.242)	-0.107 (0.283)	0.700*** (0.239)	0.128 (0.494)
log of ICT capital	0.595(0.551)	1.946**(0.938)	2.761**(1.336)	0.267(0.430)	0.202(0.523)	-0.158(0.181)	0.091(0.433)
constant	-1.674 (1.234)	-6.398*** (2.327)	-5.940* (3.194)	0.860 (0.963)	0.183 (1.504)	2.408** (0.978)	0.251 (1.686)
interaction	0.453 (0.397)	1.050 (0.784)	1.690* (0.907)	0.053 (0.315)	0.120 (0.270)	-0.201 (0.257)	0.343 (0.513)
log of ICT capital	0.377(0.359)	1.362** (0.654)	1.895** (0.903)	0.125 (0.206)	0.109 (0.294)	-0.133 (0.148)	0.092 (0.417)
observations	255	280	282	280	277	280	307
Variables	**Nigeria**	**Rwanda**	**South Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
access to computer	11.468*** (0.200)	12.564*** (0.170)	12.260*** (0.146)	11.452*** (0.161)	12.397*** (0.111)	11.389*** (0.117)	14.479*** (0.155)
no access to computer	9.974*** (0.072)	11.197*** (0.094)	10.625*** (0.166)	9.992*** (0.103)	11.423*** (0.095)	9.744*** (0.085)	13.471*** (0.120)
total gap	1.495*** (0.195)	1.367*** (0.201)	1.635*** (0.198)	1.460*** (0.189)	0.974*** (0.153)	1.645*** (0.124)	1.007*** (0.188)
endowments	1.446*** (0.214)	1.438*** (0.277)	0.869*** (0.311)	1.191*** (0.244)	0.914*** (0.151)	1.214*** (0.172)	1.002*** (0.174)
log of ICT capital	0.076 (0.115)	0.472*** (0.168)	0.618** (0.288)	0.142 (0.098)	0.142** (0.071)	-0.079 (0.077)	0.383*** (0.112)
coefficients	-0.314 (0.569)	-0.142 (0.434)	0.302 (0.306)	-0.475 (0.450)	-0.085 (0.168)	-0.111 (0.173)	-0.892*** (0.290)
log of ICT capital	0.386 (0.829)	0.147 (0.852)	-0.348 (0.933)	0.846 (0.966)	0.114 (0.432)	0.984*** (0.335)	0.852 (0.615)
Constant	-1.753 (2.123)	-1.115 (1.385)	-1.278 (1.503)	1.185 (1.529)	-0.224 (1.483)	0.138 (1.022)	-5.646*** (1.600)
interaction	0.363 (0.558)	0.072 (0.494)	0.464 (0.400)	0.745 (0.462)	0.146 (0.160)	0.542*** (0.196)	0.897*** (0.302)
log of ICT capital	0.215 (0.439)	0.074 (0.421)	-0.127 (0.346)	0.571 (0.654)	0.044 (0.168)	0.600*** (0.225)	0.369 (0.265)
observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 100 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. See appendix Table A-4.2 for full table. All country specifications include control variables in the second stage of estimation.

Table 4. 2: Oaxaca mean decomposition of turnover by internet accessibility

Variables	**Botswana**	**Cameroon**	**Ethiopia**	**Ghana**	**Kenya**	**Mozambique**	**Namibia**
access to internet	12.451*** (0.147)	10.837*** (0.456)	12.841*** (0.228)	12.330*** (0.209)	11.986*** (0.163)	12.844*** (0.130)	12.270*** (0.500)
no access internet	11.836*** (0.089)	9.631*** (0.107)	11.354*** (0.134)	11.231*** (0.104)	10.906*** (0.103)	11.052*** (0.118)	10.893*** (0.101)
mean tunover gap	0.615*** (0.165)	1.206*** (0.460)	1.487*** (0.264)	1.099*** (0.234)	1.081*** (0.205)	1.792*** (0.163)	1.377*** (0.513)
endowments	0.421*** (0.153)	1.139*** (0.301)	1.087*** (0.349)	1.015*** (0.220)	0.857*** (0.216)	1.309*** (0.260)	1.053*** (0.285)
log of ICT capital	0.150** (0.073)	0.219 (0.149)	0.291*** (0.110)	-0.056 (0.075)	0.099 (0.065)	0.292*** (0.085)	0.181** (0.085)
coefficients	0.298 (0.385)	-0.442 (5.141)	0.205 (0.364)	0.425 (0.409)	0.328 (0.365)	0.960*** (0.314)	0.974 (0.966)
log of ICT capital	1.019 (1.050)	1.241 (5.631)	0.382 (0.871)	0.526 (0.513)	0.439 (0.732)	-0.148 (0.235)	-0.294 (0.807)
constant	-1.499 (1.532)	-8.023 (18.706)	2.538 (1.658)	2.288 (1.752)	2.419 (2.271)	2.793* (1.499)	0.284 (2.578)
interaction	-0.103 (0.392)	0.510 (5.101)	0.195 (0.394)	-0.341 (0.424)	-0.104 (0.316)	-0.477 (0.290)	-0.650 (0.943)
log of ICT capital	0.187 (0.238)	0.682 (3.631)	0.215 (0.514)	0.176 (0.199)	0.184 (0.317)	-0.095 (0.155)	-0.235 (0.652)
observations	255	280	282	280	277	280	307
Variables	**Nigeria**	**Rwanda**	**South Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
access to internet	11.171***(0.332)	12.624***(0.233)	12.157***(0.246)	11.419***(0.251)	12.227***(0.176)	11.446***(0.106)	14.544***(0.169)
no access internet	10.229***(0.097)	11.371***(0.080)	11.140***(0.133)	10.211***(0.101)	11.724***(0.063)	10.042***(0.101)	13.783***(0.142)
mean turnover gap	0.942***(0.345)	1.253***(0.244)	1.017***(0.282)	1.208***(0.287)	0.503**(0.197)	1.404***(0.153)	0.761***(0.223)
endowments	0.844**(0.405)	1.278***(0.271)	0.753***(0.237)	0.792***(0.294)	0.281(0.234)	1.305***(0.171)	0.791***(0.206)
log of ICT capital	0.207 (0.134)	0.394*** (0.129)	0.236*(0.131)	0.206**(0.095)	0.082*(0.047)	0.031(0.066)	0.331***(0.094)
coefficients	-0.076(8.673)	-0.078(0.465)	0.312(0.334)	-0.509(5.963)	0.542(0.388)	0.029(0.125)	-0.327(0.303)
log of ICT capital	-1.084 (4.705)	0.052 (1.410)	1.010 (0.913)	1.140 (11.143)	0.299 (0.868)	0.518** (0.252)	-0.130 (0.603)
constant	0.482(22.045)	-1.416(2.202)	-2.134(2.093)	-0.320(13.716)	1.042(1.775)	-0.276(0.772)	-1.048(1.554)
interaction	0.174(8.676)	0.053(0.467)	-0.048(0.342)	0.925(5.907)	-0.320(0.394)	0.070(0.142)	0.297(0.351)
log of ICT capital	-0.541(2.509)	0.022(0.613)	0.255(0.242)	0.646(6.674)	0.097(0.313)	0.220**(0.110)	-0.032(0.152)
observations	265	279	290	263	351	276	281

Standard errors in parentheses are obtained using Bootstrap inference based on 100 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. See appendix Table A-4.3 for full table. All country specifications include control variables in the second stage of estimation.

The threefold mean decomposition divides the total turnover gap into three different parts, namely the differences in endowments, differences in coefficients and interactions. The endowment effect, which captures the contribution of differences in observable characteristics of the two groups of firms, suggests that the mean turnover of firms with no computer or internet access would increase if these firms possess the characteristics or endowments of firms with computer or internet access. In each country, the inter-group differences in average endowment account for more than half of the overall turnover gap for computer and internet accessibility. Table 4.1 indicates that South Africa registers the lowest contribution of differences in endowments to computer accessibility turnover gap, with Ethiopia having the highest in contribution of endowment. Differences in endowments account for about 53.2 per cent of the overall computer accessibility turnover gap in South Africa and it explains about 108 per cent in Ethiopia.

Overall, differences in endowment favour firms with access to computer across Africa. These findings indicate that if firms with no computer access had similar endowments as firms with access to computer in these countries they are likely to raise their average turnover. The results of internet accessibility decomposition for the respective countries are comparable to that of computer accessibility model. However, in Uganda the difference in total endowment shows an insignificant effect on the internet accessibility turnover gap.

The returns aspect of the turnover gap measures the differences in coefficients or returns to firms' endowments. It measures differences in returns to endowments of the two groups of firms. These findings indicate that return to the firms' endowment make no significant contribution in determining the computer accessibility turnover gap in most of the countries with the exception of Ethiopia, Mozambique and Zimbabwe. The findings for Mozambique suggest higher return to endowment for firms with access to computers, as the coefficient effect favours firms with computer access. This implies that if firms with no access to computers have the same endowments as firms with computer access they are likely to achieve on average a higher turnover equivalent to the coefficient gap. In contrast, this is not the case in Ethiopia and Zimbabwe, as the coefficient effect gives an advantage to firms with no computer access. In the case of Ethiopia, since the contribution of differences in

endowment exceeds 100 per cent it is suggestive that difference in returns to endowment favours firms lacking computer access. The findings suggest if Ethiopian and Zimbabwean firms with computer access have similar endowments as firms with no computer access their turnover might improve by 180 percentage points and 90 percentage points, respectively. The findings were no different for internet accessibility turnover gap, which shows that return to endowments is insignificant in all countries except Mozambique. Differences in coefficients favour of firms with internet access. This implies that if firms with no internet access have similar endowments as firms with internet access their average turnover is likely to rise by 96 percentage points.

Table 4.1 and Table 4.2 show that the interaction effects do not contribute to computer and internet accessibility turnover gaps in all countries. In general, the findings suggest that disparities in turnover between firms with computer and internet accessibility and those with no access to these technologies are largely driven by the observed characteristics of firms or returns to these endowments rather than an interaction of both endowment and returns.

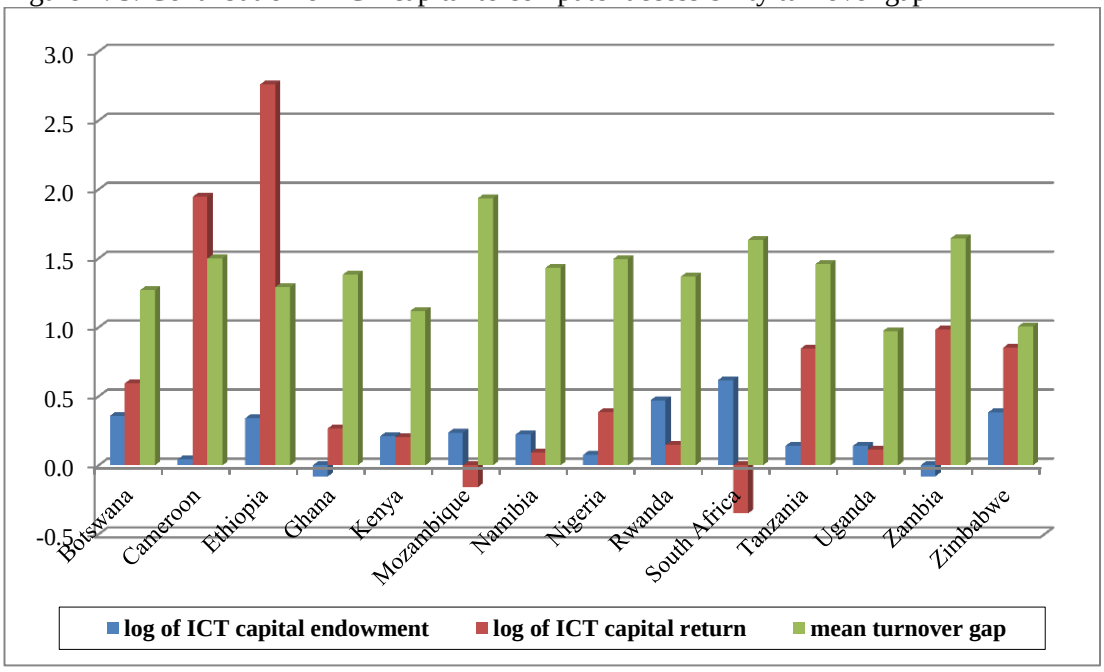
Contribution of individual covariates

The results of the detailed decomposition provide more insight into the contribution of each explanatory variable to the endowment, return and interaction effects. A positive and significant contribution indicates the widening of the turnover gap and conversely, a significant negative contribution reduces the gap. Appendix Tables A-4.1 and A-4.3 present full results of the detail decomposition. Figures 4.5 and 4.6 show a graphical display of the contribution of ICT capital to computer and internet accessibility turnover gaps, respectively. At the mean the endowment effect across Africa is driven mainly by differences in the factors of production; ICT capital stock, employment level, non-ICT capital stock and raw materials, in addition to the formality index. The contributions of the remaining firm level characteristics to endowment effect are statistically insignificant in almost all the countries.

The variable of interest, the endowment of ICT capital, is positive and statistically significant in explaining the mean turnover gap for both computer and internet

accessibility in nine (9) of the sampled countries[42]. In all these countries, differences in ICT capital endowment account for more than 10 per cent of the turnover gap for both computer and internet accessibility decompositions. The positive and significant endowment/characteristics effect of ICT capital favours firms with access to either technology, implying that firms with no access to either computer or internet will have high average turnover if they are equipped with similar ICT capital endowments possessed by firms with access to these technologies. As expected firms with access to computers or internet have high levels of ICT capital stock.

Figure 4. 5: Contribution of ICT capital to computer accessibility turnover gap

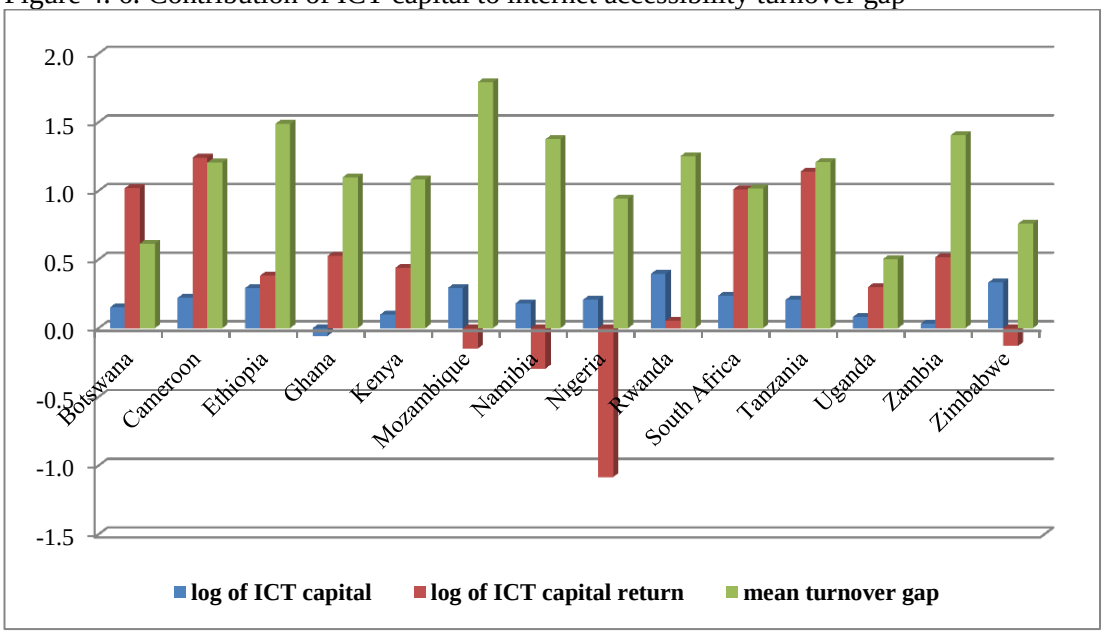


Differences in ICT capital endowment contributes the largest to computer accessibility turnover gap in Botswana, South Africa and Zimbabwe, accounting for over 50 per cent of the computer accessibility turnover gap at the mean. ICT capital endowment differences explain about 61 per cent of the turnover gap in South Africa, 58 per cent in Botswana and 50.2 per cent in Zimbabwe. That is, if firms with no computers access in Botswana, South Africa and Zimbabwe are endowed with similar ICT capital possessed by firms with computer accessibility their turnover will increase on average by 58, 61 and 50 percentage points, respectively. Differences in

[42] The endowment effect of ICT capital stock is positive and significant in determining sources of computer accessibility gap in the following countries: Botswana, Ethiopia, Kenya, Mozambique, Namibia, Rwanda, South Africa, Uganda and Zimbabwe. Whiles its contribution to internet accessibility turnover gap was significant in all these countries with the exception of Kenya. It was also positive significant in Tanzania.

ICT capital endowments account for less than 40 per cent of the computer accessibility turnover gap in the remaining countries, with Mozambique registering the lowest contribution of 13 per cent. Although difference in firm endowment does not contribute to internet accessibility turnover gap in Uganda, endowment of ICT capital favours firms with access to internet (see Table 4.2). This suggests that firms with no access to internet will have a high mean turnover if they possess similar ICT capital endowment. In five out of the nine countries[43] in which differences in ICT capital endowment make a significant contribution to computer accessibility turnover gap, differences in non-ICT capital endowment do not contribute to this turnover gap. However, in the remaining four countries the positive contribution of ICT capital is re-enforced by a positive and significant contribution of non-ICT capital.

Figure 4. 6: Contribution of ICT capital to internet accessibility turnover gap



We now turn our focus to differences in returns to ICT capital endowment to the turnover gaps. The chapter finds no evidence to suggest that differences in return to ICT capital endowment statistically significant contribute to both computer and internet accessibility turnover gaps in most of the countries. Although differences in return to endowments (return/coefficient component of total gap) fails to contribute to computer accessibility turnover gap in Cameroon and Zambia, differences in

[43] ICT capital makes positive and significant contribution to the computer accessibility in these countries: Botswana, Mozambique, Namibia, South Africa and Zimbabwe. However, non-ICT capital does not contribute to the turnover gap in these countries.

return to ICT capital endowment contributes positively to turnover gap between the two groups of firms. This finding shows that returns on ICT capital stock favours firms with computer accessibility, suggesting that in these countries firms with no computer access would earn higher turnover if they have comparable ICT capital stock as firms with computer access after controlling for all other endowments. Furthermore, the results for Zambia presented in Table 4.2 indicate that the return component of internet accessibility turnover gap is not statistically significant, in spite of this, return on ICT capital stock favour firms with access to internet in Mozambique. This finding indicates that if firms with no internet access have comparable amount of ICT capital endowment to firms with access they are likely to have a higher turnover resulting from high returns to ICT capital. This finding suggests that expansion of ICT capital stock perhaps makes labour more productive and also may replace other inputs (some form of non-ICT capital) used by the SME, thus leading to a direct deepening effect of ICT capital.

For the computer accessibility decomposition, the constant is significant in contributing to the gap in four countries (Cameroon, Ethiopia, Mozambique and Zimbabwe), while for the internet accessibility decomposition it is significant only in Mozambique. This indicates that in these countries there are some generic factors which tend to favour firms with computer or internet accessibility but are not captured in the two models. The interaction component of the total gap estimates the simultaneous effect of differences in endowments and coefficients. In almost all the countries the results indicate that this was insignificant with the exception of Ethiopia, Zambia and Zimbabwe. The interaction effect is positive and significantly different from zero in these three countries, which suggests that firms with access to computers have an advantage in terms of turnover due the that fact that they are better endowed with those characteristic which yield higher levels of average turnover.

Tables 4.3 and 4.4 present summaries of the mean decomposition of SME's turnover by computer and internet accessibility. The tables contain the contribution of key variables and firm level characteristics. Few variables significantly contribute to computer accessibility turnover gap in Botswana and Zimbabwe, with the variables favouring firms with access to computer. However, Mozambique and Uganda have

the highest number of variables which are significant in determining the sources of computer accessibility turnover gap. Some of the variables tend to favour firms with computer access, while others are in favour of SME with no computer access. Specifically, in Mozambique firms with computer access are more endowed with these variables compared to their counterpart with no computer access. Nonetheless, the returns on these endowments, especially raw materials and education, favour firms with no access to computers. Ghana and South Africa show/report the lowest number of variables which contribute significantly to internet accessibility turnover gap, with all these variables favouring firms using internet at the work place. Mozambique also registered the highest number of variables that are significant in determining the sources of internet accessibility turnover gap. Firms with internet access dominant by have relatively more endowment, while return to these endowment favours firms with no internet access.

Table 4. 3: Summary of mean decomposition by computer access

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambiq	Namibia
log of employee	+E	+E	+E	+E	+E	+E	+E, -R, -I
log of ICT capital	+E	+R, +I	+E, +R, +I		+E	+E	+E, +R
log of non-ICT capital			+E	+E	+E		-R
log of raw materials	+E	+E, +R	+E	+E	+E	+E, -R, -I	+E, +R
sole proprietorship		+R, -I					-E, -R
sec. education						-R, +I	
voc. education		-R					
tertiary education		+E			-R	-R. -I	
manufacturing							
construction					-I	-I	
formal							
semi-formal							
management control type	-R, -I						
Variables	**Nigeria**	**Rwanda**	**S. Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
log of employee	+E	+E		+E	+E	+E, +I	
log of ICT capital		+E	+E		+E	+E	+E, +I
log of non-ICT capital	+E	+E		+E	+E	+E	+R
log of raw materials	+E				+E	+E	
sole proprietorship					-R		
sec. education	+E	+R, -I	+R, -I		+R, -I		
voc. education							
tertiary education		+R, +I					
manufacturing				-R, +I	-R, +I		
construction							
formal	+E	+E		+E, -R	+E		+E
semi-formal					+E		
management control type							

Note: (+) Indicates favouring firms with computer access relative to firms with no computer access.
(-) Indicates favouring firms with no computer access relative to firms with computer access.
(E) Indicating significant endowment effect.
(R) Show significant return effect.
(I) Indicates significant interaction effect.

The differences in endowment of employees favour firms with access to computer or internet in twelve (12) countries. With respect to the internet accessibility gap, returns to endowment of employees and its interaction effect are both not significant in all countries. This finding is similar to the case of computer accessibility turnover gap, with the exception of Namibia. Return to employee endowment contributes negatively to computer accessibility turnover gap in Namibia, implies it favours firms with no computer access. That is, if Namibian firms with computers access had similar number and quality of employees as firms with no computer access they would on average improve their turnover.

Table 4. 4: Summary of mean decomposition of turnover by internet access

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambiq	Namibia
log of employee	+E	+E	+E	+E	+E	+E	+E
log of ICT capital	+E		+E			+E	+E
log of non-ICT capital			+E		+E		
log of raw materials		+E	-R	+E	+E	-R	+R
sole proprietorship							-E
sec. education						-R, +I	
voc. education						-R	
tertiary education						+E, -R, -I	
manufacturing	-R						-R
construction							
formal						+E	+E
semi-formal	-R	+E					
management control type							
Variables	**Nigeria**	**Rwanda**	**S. Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
log of employee		+E	+E	+E		+E	+E
log of ICT capital		+E	+E	+E	+E	+R, +I	+E
log of non-ICT capital	+E	+E		+E		+E, -R, -I	+E
log of raw materials						+E	
sole proprietorship							
sec. education							
voc. education							
tertiary education	+R, +I			+E			
manufacturing					+R, -I		
construction	-R, -I	+R					
formal		+E		+E	+E	+E	
semi-formal		+E					
management control type						+E	

Note: (+) Indicates favouring firms with computer access relative to firms with no access to internet.
(-) Indicates favouring firms with no computer access relative to firms with internet access.
(E) Indicating significant endowment effect.
(R) Show significant return effect.
(I) Indicates significant interaction effect.

The return on non-ICT capital endowment only contributes significantly to the internet accessibility turnover gap in Zambia, favouring firms with no internet access. For computer accessibility decomposition, return on non-ICT capital is significant in Namibia and Zimbabwe, though in both countries the endowment effect of non-ICT capital were both not significant in determining the sources of the

computer accessibility turnover gap. In Namibia, the results suggest that if firms with access to computer use similar non-ICT capital in their production process as firms with no computer access on average their turnover will rise. However, the situation is different in Zimbabwe, in which return on non-ICT capital positively contribute to the computer accessibility turnover gap. That is, SME with no computer access would increase their turnover if they had the same level and quality of non-ICT capital. The results from Table 4.4 also suggest that endowment of raw material is relevant in determining the sources of the computer accessibility turnover gap in most countries, with the exception of four[44]. In all these countries raw material endowment favours firms with computer access. However, the return on endowment of raw materials was significant in a few countries, Cameroon, Mozambique and Namibia. While in Cameroon and Namibia the return favours firms with computer access, and firms with no access to computers have the advantage in Mozambique. The return on endowment of raw material was also significant in internet accessibility decomposition for only three countries. Ethiopia and Mozambique registered negative returns on endowment of raw materials, thus favouring firms lacking internet access, and positive return was recorded in Namibia.

3.1.3 Results of mean decomposition by firm type

We now examine the results of the mean decomposition of turnover gap following Blinder (1973) and Oaxaca (1973). We implement Blinder-Oaxaca decomposition for both firm size and managerial control type differentials. Table 4.5 and Table 4.6 report an abridged threefold mean decomposition results for firm size and management control type, respectively. These tables show the contribution of the major components and that of the ICT capital variable to turnover differentials across the countries. We present tables containing additional variables in the appendix Table A-4.4 and A-4.5.

Looking at Tables 4.5 and 4.6, we see that both medium sized firms and firms managed by a full-time manager tend to have on average high levels of turnover relative to small sized firms and firms with other form of managerial control type. Generally, we expect larger firms to be more endowed and resourced, thus having

[44] The log of raw material is not significant in Rwanda, South Africa, Tanzania and Zimbabwe.

higher turnover compared to smaller firms, which have relatively small capital base. Similarly, firms with more resources have the capacity to employ a full-time manager to oversee the daily management of the organisation; hence it is not surprising that firms with full-time manager on average register a higher turnover.

Contribution of endowment and returns to endowment

The decomposition results for both firm size and managerial control type indicate that differences in endowments across all the countries are mostly responsible for the turnover gap, contributing to at least more than 70 per cent of the turnover gap in the firm size decomposition across all the countries. Table 4.5 and Figure 4.7 indicate that endowment favours small-medium sized firms. Differences in endowment also account for at least 65 per cent of management control type differential in turnover across the countries. Firms with a full-time manager are relatively more endow compared to firms with other form of managerial control type (see Table 4.6).

Figure 4. 7: Contribution of endowment and returns to firm size turnover gap

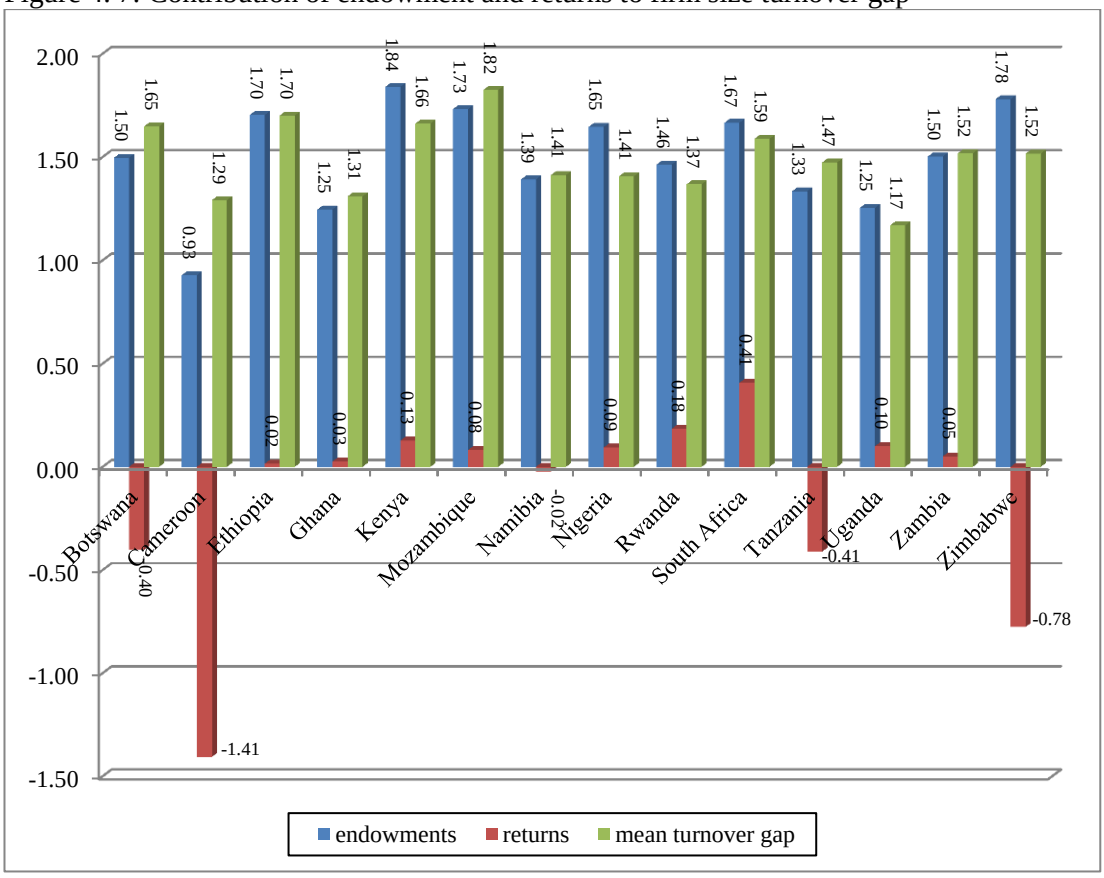


Table 4. 5: Oaxaca decomposition of turnover by firm size

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
medium size	12.286*** (0.072)	10.609*** (0.201)	12.380*** (0.116)	11.904*** (0.126)	11.768*** (0.064)	12.250*** (0.108)	11.887*** (0.153)
small size	10.638*** (0.208)	9.318*** (0.087)	10.679*** (0.155)	10.595*** (0.159)	10.106*** (0.150)	10.426*** (0.154)	10.474*** (0.090)
mean turnover gap	1.648*** (0.210)	1.291*** (0.228)	1.701*** (0.207)	1.309*** (0.206)	1.662*** (0.163)	1.824*** (0.185)	1.413*** (0.183)
endowments	1.496** (0.705)	0.928*** (0.178)	1.703*** (0.572)	1.246*** (0.357)	1.839*** (0.416)	1.732*** (0.419)	1.391*** (0.253)
log of ICT capital	0.060 (0.196)	0.056 (0.051)	0.091** (0.045)	-0.030 (0.049)	0.097 (0.067)	0.296*** (0.111)	0.165*** (0.051)
coefficients	-0.403* (0.219)	-1.406** (0.680)	0.015 (0.237)	0.026 (0.271)	0.127 (0.150)	0.082 (0.162)	-0.023 (0.487)
log of ICT capital	0.796 (0.560)	0.476 (0.717)	1.013** (0.467)	0.251 (0.349)	-0.041 (0.269)	-0.335 (0.271)	-0.347 (0.223)
constant	-0.280 (1.364)	-5.918*** (1.743)	-1.038 (1.848)	0.369 (0.975)	1.729 (1.981)	1.077 (1.073)	1.661 (1.191)
interaction	0.555 (0.626)	1.769*** (0.637)	-0.016 (0.508)	0.037 (0.387)	-0.303 (0.409)	0.011 (0.434)	0.044 (0.517)
log of ICT capital	0.359 (0.239)	0.156 (0.241)	0.332** (0.142)	0.047 (0.076)	-0.012 (0.083)	-0.138 (0.119)	-0.124 (0.090)
observations	255	280	282	280	277	280	307
Variables	**Nigeria**	**Rwanda**	**South Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
medium size	11.028*** (0.086)	12.304*** (0.109)	12.326*** (0.227)	11.087*** (0.124)	12.278*** (0.072)	11.206*** (0.106)	14.578*** (0.128)
small size	9.622*** (0.098)	10.935*** (0.111)	10.738*** (0.136)	9.613*** (0.110)	11.109*** (0.092)	9.688*** (0.069)	13.062*** (0.125)
mean turnover gap	1.406*** (0.128)	1.368*** (0.170)	1.588*** (0.287)	1.474*** (0.177)	1.169*** (0.116)	1.518*** (0.126)	1.516*** (0.177)
endowments	1.646*** (0.281)	1.463*** (0.320)	1.665*** (0.634)	1.334*** (0.248)	1.254*** (0.162)	1.502*** (0.194)	1.780*** (0.478)
log of ICT capital	0.057 (0.104)	0.211** (0.096)	0.156 (0.098)	0.141 (0.092)	0.048 (0.030)	-0.023 (0.047)	0.300** (0.131)
coefficients	0.094 (0.214)	0.184 (0.208)	0.407 (0.433)	-0.411** (0.205)	0.100 (0.129)	0.051 (0.146)	-0.776** (0.313)
log of ICT capital	0.186(0.470)	0.052(0.564)	1.538(0.977)	0.243(0.490)	-0.031(0.360)	0.465**(0.217)	-0.314 (0.599)
Constant	-0.116 (1.063)	-0.129 (0.899)	-0.700 (1.902)	-0.225 (0.971)	-0.016 (1.061)	-1.107 (1.001)	-4.976*** (1.771)
interaction	-0.334 (0.370)	-0.278 (0.315)	-0.484 (0.693)	0.550* (0.302)	-0.185 (0.197)	-0.035 (0.213)	0.512 (0.566)
log of ICT capital	0.066 (0.159)	0.012 (0.129)	0.263 (0.186)	0.085 (0.172)	-0.004 (0.048)	0.136 (0.085)	-0.075 (0.149)
observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 100 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. See appendix Table A-4.4 for full table. All country specifications include control variables in the second stage of estimation.

Table 4. 6: Oaxaca decomposition of turnover by management control type

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
full management	12.400***(0.111)	10.681***(0.166)	12.427***(0.179)	12.275***(0.180)	11.781***(0.094)	12.190***(0.144)	11.943***(0.226)
other form	11.892*** (0.074)	9.475*** (0.127)	11.558*** (0.128)	11.128*** (0.107)	10.845*** (0.102)	11.119*** (0.157)	10.992*** (0.113)
mean turnover gap	0.508*** (0.136)	1.206*** (0.221)	0.869*** (0.216)	1.147*** (0.217)	0.936*** (0.134)	1.071*** (0.190)	0.952*** (0.253)
endowments	0.515*** (0.131)	1.133*** (0.266)	0.877*** (0.266)	1.019*** (0.230)	0.946*** (0.153)	0.870*** (0.237)	0.645** (0.272)
log of ICT capital	0.115*** (0.041)	0.150* (0.090)	0.136** (0.057)	0.009 (0.016)	0.098*** (0.038)	0.088* (0.050)	0.070 (0.057)
coefficients	0.204 (0.311)	0.189 (0.301)	0.026 (0.191)	0.184 (0.334)	0.039 (0.123)	0.378** (0.177)	0.384 (0.277)
log of ICT capital	-1.990** (0.994)	-0.117 (0.522)	0.410 (0.514)	-0.257 (0.424)	-0.202 (0.348)	0.358 (0.278)	-0.217 (0.525)
constant	1.195 (2.110)	1.263 (1.633)	1.346 (1.557)	-0.101 (1.467)	2.078* (1.250)	2.033** (0.837)	1.109 (1.545)
interaction	-0.211 (0.299)	-0.116 (0.325)	-0.034 (0.206)	-0.056 (0.365)	-0.049 (0.147)	-0.177 (0.161)	-0.077 (0.295)
log of ICT capital	-0.196** (0.096)	-0.029 (0.136)	0.071 (0.096)	-0.010 (0.035)	-0.045 (0.082)	0.078 (0.060)	-0.039 (0.143)
observations	255	280	282	280	277	280	307
Variables	**Nigeria**	**Rwanda**	**South Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
full management	11.769*** (0.298)	12.085*** (0.173)	12.232*** (0.277)	10.936*** (0.160)	12.256*** (0.110)	11.465*** (0.147)	14.491*** (0.212)
other form	10.058*** (0.074)	11.323*** (0.086)	11.361*** (0.146)	10.002*** (0.091)	11.531*** (0.094)	10.027*** (0.086)	13.911*** (0.114)
mean turnover gap	1.711*** (0.317)	0.762*** (0.213)	0.871*** (0.298)	0.934*** (0.187)	0.724*** (0.136)	1.438*** (0.164)	0.580** (0.244)
endowments	1.162*** (0.202)	0.751*** (0.191)	0.680** (0.270)	0.852*** (0.159)	0.528*** (0.128)	1.035*** (0.168)	0.617*** (0.199)
log of ICT capital	0.103 (0.095)	0.222** (0.086)	0.263** (0.122)	0.088** (0.045)	0.052** (0.022)	0.031 (0.026)	0.125*** (0.044)
coefficients	-0.097 (0.681)	0.095 (0.185)	0.202 (0.432)	-0.138 (0.211)	0.016 (0.089)	0.535*** (0.159)	0.099 (0.214)
log of ICT capital	0.293 (1.140)	-0.369 (0.678)	0.336 (1.466)	0.575 (0.577)	-0.120 (0.299)	0.167 (0.473)	-0.814 (0.586)
Constant	-2.140 (2.623)	0.586 (1.366)	0.803 (1.632)	0.429 (1.139)	0.417 (1.156)	1.343 (0.832)	-3.741** (1.777)
interaction	0.646 (0.705)	-0.084 (0.188)	-0.011 (0.355)	0.219 (0.230)	0.180** (0.088)	-0.132 (0.152)	-0.136 (0.252)
log of ICT capital	0.118 (0.463)	-0.081 (0.135)	0.050 (0.199)	0.160 (0.173)	-0.013(0.033)	0.042 (0.132)	-0.093 (0.074)
observations	265	279	290	263	351	276	281

Standard errors in parentheses are obtained using Bootstrap inference based on 100 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. See appendix Table A-4.5 for full table. All country specifications include control variables in the second stage of estimation.

Contrary to the endowment component, differences in return is not statistically significant, across most of the countries[45] in determining sources of turnover gap for both firm size and management control type decompositions. Overall, there is a trade-off between the endowment effect and effect of returns, as endowment effect favours small-medium sized firms and returns on endowment favours micro sized firms. This is suggestive that micro sized firms derive higher return on their endowments relative to medium sized firms in these countries. For countries in which differences to return (coefficient) is a source of management control type turnover gap, the results suggest that return effect favours firms with a full-time manager.

Lastly, the interaction effect, which captures the simultaneous effect of differences in endowment and return, was shown not to be significant in almost all the countries for both decompositions. The results indicate that both endowment and return simultaneously exist for both medium and small sized firms in Cameroon and Tanzania and it favours medium sized firms. The interaction effect in the management control type decomposition favours those with a full-time manager and it is also significantly contributes to turnover gap in on Uganda.

Contribution of individual covariates

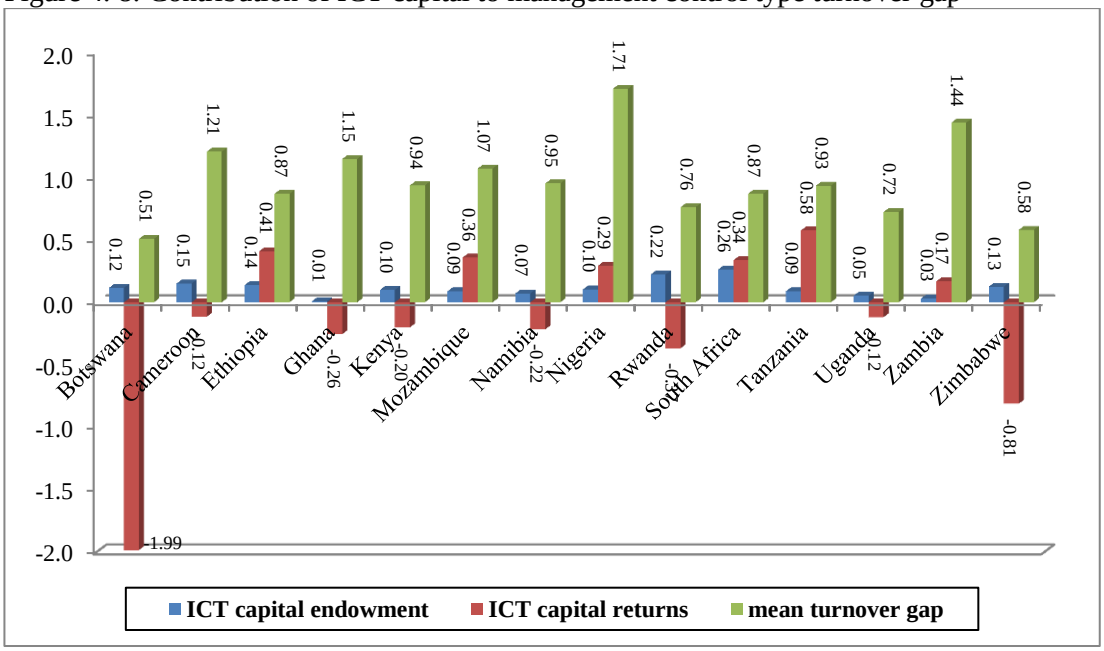
Disaggregating the overall endowment component by variables explains the sources of the endowment effect and by extension the contribution of each variable to the turnover gap. It also enables us assess the contribution of the variable of interest, ICT capital, to the other two components of the turnover gap. ICT capital plays a significant role in explaining the turnover gap between firms which employ a full-time manager and those with other form of management control in most of the countries.

The results in Table 4.6 and Figure 4.8 show that firms with full-time managers turn to have high levels of ICT capital endowment relative to firms that resort to other forms of managerial control. The high level of ICT capital investment by firms in

[45] Differences in return to endowment of firms with full-time manager and those with other form of management was significant in only Mozambique and Zambia, while differential in returns contributed to the firm size turnover gap in Botswana, Cameroon, Tanzania and Zimbabwe.

which owners employ a full-time manager enables the owner(s) and managers to share files pertaining to the activities the firms via the network. This improves decision making as information can be shared and assessed by both owner(s) and the manger for decisions made in real time. The high investment in ICT capital also allows owner(s) to monitor the activities of manager regardless of their location and also improves on the recordkeeping of the SME. Gretton et al. (2004) find that skilled managers and employees often help in making the technology function effectively and thus their firms are more likely to adopt new technology.

Figure 4. 8: Contribution of ICT capital to management control type turnover gap

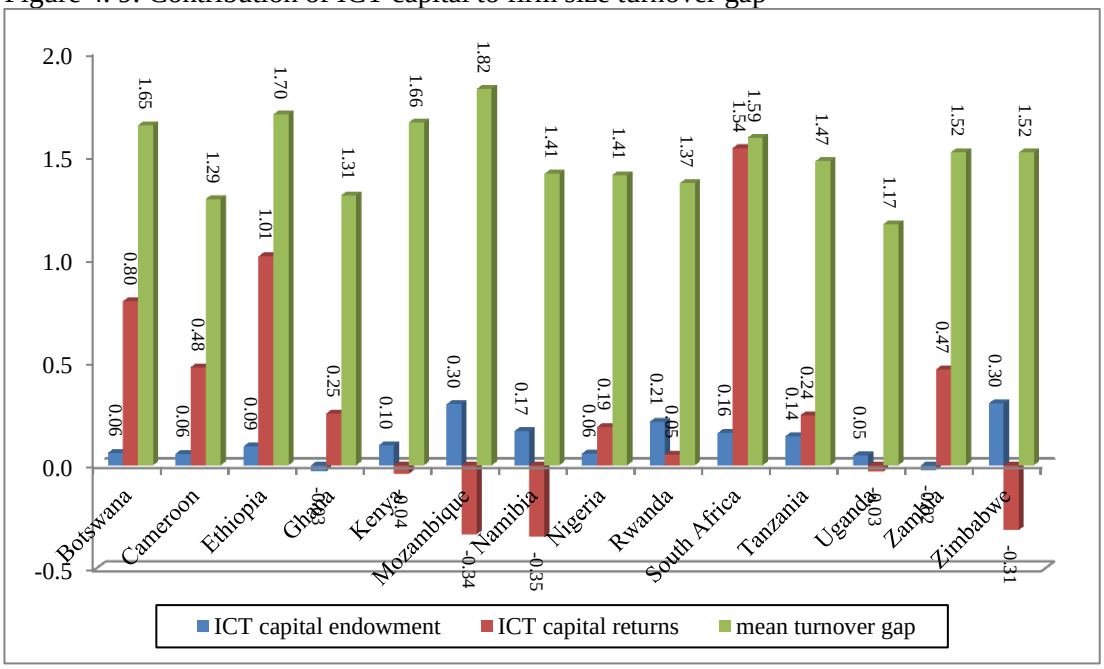


Small-medium sized firms are more likely to adopt new technology compared to micro sized firms, and possibly ICT capital, are also more likely to have higher levels of ICT capital endowment. The firm size decomposition shows that difference in endowment of ICT capital contributes to SME size turnover gap in only five of the countries[46]. Table 4.5 results indicate that ICT capital endowment favours small-medium sized firms in countries in which the differences in ICT capital partly accounts for the turnover differential (see Figure 4.9). This result is in line with the finding in chapter two of this thesis, which finds that large firms are more likely to both the internet and computers relative to small firms. Given the high risk nature and cost of adopting new technologies, medium sized firms are relatively in a more

[46] Ethiopia, Mozambique, Namibia, Rwanda and Zimbabwe.

advantageous position to adopt new technology as they potentially have relatively large financial base and high ability to absorb risk compared to small firms.

Figure 4. 9: Contribution of ICT capital to firm size turnover gap



The results in Table 4.6 also show that differences in return to ICT capital endowment significantly contribute to the firm size turnover gap in Ethiopia and Zambia. For these two countries, though differences in return do not contribute to firm size turnover differential, the differences in return to ICT capital favours small-medium sized firms. Looking at the management control type turnover gap, Table 4.7 indicates that differences in return to ICT capital is insignificant to contributing to the turnover gap all the countries, except Botswana. This indicates the absence of any systematic differences in returns to ICT capital across firm size. This finding is similar to that of Bloom et al. (2010).

We present summaries of mean decomposition of firms' turnover by firm size and managerial control type in Tables 4.7 and 4.8, respectively. The tables show the contribution of the individual covariate to endowment, returns to endowment and the interaction component. Table 4.7 indicates that South Africa, Kenya, Nigeria and Botswana have the least number of variables which significantly contribute to firm size turnover gap, with the variables favouring medium-small sized firms. Conversely, Namibia, Zimbabwe and Rwanda have the most number of variables

which are significant in explaining the sources of firm size turnover differential. In these countries most of the variables tend to favours small-medium sized firms. Small-medium sized firms have favourable characteristics compared to micro sized firms. Nonetheless, operating in the informal or semi-formal sectors in Zimbabwe yield relatively high returns compared to operating in the formal sector. The table also suggests that micro sized firms in Rwanda and Uganda have higher returns on the number of employees. Endowment of raw materials use by the firm is significant in explaining firm size turnover differential in 13 countries, with endowment favouring small-medium sized firms.

Table 4. 7: Summary of mean decomposition of turnover by firm size

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
log of employee		+R, +I		+E			+E
log of ICT capital			+E, +I			+E	+E
log of non-ICT capital		+E	+E, +I	+E	+E		
log of raw materials	+E, -I	+E	+E	+E	+E	+E	+E
sole proprietorship		+R, -I	+E, +R, -I				
sec. education							
voc. education				-R			-R
tertiary education							-R
manufacturing				-E, +R			
construction							+R, +I
formal			+E	+R	+E	+E	+E
semi-formal	+E						+E
management control type						+E, -R, -I	
Variables	**Nigeria**	**Rwanda**	**S. Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
log of employee		+E, -R, -I		+E	+E, -R	+E	
log of ICT capital		+E				+R	+E
log of non-ICT capital	+E	+E		+E		+E	+R, +I
log of raw materials	+E	+E	+E	+E	+E	+E	+R, +I
sole proprietorship							
sec. education							
voc. education							+R, -I
tertiary education		+R, +I					
manufacturing		-E, +R			-E	+R	
construction							
formal	+E	+E	+E	+E	+E	+E	+E, -R, -I
semi-formal						+E	+E, -R, -I
management control type							

Note: (+) Indicates favouring medium sized firms relative to small sized firms.
(-) Indicates favouring small sized firms relative to medium sized firms.
(E) Indicating significant endowment effect.
(R) Show significant return effect.
(I) Indicates significant interaction effect.

Table 4.8 also shows that differences in endowment of employees and non-ICT capital significantly contribute to managerial control type turnover gap in 8 and 10 countries, respectively. Endowment of these factors of production favour firms with a full-time manager. The summary results in Table 4.8 further indicate that firms that employ the services of a full-time manager have relatively high endowment of raw materials compared to their counterparts that employ other form of managerial control in 12 countries. Return to endowment of most of the variable is insignificant in explaining the managerial control type turnover differentials in most countries. Returns to number of employees significantly contributes to the gap in Mozambique, Uganda and Zimbabwe, favouring micro-sized firms. This is similar with return to non-ICT capital endowment. It contributes to the turnover differentials in Ethiopia and Zimbabwe, favouring micro sized firms in Ethiopia and small-medium sized firms in Zimbabwe.

Table 4. 8: Summary of mean decomposition of turnover by management control type

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
log of employee	+E				+E	+E, -R, -I	+E
log of ICT capital	+E, -R, -I	+E	+E		+E	+E	
log of non-ICT capital			+E, -R	+E	+E	+E	
log of raw materials	+E	+E, +R	+E	+E	+E	+E	
sole proprietorship				+E	-R, +I		
sec. education						-R	
voc. education							
tertiary education						-R	
manufacturing							
construction				+E, -R		-R, +I	
formal	+E	+E, -R, -I		+E, -I		+E	+E
semi-formal		+E					
management control type							
Variables	**Nigeria**	**Rwanda**	**S. Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
log of employee	+E			+E	-R	+E	+E, -R, -I
log of ICT capital		+E	+E	+E	+E		+E
log of non-ICT capital	+E	+E		+E	+E	+E	+E, +R, -I
log of raw materials	+E	+E		+E	+E	+E	+E
sole proprietorship					-E, -R,+I		+E
sec. education							
voc. education	-E, +R,-I						-R
tertiary education							-R, -I
manufacturing							
construction		-R, +I					
formal	+E	+E		+E	+E	+E	+R, +I
semi-formal		+E				-R	+R, -I
management control type							

Note: (+) Indicates favouring firms with full time management relative to firms with other form of management control style.
(-) Indicates favouring firms with other form of management control style relative to firms with full time management.
(E) Indicating significant endowment effect.
(R) Show significant return effect.
(I) Indicates significant interaction effect.

3.2 Decomposition of results along the turnover distribution

The principal advantage of quantile decomposition over mean decomposition is that it permits the computation of the differential along the entire distribution rather than only at the mean, which makes quantile decomposition more desirable. The study therefore employs a RIF-OLS quantile decomposition technique proposed by Fortin et al (2011). As discussed under the method section the approach is preferred to other techniques: Machado and Mata (2005) and Melly (2006) as it allows for detail quantile decompositions. Also a general limitation of these two methods is the problem of interpretation as under these approaches only conditional quantile interpretation is valid with quantile regression.

We use two specifications of quantile decomposition to examine the turnover differential across the various groups of firms. The first specification uses RIF and employs the decomposition technique proposed by Fortin et al. (2011). In the second specification, we modify this technique by combining the reweighting technique proposed by DiNardo et al. (1996) and RIF based decomposition method. This deals with possibility of a non-linear relationship that may exist between firm's turnover (dependent variable) and the covariates.

The RIF-reweighting approach requires specification of a reference group, A, to be reweighted as firms in group B. In this respect, the characteristics effect of the decomposition indicates the differentials between explanatory variables of firms in group A and those of firms in group B (the distribution of firms in group A reweighted to look like firms in group B) under the production process of firms in group A (group A's coefficient estimates). That is to say, will turnover of firms in group B be higher or otherwise if they have similar characteristics[47] as firms in group A? Also under this technique, the coefficients or returns effect of the turnover differential indicates the difference between coefficients of group A firms and group B firms (group A firms reweighted to resemble firms in group B) when the endowments of firms in group B are assigned to those in group A. Thus what will the turnover group B firms if they have similar endowment as firms in group A?

[47] Endowment and characteristics are used interchangeably.

We present summary results of decomposition based on both reweighting and RIF technique in the main text and present the detailed results of the two decomposition specifications in the appendix for each of the groupings. The detailed quantile decomposition enables us to assess the contribution of the variables of interest. The discussion of the results is based on the RIF-reweighting technique and it is split into three sections. We discuss results of decomposition by firm's size and managerial control type. The study also presents results and discussion of decomposition by technology type (access to computer and internet).

3.2.1 Quantile decomposition by type of technology

Differences in turnover exist along the turnover distribution between firms with and without access to computers (the internet) across various countries (see Figures 4.1 and 4.2). Figure 4.1 and Figure 4.2 show the kernel density distributions of turnover for firms with and without computer and internet accessibility respectively. The graphs indicate that for all countries there are overlaps at varying points along the turnover distribution for both firms with or without computer (internet) accessibility. Table 4.9 and Table 4.10 present summary results of Oaxaca quantile decomposition by computer and internet accessibility, respectively. The tables indicate that the reweighting errors are insignificant for the 25^{th}, 50^{th} and 75^{th} percentiles implying that the reweighting factor is consistently estimated. The result is similar in the case of the specification errors

At the aggregate level we find that firms with access to computer and internet have relatively high turnover compared to firms with no access to any of these technologies along the entire distribution. Computer accessibility turnover differentials along the entire distribution are significant in all countries, except at the 75^{th} quantile in the case of Ghana. The story is similar in the case of internet accessibility turnover gap, which is positive and significant in most countries with exception of some few (Ghana, South Africa, Tanzania, Uganda and Zambia). The significant internet accessibility turnover gap indicates that firms with internet access have comparatively high turnover along the distribution.

Table 4. 9: Quantile decomposition of turnover by computer accessibility

Variables	Botswana			Cameroon			Ethiopia		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
Computer	12.53**	13.07***	14.30***	12.96***	13.39***	13.96***	15.60***	16.87***	17.54***
	(0.090)	(0.115)	(0.133)	(0.151)	(0.155)	(0.175)	(0.223)	(0.158)	(0.159)
No computer	11.59***	12.40***	12.89***	9.99***	10.73***	12.12***	12.22***	13.01***	14.06***
	(0.169)	(0.172)	(0.163)	(0.119)	(0.116)	(0.144)	(0.143)	(0.118)	(0.199)
Turnover gap	0.941***	0.671***	1.41***	2.97***	2.66***	1.85***	3.377***	3.859***	3.479***
	(0.191)	(0.207)	(0.210)	(0.192)	(0.194)	(0.227)	(0.265)	(0.197)	(0.255)
Characteristics	-0.218	-0.186	0.435*	-1.450***	-1.248***	-1.594***	0.490	0.709***	2.358***
	(0.245)	(0.352)	(0.233)	(0.312)	(0.289)	(0.320)	(0.304)	(0.255)	(0.381)
ICT capital	-0.372**	-0.141	-0.046	-0.612***	-0.0416	-1.045***	-0.204	-0.334***	-0.029
	(0.171)	(0.168)	(0.147)	(0.186)	(0.183)	(0.193)	(0.142)	(0.120)	(0.150)
non-ICT capital	-0.019	-0.012	-0.010	-0.264***	-1.021***	-0.169	0.114	-0.192**	-0.148
	(0.077)	(0.049)	(0.040)	(0.095)	(0.178)	(0.197)	(0.089)	(0.085)	(0.097)
Specification error	4.038	4.241	4.414	5.276	4.476	4.619	11.194	3.477	8.229
	(3.769)	(3.987)	(2.891)	(4.511)	(2.931)	(4.821)	(12.988)	(1.997)	(6.732)
Coefficient	-2.261**	-2.416**	-3.204***	-0.658***	-0.755***	-1.007***	-4.83***	1.95***	-1.890*
	(1.087)	(1.091)	(1.211)	(0.203)	(0.142)	(0.175)	(0.223)	(0.594)	(1.068)
ICT capital	-9.239**	-10.12***	-10.96**	-1.055	-1.829**	1.121**	-2.354	12.29***	4.033
	(3.867)	(3.883)	(4.315)	(0.887)	(0.820)	(0.490)	(2.521)	(2.016)	(3.079)
non-ICT capital	-5.363***	-6.012***	-7.339***	1.321	-0.899	-3.091***	-4.77***	-7.20***	1.734*
	(1.444)	(1.467)	(1.629)	(1.108)	(0.601)	(0.935)	(1.35)	(0.789)	(0.916)
Reweighting error	-0.618	-0.968	-0.235	-0.198	0.187	-0.168	-3.477	-2.277	-5.218
	(0.651)	(1.124)	(0.314)	(0.213)	(0.354)	(0.715)	(2.782)	1.919)	(4.171)
constant	12.00***	13.54***	12.77***	-3.301**	-1.678	-1.253	7.952***	-15.36***	-6.933*
	(4.180)	(4.205)	(4.672)	(1.677)	(1.119)	(1.290)	(2.941)	(2.448)	(3.806)

	Ghana			Mozambique			Namibia		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
Computer	13.10***	14.43***	16.43***	13.04***	14.28***	14.53***	13.18***	13.75***	14.13***
	(0.193)	(0.199)	(0.459)	(0.168)	(0.138)	(0.109)	(0.163)	(0.139)	(0.117)
No computer	11.96***	13.53***	15.64***	11.79***	12.87***	13.44***	11.68***	12.95***	13.68***
	(0.197)	(0.165)	(0.343)	(0.158)	(0.118)	(0.111)	(0.161)	(0.109)	(0.119)
Turnover gap	1.139***	0.898***	0.790	1.25***	1.41***	1.09***	1.49***	0.794***	0.452***
	(0.276)	(0.258)	(0.573)	(0.230)	(0.182)	(0.155)	(0.229)	(0.177)	(0.167)
Characteristics	-0.033	1.059***	-1.292**	0.131	0.291	0.131	-0.509*	-1.267***	-0.828***
	(0.458)	(0.328)	(0.536)	(0.394)	(0.266)	(0.394)	(0.305)	(0.201)	(0.225)
ICT capital	-0.858***	-0.230	-1.688***	-0.226*	-0.073	-0.145**	0.545**	-0.243	-0.418**
	(0.263)	(0.171)	(0.277)	(0.124)	(0.076)	(0.06)	(0.232)	(0.149)	(0.162)
non-ICT capital	0.027	0.021	0.030	0.184**	0.031	-0.032	0.036	0.026	0.059
	(0.050)	(0.0374)	(0.054)	(0.082)	(0.041)	(0.031)	(0.052)	(0.037)	(0.085)
Specification error	1.736	0.717	4.440	1.152	-0.311	0.564	2.118	1.710	-0.129
	(1.251)	(0.587)	(2.967)	(0.871)	(0.451)	(0.395)	(1.471)	(1.281)	(0.861)
Coefficient	-0.005	-0.736***	-0.863*	0.934***	1.75***	0.934***	0.873***	1.05***	1.09***
	(1.293)	(0.183)	(0.455)	(0.293)	(0.217)	(0.293)	(0.232)	(0.212)	(0.192)
ICT capital	-29.99***	-1.230	-.163***	2.492**	1.239	-0.812	0.025	1.444**	0.667
	(5.734)	(0.943)	(1.741)	(1.150)	(0.810)	(0.746)	(0.736)	(0.589)	(0.505)
non-ICT capital	-9.633***	-0.445	-0.497	1.745**	2.18***	-0.048	-0.907**	-1.903***	-1.841***
	(2.314)	(0.479)	(0.924)	(0.738)	(0.509)	(0.464)	(0.463)	(0.388)	(0.361)
Reweighting error	-0.559	-0.142	-1.495	-0.967	-0.320	-0.539	-0.992	-0.699	0.319
	(0.431)	(0.231)	(1.214)	(0.723)	(0.251)	(0.467)	(0.751)	(0.818)	(0.228)
constant	21.39***	-6.333***	4.400	-1.008	-1.801	0.913	-2.641**	-1.006	-0.350
	(7.991)	(1.975)	(3.897)	(1.957)	(1.360)	(1.250)	(1.114)	(0.886)	(0.761)

Note: Positive values favour firms with computer access and negative values favours firms with no computer access. Bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All specifications include control variables and the detail tables are presented in Appendix Tables A-4B.1 to A-4B.14

Table 4.9 continues …

Variables	Nigeria			Rwanda			South Africa		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
computer	15.29***	17.78***	18.28***	13.42***	16.41***	16.43***	15.20***	16.07***	17.71***
	(0.541)	(0.123)	(0.123)	(0.279)	(0.137)	(0.099)	(0.183)	(0.179)	(0.198)
no computer	10.57***	11.76***	13.81***	11.75***	13.48***	15.48***	11.58***	12.57***	14.42***
	(0.151)	(0.181)	(0.227)	(0.129)	(0.300)	(0.109)	(0.219)	(0.199)	(0.167)
turnover gap	4.714***	6.021***	4.468***	1.667***	2.931***	0.953**	3.622***	3.504***	3.291***
	(0.561)	(0.218)	(0.258)	(0.307)	(0.330)	(0.147)*	(0.286)	(0.268)	(0.259)
characteristics	0.614**	1.020***	2.101***	1.475***	3.004***	0.565***	0.712***	0.524**	0.203
	(0.257)	(0.290)	(0.325)	(0.336)	(0.591)	(0.173)	(0.241)	(0.235)	(0.224)
ICT capital	0.325	-0.463**	-0.174	-0.199	-0.795	-0.908***	0.347**	-0.067	0.056
	(0.200)	(0.214)	(0.144)	(0.380)	(0.609)	(0.152)	(0.176)	(0.116)	(0.083)
non-ICT capital	0.0711	-0.244	0.043	0.327	-0.936	0.268*	0.233*	0.141*	0.073
	(0.166)	(0.179)	(0.120)	(0.368)	(0.590)	(0.141)	(0.123)	(0.0832)	(0.056)
specification error	4.129	0.945	6.192	-0.656	-0.554	-0.647	3.301	0.886	-7.488
	(3.761)	(6.817)	(3.922)	(0.428)	(0.597)	(0.876)	(1.891)	(1.231)	(2.13)
coefficient	0.396	2.559***	-2.588***	-0.588	-0.873***	0.488***	1.627***	3.46***	-4.217***
	(0.932)	(0.227)	(0.227)	(0.455)	(0.121)	(0.096)	(0.339)	(0.584)	(0.245)
ICT capital	-16.04***	1.233***	-1.233***	3.488	-1.728	1.327	-4.830***	3.958**	-1.766***
	(2.696)	(0.396)	(0.396)	(3.513)	(1.431)	(1.553)	(0.925)	(1.584)	(0.471)
non-ICT capital	10.95***	-4.300***	4.300***	-3.421	1.136	-1.962**	2.358**	-1.268	2.216***
	(2.693)	(0.464)	(0.464)	(2.171)	(0.786)	(0.851)	(1.075)	(1.659)	(0.688)
reweighting error	-0.425	1.497	-1.237	0.124	0.246	0.547	-2.018	-1.366	-0.183
	(0.374)	(0.915)	(1.019)	0.562)	(0.321)	(1.082)	(1.731)	(0.915)	(0.131)

	Tanzania			Uganda			Zambia		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
computer	12.20***	12.62***	14.65***	15.57***	15.08***	15.57***	12.50***	13.70***	15.29***
	(0.149)	(0.187)	(0.248)	(0.109)	(0.163)	(0.109)	(0.165)	(0.231)	(0.171)
no computer	10.67***	11.70***	13.00***	13.51***	12.95***	13.51***	10.31***	11.20***	12.06***
	(0.138)	(0.200)	(0.157)	(0.096)	(0.088)	(0.096)	(0.143)	(0.131)	(0.154)
turnover gap	1.533***	0.923***	1.659***	2.056***	2.133***	2.056***	2.191***	2.502***	3.228***
	(0.204)	(0.274)	(0.293)	(0.146)	(0.186)	(0.146)	(0.218)	(0.266)	(0.230)
characteristics	0.629	0.434	-0.920*	0.058	-0.305**	-0.293*	0.005	-0.035	-0.501**
	(0.567)	(0.646)	(0.503)	(0.192)	(0.150)	(0.157)	(0.232)	(0.209)	(0.212)
ICT capital	1.144***	0.490	-0.079	0.059	0.129*	0.0178	0.223**	0.152	-0.406***
	(0.362)	(0.400)	(0.309)	(0.089)	(0.069)	(0.073)	(0.101)	(0.094)	(0.119)
non-ICT capital	-0.057	-0.155*	-0.174*	-0.046	-0.024	-0.082**	-0.060	-0.007	0.013
	(0.045)	(0.085)	(0.089)	(0.033)	(0.022)	(0.041)	(0.050)	(0.015)	(0.020)
specification error	0.073	0.340	2.391	4.018	3.500	3.016	2.264	3.755	3.294
	(1.024)	(0.512)	(1.325)	(2.919)	(0.891)	(1.996)	(2.641)	(2.553)	(2.723)
coefficient	1.492***	1.510***	1.603***	-0.656**	0.126	0.428	2.123***	0.921***	2.210***
	(0.149)	(0.185)	(2.015)	(0.306)	(0.304)	(0.262)	(0.403)	(0.355)	(0.462)
ICT capital	2.508*	3.469**	2.347***	-0.396	-9.518***	-5.773***	6.427***	8.498***	1.866
	(1.424)	(1.617)	(0.548)	(1.602)	(1.448)	(1.139)	(1.667)	(1.576)	(1.419)
non-ICT capital	0.274	0.568	-1.059***	6.449***	2.103	0.183	1.811	1.711	5.932***
	(0.535)	(0.606)	(0.094)	(1.795)	(1.398)	(0.884)	(1.269)	(1.092)	(1.184)
reweighting error	-0.661	-1.361	-1.415	-1.364	-1.188	-1.095	-2.201	-2.139	-1.775
	(0.781)	(0.915)	(1.210)	(0.982)	(0.786)	(0.875)	(1.812)	(1.785)	(1.302)

Note: Positive values favour firms with computer access and negative values favours firms with no computer access. Bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All specifications include control variables and the detail tables are presented in Appendix Tables A-4B.1 to A-4B.14

The results also show the lack of significant difference in the internet accessibility turnover gap at 25th percentile for firms in Ghana (see Table 4.10). This finding is in contrast to the computer accessibility gap which is significant at the 25th percentile in Ghana (see Table 4.9). It is interesting to note that at the 75th percentile computer accessibility turnover gap is not significant for firms operating in Ghana however, at the same percentile internet accessibility turnover gap is negative and significant. This indicates that firms with no internet have higher turnovers relative to firms with internet at the upper end of the distribution. Furthermore, we find no evidence to show significant difference in internet accessibility turnover gap in Tanzania and Zambia at the median (see Table 4.10). We also find no statistical significant difference in turnover between firms with internet access and those without access to the technology at the 75th percentile in South Africa, Tanzania and Uganda. In summary, the evidence suggests that there are significant differentials in turnover of firms with access to the technology and those without access at least at one point of the distribution. Firms with access to the technologies have relatively high turnover compare to firms with no access to these technologies.

The source of internet and computer accessibility turnover gaps along the distribution appears to be consistent for most countries. However, in a few countries there is the lack of a clear pattern as to which component (endowment or returns to endowment) is responsible for the gaps. The results suggest internet accessibility turnover gap (Table 4.10) is largely attributable to difference in returns to characteristics (coefficient) in Botswana, Ethiopia, Ghana, Rwanda, Tanzania and Zimbabwe. Interestingly, though firms with access to internet in Botswana have better endowments, however, after controlling for difference in these endowments returns to characteristics remain positive and significant. This implies the presence of unexplained internet turnover gap along the distribution. By contrast, in Cameroon differences in firm's endowment is largely responsible for the gap as firms with internet access have significantly greater endowment than firms with no internet access. After controlling for differences in endowment we find no unexplained component of internet turnover gap along the distribution.

Table 4. 10: Quantile decomposition of turnover by internet accessibility

Variables	Botswana			Cameroon			Ethiopia		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
internet	13.30***	14.28***	14.58***	12.79***	13.19***	14.39***	15.66***	16.94***	17.72***
	(0.311)	(0.149)	(0.146)	(0.208)	(0.259)	(0.453)	(0.257)	(0.193)	(0.193)
no internet	12.23***	12.61***	12.92***	11.02***	12.63***	13.67***	12.68***	13.38***	15.99***
	(0.066)	(0.068)	(0.065)	(0.208)	(0.153)	(0.108)	(0.115)	(0.141)	(0.153)
turnover gap	1.067***	1.674***	1.661***	1.768***	0.566*	0.720	2.984***	3.556***	1.730***
	(0.318)	(0.164)	(0.160)	(0.294)	(0.301)	(0.466)	(0.282)	(0.239)	(0.246)
characteristics	0.402***	0.315***	0.257***	2.714***	2.036***	0.992***	-2.711***	-1.585***	-2.537***
	(0.098)	(0.100)	(0.094)	(0.359)	(0.248)	(0.157)	(0.443)	(0.508)	(0.416)
ICT capital	0.126	-0.083	-0.094	1.684***	1.061***	0.516***	0.126	0.267	0.427**
	(0.078)	(0.080)	(0.075)	(0.317)	(0.207)	(0.111)	(0.207)	(0.238)	(0.188)
non-ICT capital	0.154**	0.200***	0.239***	0.938***	0.499***	-0.240***	0.0002	-0.006	-0.003
	(0.062)	(0.066)	(0.065)	(0.264)	(0.170)	(0.092)	(0.002)	(0.026)	(0.013)
specification error	1.067	2.451	2.693	0.341	-0.176	1.451	6.858	8.954	6.524
	(0.871)	(1.541)	(3.111)	(0.261)	(0.312)	(1.611)	(7.213)	(5.972)	(4.891)
coefficient	0.553*	1.193***	1.396***	-0.077	-0.229	0.583	5.215***	6.165***	6.620***
	(0.303)	(0.150)	(0.196)	(0.248)	(0.273)	(0.434)	(0.258)	(0.194)	(0.194)
ICT capital	6.677***	3.466***	6.832***	-6.421***	-4.754***	7.183*	6.464**	-5.637***	-5.637***
	(2.021)	(0.845)	(0.919)	(1.706)	(1.338)	(3.821)	(2.917)	(1.870)	(1.870)
non-ICT capital	-0.818	-1.966***	-0.705	2.450**	4.375***	2.928	5.959***	0.339	0.339
	(1.596)	(0.738)	(0.807)	(1.151)	(0.922)	(2.560)	(1.627)	(1.042)	(1.042)
reweighting error	-0.151	-0.101***	-0.107	1.364	1.523	1.139	-4.052	-2.352	-4.363
	(0.641)	(0.012)	(0.284)	(0.893)	1.342)	(0.765)	(3.617)	(1.775)	(3.541)

	Ghana			Kenya			Mozambique		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
internet	13.07***	14.51***	14.79***	12.70***	13.25***	14.23***	13.30***	14.35***	14.39***
	(0.246)	(0.221)	(0.207)	(0.152)	(0.167)	(0.238)	(0.240)	(0.155)	(0.126)
no internet	12.75***	13.80***	16.07**	11.72***	12.36***	13.06***	12.06***	13.09***	13.49***
	(0.156)	(0.156)	(0.270)*	(0.112)	(0.095)	(0.010)	(0.167)	(0.105)	(0.095)
turnover gap	0.313	0.707***	-1.283***	0.975***	0.894***	1.170***	1.242***	1.258***	0.899***
	(0.292)	(0.271)	(0.340)	(0.189)	(0.192)	(0.258)	(0.293)	(0.187)	(0.158)
characteristics	0.165	-0.315	-0.445	0.226	0.403***	0.357***	0.367	0.096	0.602***
	(0.198)	(0.205)	(0.335)	(0.148)	(0.123)	(0.132)	(0.246)	(0.156)	(0.132)
ICT capital	-0.100*	-0.127**	-0.347***	-0.041	0.056	0.078	-0.182	-0.199**	0.379***
	(0.059)	(0.049)	(0.112)	(0.097)	(0.088)	(0.103)	(0.150)	(0.082)	(0.085)
non-ICT capital	-0.143**	-0.144***	-0.154**	-0.024	-0.033	-0.045	0.245**	0.051	-0.248***
	(0.065)	(0.052)	(0.074)	(0.027)	(0.038)	(0.051)	(0.114)	(0.058)	(0.065)
specification error	-0.025***	-1.383	-1.546	0.419	0.015***	1.544	2.103	3.001	0.325
	(0.005)	(0.896)	(1.123)	(0.342)	(0.006)	(1.087)	(1.657)	(2.054)	(0.431)
coefficient	0.499**	-1.540***	0.180	0.105	-0.027	1.056***	0.920***	1.605***	0.162
	(0.246)	(0.273)	(0.461)	(0.159)	(0.166)	(0.233)	(0.271)	(0.256)	(0.222)
ICT capital	0.975	1.388*	1.780*	0.514	3.707***	-3.157**	1.456	3.499***	3.412***
	(0.956)	(0.833)	(0.930)	(1.327)	(1.370)	(1.598)	(1.483)	(1.097)	(1.083)
non-ICT capital	1.379*	-0.592	-5.732***	-1.915	-2.575*	2.793*	1.095	2.349***	-1.214*
	(0.720)	(0.627)	(0.766)	(1.332)	(1.369)	(1.594)	(0.818)	(0.693)	(0.664)
reweighting error	-0.672	-0.865	-0.888	-0.435	-0.449	-0.325	0.308	0.234	-0.134
	(0.521)	(0.765)	(0.651)	(0.557)	(0.378)	(0.257)	(0.542)	(0.324)	(0.245)

Note: Positive values favour firms with internet access and negative values favours firms without internet access. Bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All specifications include control variables and the detail tables are presented in Appendix Tables in A-4C.1 to A-4C.14

Table 4.10 continued …

Variables	Nigeria			Rwanda			South Africa		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
internet	14.26***	15.38***	15.58***	15.03***	15.56***	15.92***	15.16***	16.06***	17.77***
	(1.110)	(0.152)	(0.174)	(0.153)	(0.153)	(0.263)	(0.187)	(0.205)	(0.233)
no internet	14.54***	17.76***	18.27***	11.86***	13.29***	16.43***	13.94***	17.17***	18.03***
	(0.704)	(0.063)	(0.063)	(0.145)	(0.161)	(0.130)	(0.313)	(0.376)	(0.107)
turnover gap	0.278	2.376***	2.690***	3.165***	2.271***	-0.514*	1.217***	-1.105***	-0.261
	(1.315)	(0.165)	(0.185)	(0.211)	(0.222)	(0.293)	(0.365)	(0.428)	(0.256)
characteristics	9.313***	2.568***	1.267***	0.218	-0.132	-0.499***	-2.741***	-5.530***	-1.501***
	(0.944)	(0.798)	(0.065)	(0.226)	(0.244)	(0.184)	(0.478)	(0.532)	(0.132)
ICT capital	8.710***	0.280***	0.280***	-0.009	-0.089	0.340***	0.351**	0.382***	0.056*
	(1.405)	(0.039)	(0.039)	(0.091)	(0.080)	(0.082)	(0.153)	(0.137)	(0.029)
non-ICT capital	0.718	0.084***	0.084***	0.048	0.008	-0.029	-0.176	-0.046	-0.050
	(0.877)	(0.025)	(0.025)	(0.045)	(0.032)	(0.027)	(0.120)	(0.057)	(0.032)
specification error	-8.487	-1.063	1.232	5.161	4.696	-0.624	5.730	3.716	-0.625
	(6.219)	(0.897)	(1.091)	(3.543)	(3.412)	(0.567)	(3.786)	(2.534)	(1.105)
coefficient	1.193	-1.271*	0.175	-2.175***	-2.554***	-1.341***	0.630**	2.510***	1.867***
	(0.989)	(0.668)	(0.626)	(0.489)	(0.434)	(0.460)	(0.315)	(0.371)	(0.330)
ICT capital	1.392	-0.221	-8.961***	-0.862	-0.467	1.930	-5.236***	-0.035	1.039
	(2.795)	(0.890)	(0.897)	(1.464)	(1.434)	(2.864)	(1.266)	(1.369)	(1.385)
non-ICT capital	-1.232	-7.375***	2.895***	0.495	0.176	-1.220	1.420	5.779***	1.304
	(5.028)	(1.214)	(1.028)	(0.955)	(0.782)	(1.490)	(0.939)	(0.955)	(1.024)
reweighting error	-1.741	0.016***	0.016**	-0.039	0.261	0.702	-2.402	-1.801	-0.002
	(1.049)	(0.005)	(0.008)	(0.076)	(0.412)	(0.643)	(1.765)	(1.481)	(0.123)

	Tanzania			Uganda			Zambia		
	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q	25th Q	50th Q	75th Q
internet	11.81***	12.54***	13.75***	13.44***	14.40***	15.05***	12.52***	13.11***	14.15***
	(0.306)	(0.320)	(0.694)	(0.428)	(0.164)	(0.169)	(0.168)	(0.187)	(0.152)
no internet	10.93***	12.19***	13.36***	12.66***	13.43***	15.31***	11.79***	13.01***	15.73***
	(0.164)	(0.132)	(0.249)	(0.091)	(0.118)	(0.107)	(0.175)	(0.206)	(0.097)
turnover gap	0.875**	0.347	0.385	0.777*	0.971***	-0.257	0.726***	0.102	-1.588***
	(0.347)	(0.347)	(0.737)	(0.437)	(0.202)	(0.200)	(0.242)	(0.278)	(0.180)
characteristics	0.919	0.079	-0.084	-1.24***	-0.678*	0.894***	-0.893**	-1.978***	-1.199***
	(0.609)	(0.439)	(0.797)	(0.311)	*(0.329)	(0.314)	(0.352)	(0.375)	(0.148)
ICT capital	0.829**	0.389	0.522	-0.161	-0.346*	1.297***	-0.081	-0.135**	0.059**
	(0.410)	(0.293)	(0.529)	(0.174)	(0.179)	(0.180)	(0.059)	(0.061)	(0.025)
non-ICT capital	0.131	0.125	0.014	0.007	-0.164***	-0.076**	-0.116	-0.419**	-0.094**
	(0.140)	(0.100)	(0.180)	(0.025)	(0.060)	(0.036)	(0.085)	(0.165)	(0.043)
specification error	-0.751	-0.467	-2.747	2.093	0.696	-3.446	3.041	3.116	1.788
	(0.561)	(1.003)	(3.685)	(1.934)	(1.602)	(2.344)	(2.197)	(2.044)	(1.566)
coefficient	0.480*	0.909***	1.821***	0.958**	1.607***	1.944***	-0.456	0.008	-1.599***
	(0.275)	(0.266)	(0.651)	(0.405)	(0.149)	(0.155)	(0.313)	(0.228)	(0.408)
ICT capital	7.259***	0.892	4.592	2.597	2.074**	-1.032***	1.810	2.803**	-1.401
	(2.471)	(1.709)	(5.573)	(2.270)	(0.893)	(0.199)	(1.773)	(1.386)	(1.438)
non-ICT capital	-0.718	-1.623	21.24***	1.947	0.862	0.239	0.526	0.315	6.740***
	(2.773)	(1.926)	(6.277)	(3.539)	(1.381)	(0.251)	(1.170)	(0.862)	(1.020)
reweighting error	0.227	-0.174	1.395	-1.041	-0.654	0.351	-0.966	-1.044	-0.578
	(0.342)	(0.351)	(0.987)	(0.875)	(0.543)	(0.636)	(1.251)	(0.891)	(0.539)

Note: Positive values favour firms with internet access and negative values favours firms without internet access. Bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All specifications include control variables and the detail tables are presented in Appendix Tables A-4C.1 to A-4C.14

The results also show inconsistency across the distribution in Mozambique and South Africa. In Mozambique, the differential is largely due to difference in endowment of firms at the upper end of the distribution, however at the median and lower tail returns to endowment is mainly accountable for the differential. Furthermore, though

the results suggest there is no difference in endowment at the lower tail and median of the distribution, in Mozambique returns favour firms with access to internet. By contrast, in the case of South Africa, at both lower end and median of the distribution internet accessibility turnover gap is largely attributable to difference in endowment while differences in return to firms' resources is largely responsible for the gap at the upper tail.

Table 4.10 shows that for South Africa and Ethiopia, firms with internet access have greater endowment compared to firms with no internet access, as the characteristics effect is generally significant and negative along the distribution. However, the returns to endowment favour firms with internet access, after accounting for differences in endowment. This finding suggests the presence of unexplained factors why firms with internet have higher turnover than firms with no internet access.

Turning to computer accessibility differential, Table 4.9 shows that differences in returns to endowments (coefficient) largely accounts for this differential in Botswana, Mozambique, Rwanda, Tanzania and Zambia. Conversely, for Cameroon and Ghana differences in endowment of firms is mainly responsible for the computer accessibility turnover gap along the distribution. Firms with computer access in Nigeria and Rwanda have better endowment of resources at all points along the distribution. The situation is similar for firms in Ethiopia (characteristic effect is significant at the median and 75^{th} percentile) and South Africa (significant at 25^{th} percentile and the median). By contrast, characteristic effects favour firms with no computer access along the distribution in Cameroon and Namibia.

After controlling for differences in endowments, which favours firms with no computer accessibility in Cameroon returns to characteristics continue to favour these firms (see Table 4.9). This suggests that there remains an unexplained component of computer accessibility turnover gap along various points of the distribution. Similarly, even after accounting for differences in endowment, which favours firms with computer access in Mozambique, returns to characteristics is positive and significant indicating existence of unexplained factors contributing to the computer accessibility turnover gap. While the characteristics effect along the distribution is generally negative and significant, indicating that firms with no access

to computer have better endowments in Namibia, the return on these endowments is positive and significant, indicating that in spite endowment favouring firms with no computer access the returns are high for firms with computer accessibility.

The detailed decomposition results give further insight by capturing the influence of each of the individual covariates on both characteristics and coefficient effects in the estimated quantile turnover equation. Here we concentrate our attention on the variable of interest, ICT capital stock and non-ICT capital. Beginning with the computer accessibility turnover gap, the results suggest that there is no clear pattern in the influence of our variable of interest, ICT capital, on the characteristics effect in most of the country except in Cameroon, Ghana, Mozambique, Namibia and Zambia. For Cameroon, Ghana and Mozambique the results suggest that firms with no access to computers have higher levels of ICT capital, especially at the lower and upper tails of the distribution as the characteristic effects are negative and significant at these points of the distribution. More interestingly, in the case of Ghana after accounting for ICT capital endowment differences the return to ICT capital remain negative and significant at the lower and upper tails of the distribution. This implies that firms with no computer access earn higher returns on their other forms of information and communication technologies. These negative and significant coefficient effects at the lower and upper tail of the distribution in addition to that of the characteristic effects suggest the presence of unexplained factors contributing to the computer turnover gap.

4. Conclusion

This Chapter analyses turnover differential across various groups of firms, focusing on contribution of ICT capital to the differentials in each of the countries. The various groups of firms analysed include SME size, management control type, firm's access to computer and Internet. Turnover differential is estimated for fourteen countries: Botswana, Cameroon, Ethiopia, Ghana and Kenya Mozambique, Namibia, Nigeria, Rwanda, South Africa Tanzania, Uganda, Zambia and Zimbabwe.

Using a cross-sectional firm level data on sampled African countries we estimate turnover differentials looking beyond the mean values and also estimates the differentials along the various sections of the distribution. In this regard, we applied a

novel technique proposed by Fortin et al (2011) to estimate turnover differentials at different points of the distribution of turnover for each country and income groupings. The Fortin et al (2011) approach is more appealing as it enables us to estimate the contribution of the various covariates to both endowments and returns to endowments components of turnover differential.

Firms with computer and internet accessibility tend to employ relatively high levels of ICT capital compared to their counterparts with no access to these technologies in nine of the sampled countries with lack of significant difference in ICT capital endowment across the remaining five countries. Our finding suggests that if firms with no access these technologies are endowed with similar technologies they are likely to increase their turnover in these nine countries, thus underlying the importance of computer and internet accessibility to firms in these countries. Return to ICT capital among firms in most countries does not contribute to computer accessibility turnover differential, except for firms in Cameroon, Ethiopia and Zambia. Similarly, returns to ICT capital endowment do not contribute to internet accessibility turnover differential in all the countries except for Zambia, in which if firms with no internet access are equipped with the technology will increase their turnover. This would be made possible by increasing returns on ICT capital.

The chapter explores in detail each of the decomposition analyses by assessing these differentials beyond the mean and along the distribution using a quantile decomposition approach. Decomposition of turnover along the distribution shows a clear pattern of the contribution of ICT capital to technology (Internet and computer) accessibility turnover gap across the countries. However, firms with access to these technologies have comparatively high turnover but the returns do not necessarily favour these firms. Actually, returns to endowment of these technologies differ across countries and the distribution.

Overall the general deduction that could be drawn from this chapter is there is the existence of a clear pattern of turnover gap at the mean of the distribution, which is attributable to contribution of ICT capital. However, along the distribution there is no clear trend as to the contribution of ICT capital to turnover differentials across the various countries.

CHAPTER 5 – CONCLUSIONS

1 Introduction

Increased competition in the modern economy has driven firms to search for increased efficiency, as well as an increased access to information. This, in conjunction with the continual advancement in ICTs, and coupled with falling prices, has inspired firms to adopt different types of ICTs in order to be competitive. This has heightened and provoked research interest in the effectiveness of ICT at the firm level. However, most studies of ICT usage and firm development focus on developed economies, with mainly anecdotal evidence on many developing countries. There is a lack of empirical evidence on factors motivating the adoption, usage and the contribution of ICT to firms' turnover in developing countries including SSA. The thesis therefore focuses on an increasingly essential area of research, and contributes to the existing literature by furthering the understanding of adoption of ICT, returns to ICT and the variation of ICT contribution to the turnover of various types of firms in Africa. This thesis uses data collected on 3,996 SMEs across 14 selected SSA countries. The data allow us to look at the adoption of two types of ICT facilities: computers and the Internet. The data also enable us to assess the effect of ICT on SMEs' turnover and the technical efficiency of SMEs in SSA. In addition, we are able to examine variations in returns to ICT across various groups of SMEs.

2 Summary of major findings

The economies of countries in SSA share some similar characteristics; notably, a large and vibrant informal sector predominantly consisting of small firms. In spite of these similarities, the findings of the thesis indicate that the factors that influence the adoption decisions of SMEs vary significantly across countries in SSA. However, using a meta-analysis technique we identify common determinants of ICT adoption across the selected countries. These determinants are weighted averages and they are consistent across the countries. We find that SMEs owned by individuals with tertiary education are more like to adopt both computers and internet relative to SMEs owned by individuals with lesser educational qualifications. Our findings suggest that SMEs are more likely to adopt computers and the internet if a high percentage of SMEs in their industrial sector have a high penetration of computers and internet usage.

With respect to the relationship between ICT capital and SMEs' turnover, our finding is in line with evidence from developed countries. The finding indicates that ICT capital has a positive and significant association with the turnover of SMEs in 11 of the selected countries. We find that returns to ICT capital vary considerably across the countries and it is greater than returns to non-ICT capital in most countries. The results further reveal that South African firms have the highest return to ICT capital. The thesis also finds that SMEs operate at very low technical efficiency level in most of the countries, except South Africa. This is in spite of ICT adoption having a positive and significant effect on technical efficiency of firms in Africa.

There is a considerable variation in returns to ICT adoption across SSA countries. SMEs operating in LICs have relatively high returns to ICT compared to their counterparts in LMICs. This indicates that SMEs in LICs may have greater ability in using ICT capital. By contrast, there are no significant differences in returns to ICT capital when we compare SMEs in UMICs to those in LICs. The thesis also examines the contribution of differences in return to ICT to turnover differential between SMEs with access to computer and Internet and those with no access. Our results indicate that SMEs using either computers or the Internet have relatively high return to ICT capital compared to SMEs with no access to these technologies.

3 Limitations of the research

The study uses a cross-sectional dataset, which does not allow us to analyse ICT adoption, effect of usage and variation in returns over a time period. This limitation of the data does not allow the exploration of causal relationships between ICT adoption and SMEs' turnover across the selected countries. Using multiple instrumental variables is desirable in dealing with endogeneity problems; however, the study could find only one instrument for ICT capital (which is a 12 months lag of ICT capital). Also, the survey only collected information on SMEs located in the capital cities and two other economically active cities of the selected countries. This implies the need to exercise caution when generalising the results to reflect the entire country.

The study further acknowledges that other factors may influence adoption of ICT, as well as technical efficiency of firms, which are not captured in this study due to data

limitations. This is largely due to a limitation of the dataset. The turnover of firm is used as a proxy for measuring the firm's output. This approach has its limitations, and deflating turnover by a price deflator would have been more desirable. However, the data have no information on prices. Nonetheless, Kettle and Grilliches (1996) show that the use of deflated sale/turnover as a proxy for real output has a tendency to create a downward bias in the scale estimate derived from the production function regression.

4 Policy implications

The thesis finds the presence of the epidemic effect of technology diffusion among SMEs in SSA, implying that an increased number of SMEs using ICT influences rival firm's decisions to adopt the technology. This requires policymakers to embark on efficient and effective public policy interventions to promote ICT usage among SMEs so as to speed up the diffusion process. The design of technologically oriented policies, providing improved and efficient ICT infrastructure, will reduce the cost of ICT leading to an increase in adoption rates across SSA.

The review of the literature and the empirical evidence from this thesis shows substantial differences in the effect of ICTs on turnover. Furthermore, there are considerable differences in the contribution of returns to ICT adoption to turnover differentials across various types of firms. These differences imply that some SMEs lag behind in their adoption of ICT, and productivity gains from adoption. This may call for governments in SSA to provide support to SMEs in their adoption of ICT.

The presence of highly skilled human resources influences the adoption decision of SMEs in SSA countries and it is important for SMEs to provide technical training programmes that enhance the technical skills of its employees in the use of ICT. This support will improve the quality of human capital, which will help to accelerate the adoption of ICT and assist SMEs to fully realise the potential for productivity gains from ICT adoption in these countries. SMEs in SSA are constrained in terms of productive resources and they must considerably improve their technical efficiency if they are to be competitive in the global market. The thesis shows that SMEs in countries such as South Africa have the highest return to ICT adoption as well as being the most technically efficient compared to SMEs in the other selected

countries. This suggests that technical efficiency among SMEs could probably increase if more attention is given to investment in ICTs.

5 Future research

Due to reliance on cross-section data, the study models the decision of ICT adoption and usage, as well as its effect on turnover and technical efficiency as time invariant. This research therefore does not capture the time dimension, which is critical for the ICT diffusion process. It would be desirable to collect and analyse longitudinal data to examine dynamic aspects of the issues analysed in this thesis. Given the limitation of the data the thesis examines the effect of ICT adoption on technical efficiency only. We recommend further research on the effect of ICT adoption on allocative efficiency of firms.

Disaggregation of ICT into various types and examining possible differences in their impact on turnover is recommended for future studies. The disaggregation of ICT into various parts will give more insight with regard to the effect that each ICT component has on turnover. Unfortunately, limitations in the data prevent the current research from estimating the effect of various types ICT on turnover. Furthermore, most empirical studies have overlooked intra-firm ICT adoption effects on performance. We recommend research to address the issue of intra-firm ICT adoption and productivity in Africa. We further recommend studies that examine the complementarity of ICT, such as organisational restructuring, and its effect on firms' performance in Africa.

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APPENDIX

Appendix 1: SME e-Access and Usage survey questionnaire

MODULE 1: QUESTIONNAIRE IDENTIFICATION AND INTERVIEWER VISITS			
Q.1 QUESTIONNAIRE NUMBER		**Q.2 INTERVIEWER ID:**	
Q.3 COUNTRY NAME	**1 = BOTSWANA** **2 = CAMEROON** **3 = ETHIOPIA** **4 = GHANA** **5 = KENYA**	**6 = MOZAMBIQUE** **7 = NAMIBIA** **8 = NIGERIA** **9 = RWANDA** **10 = SENEGAL**	**11 = SOUTH AFRICA** **12 = TANZANIA** **13 = UGANDA** **14 = ZAMBIA** **15 = ZIMBABWE**
Q.4 BUSINESS NAME, CONTACT DETAILS			
Q.5 NAME OF PERSON INTERVIEWED AND POSITION:			
INTERVIEWER TO COMPLETE THE FOLLOWING FOR EACH VISIT AND THE SUPERVISOR TO COMPLETE THE CHECK BACK			

VISIT 1		*VISIT 2*		*FINAL VISIT*		*CHECK BACK Country Manager*	
DAY		**DAY**		**DAY**		**DAY**	
MONTH		**MONTH**		**MONTH**		**MONTH**	
***RESULT Q.6.1**		***RESULT Q.6.2**		***RESULT Q.6.3**		**FINDING Q.7**	
1 = completed, 2 = unavailable, 3 = postponed, 4 = refused, 5 = partly completed						1 = interview acceptable in-field 2 = interview acceptable in-office 3 = interview need further visit 4 = interview to be rejected	

OFFICE ADMINISTRATION				
INTERVIEWER	**FIELD SUPERVISOR**	**COUNTRY MANAGER**	**CODERS**	**DATA CAPTURER**
Date of completion ____ / ____ /2005 dd mm yy	Date of completion ____ / ____ /2005 dd mm yy	Date of completion ____ / ____ /2005 dd mm yy	Date of completion ____ / ____ /2005 dd mm yy	Date of completion ____ / ____ /2005 dd mm yy
Signature	Signature	Signature	Signature	Signature

MODULE 2: BUSINESS INFORMATION				
D.1FORM OF OWNERSHIP?	1 = Sole proprietor, 2 = Partnership 3 = Close corporation, 4 = Business (Pty limited), 5 = Other (Specify):			
D.2 PLEASE DESCRIBE IN A FEW WORDS THE MAIN ACTIVITY OF YOUR ENTERPRISE :				
D.3 IS YOUR BUSINESS REGISTERED WITH THE RECEIVER OF REVENUES? (PAY TAX?)	0 = No 1 = Yes			
D.4 IS YOUR BUSINESS REGISTERED FOR VAT?	0 = No 1 = Yes			
D.5 IN WHAT YEAR WAS THIS BUSINESS ESTABLISHED?				
D.6 HOW MANY EMPLOYEES DOES YOUR BUSINESS HAVE (EXCL. OWNERS)?	A: Full-time:	B: Part-time:	C: On Commission:	
D.7 HOW MANY OWNERS DOES YOUR BUSINESS HAVE?	A: Men:	B: Women		
D.8 IS THIS BUSINESS OWNED BY FAMILY?	0 = No 1 = Yes			
D.9 WHO MANAGES THE BUSINESS?	1 = owner 2 = full time manager 3 = family member .4 = other (specify):			
D.10 HIGHEST FORMAL EDUCATIONAL LEVEL OF THE BUSINESS OWNERS? (IF MORE THAN 1 OWNER, CHOOSE THE OWNER WITH THE HIGHEST EDUCATION LEVEL)	1 = Primary, 2 = Secondary, 3 = Tertiary, 4 = Vocational, 5 = Self educated			
D.11 HOW MANY OF YOUR EMPLOYEES HAVE A WRITTEN EMPLOYMENT CONTRACT?				
D12 DOES YOUR BUSINESS STRICTLY SEPARATE BUSINESS FINANCES FROM PERSONAL FINANCES?	0 = No 1 = Yes			
D.13 WHAT WERE THE MAIN REASONS TO START A BUSINESS FOR YOU?	1 = My own business pays more than being employed 2 = To make money additional to my salary 3= Otherwise I would have been unemployed 4 = Other (please specify):			
D.14 DOES YOUR BUSINESS KEEP FINANCIAL RECORDS?	1 = Simple bookkeeping 2 = Double entry bookkeeping 3 =audit annual financial statements 4 = None 5 = Other, specify:			
D.15 DOES YOUR BUSINESS HAVE INTERNET ACCESS?	*0 = No 1 = Yes*			
D. 16 DOES YOUR BUSINESS HAVE A WEBSITE?	*1 = web presence (static information)*			

	2 = web portal (data base driven) 3 = fully fledge e-commerce website with payment facility 4 = no website	
D. 17 DO YOU AND YOUR EMPLOYEES HAVE EMAIL ADDRESSES, IF YES WHICH TYPE?	*1=Web mail (free, e.g. hotmail or yahoo)* 2= Subscription (with ISP) 3=own email server 4=Internet Cafe 5= do not have email addresses	Go to next module if =4
D.18. HOW MANY OF YOUR EMPLOYEES HAVE EMAIL ADDRESS?		
D.19. DOES YOUR COMPANY MAKE USE OF ELECTRONIC DATA INTERCHANGE (EDI)?	*0 = No 1 = Yes*	
D.20. DOES YOUR COMPANY MAKE USE OF INVENTORY CONTROL SOFTWARE?	*0 = No 1 = Yes*	
D.21. IF YOUR COMPANY USES INVENTORY CONTROL SOFTWARE PLEASE STATE WHICH ONE:		

MODULE 3: BUSINESS COMMUNICATIONS								
		A: TELEPHONES	**B: MOBILES**	**C: FAX**	**D: POST BOXES**	**E: COMPUTERS**	**F: INTERNET CONNECTIONS**	
C.1	*How many working… does your business have?*							
C.2	How long ago did you get ….? (answer in years)							
C.3	What types? (multiple responses)	1 = Monthly billing, 2 = Pre-paid 3 = both	1 = Monthly billing *2 = Pre-paid* *3 = both*	*1=own dedicated line* *2=same line as fixed line telephone*	*1 = business post box* 2 = post box shared *3 = private post box used for business*	*N/A*	*1=Modem* *2=Leased line* *3=wireless*	*4=ISDN* *5=DSL*
C.4	Could you tell me how much the business spent last month?	*On fixed line calls and line rental:*	*Monthly subscription and calls:*	*Faxes sent:*	*Box rental and stamps for outgoing mail:*	*N/A*	*Monthly subscription and time spend online:*	
C.5	Please describe briefly what your business is using …for? 1 = Communicating with clients and customers, 2 = Ordering supplies, 3 = private use, 4 = other: please rite into box							
C.6	Who can use it? (Multiple responses): 1 = owners, 2 = managers, 3 = employees ;4 = customers 5 = Family and Friends							
C.7	Who is using it most? 1 = owners, 2 = managers, 3 = employees, 4 = customers, 5 = Family and Friends							
C.8	*If you charge, how much on average do you charge / earn every month for letting others use it?*							
C.9	If your business does not have … why not? *1 =Too expensive, 2 = No need, 3 =Not available, 4 = other: write in box*							
C.10	If your business does not have … is your business using someone else's…. 1=own private facilities, 2=cyber cafes, 3=friends or family, 4=other businesses, 5= none							
C.11	If you haven't got any … do you plan to use it in the future? 1= Yes; 2=No; , 3= Don't know/ maybe							
C.12	How important is the usage of … for your business activities?: 1=Very important, 2=Important, 3=Neither/ nor, 4=not important, 5=not important at all							

MODULE 4: FINANCIALS

	Month	Year
F.1 What is the AVERAGE turnover of your business ?		
F.2 What are your AVERAGE water, electricity, cost?		
F.3 What is THE AVERAGE cost for your premesis in terms of rent, land taxes mortgage payments ?		
F.4 What does your busienss spend on telephone calls, fax, postage, internet on average?		
F.5 What is THE AVERAGE Wage Bill?		
F.6 What are AVERAGE Direct Cost (raw materials and other intermediary inputs or goods bought for resale)?		
F.7 What is the AVERAGE annual after tax Profit of your business?		
F.8 What is the Total Value of fixed assets excluding ICT equipment (vehicles, FURNITURE, MACHINERY)?		
F.9 What is the Value of the ICT equipment of your business (Computers, telephones, printers, scanners, fax machines etc.)?		
F.10 How much was invested during the last 12 months, (excluding investments into ICT)?		
F.11 How much was invested into ICT equipment during the last 12 months?		

MODULE 5: BANKING AND TRANSACTIONS

B.1 Do you know WHAT INTERNET Banking is?	0 = No 1 = Yes	
B.2 Do you know WHAT CELL Phone Banking is?	0 = No 1 = Yes	
B.3 How does your business bank? (multiple responses allowed)	1 = business savings account 2 = business checking account 3 = private savings account used for business purposes 4 = private checking account used for business purposes 5 = no account with a bank or post office 6 = Internet banking	7 = cell phone banking 8 = telephone banking (fixed line phone) 9 = fax banking (sending a fax to initiate a financial transaction) 10 = Electronic Fund Transfer (EFT)

B.4 How does your business transact with suppliers? Out of 10 transactions, how many are made using one of the following options?

	Out of 10 transactions? Local supplier or customer	Out of 10 transactions? Foreign supplier or customer
Cash		
Check		
Credit card		
Money transfer		
Online banking		
Cell phone banking		
Letter of Credit		
Total		

B.5 How does your business transact with customers? Out of 10 transactions, how many are made using one of the following options?

Cash		
Check		
Credit card		
Money transfer		
Online banking		
Cell phone banking		
Letter of Credit		
Total		

B.6 Please state reason for your PREFERRED transaction form with local and foreign suppliers:		
B.7 Please state reason for your PREFERRED transaction form with local and foreign Customers:		
B.8 Do your staff and Yourself use ATM for business purposes?	0 = No 1 = Yes	
B.9. Do you have a corporate credit Card?	0 = No 1 = Yes 2 = use personal credit card for business purposes	
B.10 Have you ever recieved SMS from your Bank such as Bank Statements, Balance, Deposits and Withdrawal information?	0 = No 1 = Yes	
B.11 Would you be interested in Cell Phone Banking if it were cheaper and equally safe compared to ATMs and checks? (enumerator should explain what cell phone banking is if B.2 was no)	0 = No 1 = Yes	
B.12 Would you be prepared to change your bank or apply for a bank account in the first place if this bank offers Cell Phone Banking? (enumerator should explain what cell phone banking is if B.2 was no)	0 = No 1 = Yes	

MODULE 6: PUBLIC ACCESS

P.1 Did you use any of the following PUBLIC PHONES for your business in the last three months?	A: public fixed line phone (ticky box)?	0 = No 1 = Yes	If 'NO' ⇨ next module
	B: private fixed line phone?	0 = No 1 = Yes	
	C: private cell phone kiosk?	0 = No 1 = Yes	
	D: telecentre?	0 = No 1 = Yes	
P.2 How long does each trip (one way) take to reach the following PUBLIC PHONES from your business on foot? (in mins please) *MULTIPLE RESPONSE?*	A: public fixed line phone (ticky box)?	mins	
	B: private fixed line phone?	mins	
	C: private cell phone kiosk?	mins	
	D: telecentre?	mins	
P.3 How many days ago did you last USE A	A: public fixed line phone (ticky box)?	Days	
	B: private fixed line phone?	Days	
	C: private cell phone kiosk?	Days	
	D: telecentre?	Days	
P.4 On average how much do you spend monthly on PUBLIC PHONES for business purposes?	A: public fixed line phone (ticky box)?		
	B: private fixed line phone?		
	C: private cell phone kiosk?		
	D: telecentre?		
P.5 Has your most recent average monthly expenditure any on the above PUBLIC PHONES - increased, decreased or remained constant during the past six months?		1 = Increased 2 = Constant 3 = Decreased	

MODULE 7: SMS (IS ASKED ONLY IF QUESTION C.1B WAS ANSWERED WITH YES)

S.1 Do you send SMS or text messages for business purposes?	0 = No 1 = Yes	
S.2 Do you receive SMS or text messages for business purposes?	0 = No 1 = Yes	

S.3 WHAT ARE THE MAIN PURPOSES YOU USE SMS OR TEXT MESSAGES FOR (MULTIPLE RESPONSE)?	1 = communicate with colleagues 2 = communicate with suppliers 3 = communicate with customers 4 = get information, e.g. banking 5 = Other, please specify:_	

MODULE 8: INTERNET USAGE AND E-COMMERCE						
I.1 DO YOU EVER USE THE INTERNET FOR BUSINESS PURPOSES?	1 = Yes, from my office or business 2= Yes, from home 3 = Yes, using a Cyber or Internet Café 4 = No					**IF NO ⇨ next module**
I.2 HOW MANY HOURS DID YOU SPEND LAST WEEK ON THE INTERNET FOR BUSINESS PURPOSES?	hrs					
I.3 HAS YOUR INTERNET USAGE– INCREASED, DECREASED OR STAYED THE SAME DURING THE PAST SIX MONTHS?	1 = Increased 2 = Stayed same 3 = Decreased					
I.4 ON AVERAGE, WHAT PERCENTAGE OF TIME SPENT ON-LINE DURING BUSINESS HOURS IS SPENT FOR EMAILING AS OPPOSED TO BROWSING*? (NAMELY EMAILING AS A PERCENTAGE OF TOTAL TIME ADDING EMAILING AND BROWSING)*	%					
I.5 FOR WHAT PURPOSES DOES YOUR ENTERPRISE USE THE INTERNET AS CONSUMER (USER)? (MULTIPLE RESPONSE POSSIBLE)	1 = Market monitoring (e.g. prices) 2 = Receiving digital products 3 = Obtaining after sales services 4 = Banking and financial services 5 = Researching new products 6 = Other – please specify					
I.6 FOR WHAT PURPOSES DOES YOUR ENTERPRISE USE THE INTERNET AS PROVIDER? (MULTIPLE RESPONSE POSSIBLE)	1 = Marketing the enterprise's products 2 = Facilitating access to product catalogues and price lists 3 = Delivering digital products 4= Providing after sales support 5= Providing mobile Internet services 6 = Other – please specify					
I.7 HAS THE ENTERPRISE PURCHASED PRODUCTS/SERVICES VIA THE INTERNET?	0 = No 1 = Yes					
I.8 HAS THE ENTERPRISE RECEIVED ORDERS VIA THE INTERNET?	0 = No 1 = Yes					
I.9 WHAT ARE THE POTENTIAL OBSTACLES TO A WIDER USE OF E-COMMERCE?	1= Products / services of enterprise not suitable for sales by the Internet 2= Customers or other enterprises are not ready to use Internet commerce 3= Security problems concerning payments 4= Uncertainty concerning contracts, terms of delivery and guarantees 5=Logistical problems					
I.10 WHAT ICTS ARE YOU USING TO KEEP IN CONTACT AND IMPROVE LINKAGES WITH OTHER BUSINESSES?	1 = fax, 2 = telephone , 3 = mobile, 4 = email, 5 = Internet					
MODULE 9: BUSINESS CLIMATE						
E.1 HOW DO YOU RATE THE CURRENT PERFORMANCE OF YOUR BUSINESS (2005)?	Very Good	Good	Fair	Bad	Very Bad	
E.2 HOW DO YOU EXPECT YOUR BUSINESS TO PERFORM IN 2006?	Very Good	Good	Fair	Bad	Very Bad	
E.3 DO YOU PLAN TO EMPLOY MORE OR LESS IN 2006?	Much more	More	Same	Less	Much less	
E.4 DO YOU PLAN TO INVEST MORE OR LESS IN 2006?	Much more	More	Same	Less	Much less	
E.5 WHEN COMPARED TO OTHER BUSINESSES, DO YOU CONSIDER YOUR BUSINESS COMPETITIVE?	**LOCALLY**	0 = No 1 = Yes				
	NATIONALLY	0 = No 1 = Yes 2 = N/A				
	International	0 = No 1 = Yes 2 = N/A				
E.6 WHAT DO YOU CONSIDER YOUR MAJOR BUSINESS OBSTACLES?						
E.7 WHAT DO YOU CONSIDER YOUR MAJOR OBSTACLE FOR USING ICTS FOR BUSINESS?						

Appendix 2: Definition and construction of variables

Access to ICT: According to Barba-Sánchez et al (2007), ICTs in today's world must be broadly conceived to encompass the information created and used by businesses, as well as the wide spectrum of increasingly convergent and linked technologies that process the information. They view ICT to encompass a wide range of devices and facilities used in the processing of

information. However, in this thesis we employ two ICT devices/facilities: access to internet and computer. Access to internet/computer is measured as a discrete variable taking the value one (1) if a firm indicates that it has internet connection (computer) which is in working condition and takes the value zero (0) otherwise.

Average wage of the firm: This is measured as the ratio of average wage bill of firm to the number of employees hired by the organisation, including the business owner(s). The questionnaire collected information of average wage bill, as well as the number of employees working within the organisation. It also collected information on the number of owners of the firm. This allows for the calculation of the average wage of the firm.

Number of employees: This variable measures the number of individuals the firm employees to undertake its production activities, including the owner(s) if the individual(s) is/are involved in the daily activities of the organisation. The number of employees also include both permanent and casual workers. This variable is obtained from responses of firms.

Human capital has been identified as a key factor in a firm's decision to adopt ICT as some level of skill is need to use new technology. Employees who use these technologies require appropriate training, thus the cost of adoption will be dependent on the number of trained staff who are retained by the firm. Parente (1994) and Black and Lynch (2004) stress the importance of human capital in the adoption and usage of general purpose technologies, as they are of the opinion that profitable use of these technologies is dependent on appropriate use by the human capital. It has been argued that firms endowed with high human capital are more likely to be early adopters of ICT. Doms et al (1997) have shown that firms which turn to complex technologies require highly skilled employees. Arvanitis (2005) also opines that firms with highly skilled employees are likely to adopt new technology as these workers innovate and facilitate adoption within the firm. Human capital in this chapter is proxied by the average wage of the firm and this is in accordance with Haller and Siedschlag (2008), and we expect human capital to be positively and significantly related to ICT adoption.

Age of the firm: This variable is directly obtained from responses provided by the firms. It is measures the number of years the firm has being in operation till the date of the survey. Age of the firm is measured in years with months converted into years, by dividing the number of months by twelve (12) months.

Age of the firm, as a characteristic of the firm, is measured by the number of years the firm has been in operation. The firm's age and its square are used to capture accumulation of experience in general and also measures reduction in the perceived risk of ICT investments. Theoretically it has been argued that old firms are more likely to adopt as they benefit from long usage of previous versions of ICT and thus have learned the advantage of using of newer versions compared to younger firms. On the other hand, younger firms arguably find it easier to implement recent technologies associated with younger generations. Both empirical and theoretical literature show inconclusive results as some studies have found no relationship between ICT and firm age and others have indicated to a negative relationship. We expect the results from our estimations to vary depending on the category of ICT that the firm adopts, thus the results on the relationship between ICT adoption and age and its square are ambiguous.

Form of ownership: The questionnaire asks respondents to identify the form of ownership structure within the organisation. The firms were to choose from the various options: Sole proprietor; Partnership; Close corporation; Business [Proprietary Limited companies; Other form.

In this thesis ownership is measured by whether the business or organisation has a sole proprietorship ownership structure or other form of ownership. Thus the various types of ownership is divided into two groups. This variable takes the value one (1) if the firm is solely owned and zero (0) otherwise.

The ownership structure is an important variable in the determination of ICT adoption at firm level. Studies that have analysed the relationship between ownership and ICT adoption have mainly looked at whether the firm is a multinational or a locally owned firm. All the SMEs sampled in our dataset are locally owned firms, however we use the ownership structure to define the form of business ownership, ranging from sole proprietorship, partnership, close corporation, business entity and other forms of ownership. The ownership structure of the firm measures the corporate status of the firm and we expect business entities to be early adopters of ICT compared to sole proprietorship.

Education: The educational variable captures the highest educational attainment of the firm owner, ranging from no formal education to tertiary education. It is used as a proxy for measuring the skill level of the workforce. If the firm has more than one owner, the highest educational qualification of the owner with the highest level of education is used as a measure of the educational level of the owner. The study combines owners with no formal education and

primary education into one variable, this is because firms owners lacking formal education form just about 2 percent of the entire observation.

From both the theoretical and empirical literature the explanatory variables identified are characteristics of the firm owner, which we proxy by the owner's educational attainment. From the empirical literature educational attainment of the owners is positively related to the adoption of ICT. The literature shows that a highly qualified manager or owner is likely to increase the firm's wiliness to embrace new technology and innovation, as higher educational level is likely to make prospective adopters more innovative. This variable is measured by the highest educational attainment of the owner ranging from the lack of formal education to having tertiary education. We also use the educational attainment of the owner as a measurement of the skills of the workforce. A highly skilful workforce is likely to facilitate the firm's adoption of ICT and make it more innovative. It has been argued that highly skilled employees are capable of making ICT investments mainly because their higher educational level promoted ICT usage and increases the expected impact (Morgan et al., 2006; Arvanitis, 2005; Fabiani et al., 2005; Falk, 2005; Pe´rez et al., 2005 and Bresnahan et al., 2002).

Perceived Competition: The survey solicited information from respondent on perceived competition at both local and national levels. Thus, two types of perceived competition is measured in this thesis: competition at the local and national levels. Firms were asked to indicate whether they perceive competition at the local level or not. The local competition variable takes the value one (1) if firms perceive the existence of competition at the local level and zero (0) otherwise. The firms were also asked to indicate whether they perceive competition at the national level or not, with national competition variable taking the value one (1) if they perceived competition at the national level and zero (0) if otherwise.

The competitive environment in which the firm operates plays an important role providing the firm with an incentive to innovate and adopt new technologies in their production process. Porter (1990) argues that local competition faced by the firm enhances incentives to innovate and adopt new technologies. Several studies (Dasgupta et al., 1999; Hollenstein, 2004; Kowtha and Choon, 2001) have found competition to have a positive and significant effect on the adoption decision of firms. Conversely, others have found no significant relationship between adoption of ICT and competitive pressure (Lee, 2004; Teo et al., 1997; Thong, 1999). Haller and Siedschalag (2008) used export intensity, its square term and industry concentration as a measure of the competitive pressure faced by the organisation. In this chapter the competitive pressure facing the firm is

captured in our model by the competitive environment that the firm is faced with at both local and national levels. We expect that competition at the national level will be significantly different from that at the local level. Infrastructure is used as an explanatory variable as the presence or otherwise of this can influence the firm's decision to adopt ICT. This variable is measured by the firm's average expenditure on the usage of electricity and water, thus we use the average expenditure on utilities as a proxy for the availability of infrastructure.

Internet and Computer user ratio: The two variables measure the proportion of firms with either internet and computers operating in a particular industry, respectively. These two variables captures the epidemic effects of ICT adoption, which states that firm's propensity to adopt new technology at a particular period is partly dependent on current or past level of diffusion in the industry it operates as well as the entire economy. ICT (internet and computer) user ratio is given as follows:

$$ict_{i,z} = \sum \frac{X_j^z}{N_j}$$

In the above expression, $ict_{i,z}$ refers to the z ICT variable (internet or computer) possessed by firm *i* operating in the *j*th industry. X_j^z represents the number of firms excluding firm i that have adopted the technology z while the denominator - N_j is the total number of firms in the *j* industry.

Industrial sector: The survey asks a qualitative question regarding the main business activity of firms. Based on the responses, SMEs are classified into various industrial sectors based on International Standard Industrial Classification (ISIC). Overall, the firms were classified into seven (7) sectors. The sectors are as follows: Manufacturing; Construction; Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods; Hotels and restaurants; Transport, storage and communications; Financial intermediation and real estate, renting and business activities; Education, health, social work, other community, social and personal service activities. For this thesis we further group the SMEs into three broad industrial classifications of manufacturing, construction and services.

The industry sector the firm operates in is used as a measure of the environment in which the firm operates. The sector is an important determinant of ICT adoption so far as differences in certain aspect are captured (Bayo-Moriones and Lera-Lopez, 2007). Hollenstein (2004) for instance argues that firms in different sectors of the economy will have varying technological needs, as different business environments exist in the various sectors. The industry sector

according to Bayo-Moriones and Lera-Lopez (2007) also reflects business environment factors such as heterogeneity and uncertainty, which are important for ICT adoption. Several studies (Love et al, 2005; Hollenstein, 2004; Haller and Siedschalg, 2010; Cheung and Huang, 2002) have found varying rates of adoption and use of ICT by different sectors. While other studies have also found that there is no significant difference across industries in their use of ICT (Fabiani, 2005; Teo and Ranganathan, 2004). ICT adoption is anticipated to be high among firms operating in the service and manufacturing industries. The formality level of the firm is also important as it also measures the business environment the firm operates in. The formality level variable ranges from informal, semi-formal and formal sector firms. Formal sector firms are more likely expected to adopt ICT compared to informal and semi-formal sector firms.

Formality Index: The thesis classifies firms into formal, semi-formal and informal sector firms based on responses they provided regarding questions on the form of ownership; whether the business is registered with government revenue agency (that is whether the firm pays taxes); whether the business is VAT registered. Other questions include number of employees with written employment contract; whether the business strictly separates business from personal finances; whether the business keeps records. Values are assigned to each response with the maximum value a firm can attain being a value of 4.5. Businesses with an index value of 1.5 and below are classified informal, and those with index value of above 2.0 but less than 3.5 are categorised as semi-formal, while an index value of 3.5 and above are classified as formal sector firms (Source: Gillwald and Stork, 2008).

Turnover: This variable is used as a proxy for output and it is the firm's reported annual sales. The survey solicited information on the annual sales of firms in local currencies, which are converted into United States Dollars (US$) using the Implied 2005 Purchasing Power Parity.

ICT capital: This is the market value of ICT equipment/facility in working condition used in the production process of the organisation. Firm are asked to list the ICT equipment/facilities and the year of purchase. Based on the year of purchase a present market value is estimated and assigned to each of these devices after taking into consideration their depreciation value. The total value of all ICT equipment/facilities is taken as the ICT capital stock.

Non-ICT capital: This variable captures the value of the firm's fixed assets. Firms are asked to give the present market value of the organisation's fixed assets excluding ICT equipment. The present value of fixed assets are stated in local currencies but converted into US Dollars using the Implied 2005 Purchasing Power Parity.

Raw materials: This is measured by the average direct operational cost of the firm. It includes the cost of purchasing raw materials as well as other intermediary inputs used by firms in the production process. Again the values are in local currencies and converted into dollars using the same procedure as in the above.

Management control type: The survey questionnaire asks firms to indicate the person who manages the daily activities of the firm. The firms were presented with four options: owner; full time manager; family member; other (specify). The thesis divides the responses into two group to generate the managerial control type variable: firms employing full time manager and firms employing other forms of managerial control. The managerial control type variable takes the value one (1) if firm employs a full time manager and zero (0) otherwise.

ICT possession index: This is the number of ICT equipment/facilities employed within the organisation. The survey collected information on nine (9) ICT equipment/facilities used by firms and for each device the firm possesses the value one (1) is assigned, thus the maximum value a firm can attain is nine (9). The index takes the value zero (0) if the firm has not ICT equipment/facility.

Firm Size: The thesis uses the number of employees hired by the firm as a measure of firm size. This has become necessary as some SMEs in Africa are run by just the owner and do not employ anyone. Firms employing less than five (5) employees are classified as micro sized, those with employees larger than five (5) but less than twenty (20) are small sized enterprises and firms employing twenty (20) and one hundred (100) workers are classified as medium sized firms. The classification of the firms is based on the UNIDO classification of firms.

Firm size has been used by several studies of technology adoption (Bayo-Moriones and Lera-Lopez, 2007; Fabiani et al, 2005; Dholakia and Kshetri, 2004; Giunta and Trivieri, 2007) as an explanatory variable in estimating the firm's decision to adopt new technology or innovation. Varying views have been expressed in empirical literature on the relationship between adoption of new technology and firm size. It has been argued that larger firms are able to allocate more resources and capital to deal with the cost of switching from old technology to a newer version. Larger firms as argued by Geroski (2000) are more likely to take risks as they have the capacity to absorb losses associated with switching compared to smaller firms. In the literature several measures of firm size have been used among them are number of employees, turnover of the firm and total fixed assets of the firm. A positive relationship is expected to exist between ICT adoption among firms in Africa and the size of those firms.

Appendix 3: Effect of ICT adoption on turnover and technical efficiency

Table A-3. 1: Results of baseline Cobb-Douglas model

Variables	Botswana	Ethiopia	Cameroon	Ghana	Kenya	Mozambique	Namibia
log of employment	0.409***	0.308***	0.412***	0.491***	0.370***	0.501***	0.541***
	(0.096)	(0.114)	(0.084)	(0.082)	(0.085)	(0.075)	(0.148)
log of ICT capital	0.135***	0.111**	0.117***	-0.019	0.080***	0.094***	0.082***
	(0.037)	(0.045)	(0.038)	(0.029)	(0.029)	(0.021)	(0.023)
log of capital	0.059**	0.131**	0.130***	0.134***	0.168***	0.048**	0.055
	(0.026)	(0.060)	(0.048)	(0.028)	(0.047)	(0.021)	(0.036)
log of raw materials	0.145***	0.247***	0.325***	0.290***	0.327***	0.138***	0.199***
	(0.036)	(0.051)	(0.057)	(0.043)	(0.070)	(0.026)	(0.055)
sole proprietorship	-0.000	0.376	0.024	-0.359**	0.049	-0.106	-0.080
	(0.089)	(0.403)	(0.195)	(0.142)	(0.115)	(0.147)	(0.209)
sec. education	0.051	0.039	-0.353**	0.098	-0.157	0.055	-0.026
	(0.176)	(0.172)	(0.169)	(0.176)	(0.254)	(0.236)	(0.204)
voc. education	0.035	0.202	-0.295	-0.209	-0.115	0.085	-0.258
	(0.172)	(0.234)	(0.196)	(0.208)	(0.258)	(0.325)	(0.239)
tertiary education	0.055	0.062	-0.327	0.140	-0.033	0.328	-0.241
	(0.169)	(0.280)	(0.202)	(0.190)	(0.245)	(0.271)	(0.348)
manufacturing	-0.116	-0.130	-0.017	-0.255**	-0.063	-0.014	-0.598**
	(0.123)	(0.165)	(0.122)	(0.118)	(0.098)	(0.154)	(0.252)
construction	-0.190*	0.436	0.351	0.844**	-0.122	0.063	0.599
	(0.096)	(0.280)	(0.420)	(0.402)	(0.112)	(0.293)	(0.395)
formal sector	0.449***	0.857***	0.337	0.479**	0.269	0.929***	0.905***
	(0.171)	(0.318)	(0.366)	(0.198)	(0.187)	(0.185)	(0.265)
semi-formal	0.459***	0.806***	0.080	-0.089	0.044	0.662***	0.382**
	(0.160)	(0.209)	(0.146)	(0.148)	(0.109)	(0.154)	(0.164)
managerial skills	-0.010	0.107	0.055	0.155	-0.024	0.197	0.323*
	(0.123)	(0.166)	(0.134)	(0.145)	(0.091)	(0.131)	(0.180)
Constant	7.656***	5.164***	5.807***	6.618***	5.330***	7.649***	7.609***
	(0.324)	(0.899)	(0.867)	(0.442)	(0.709)	(0.339)	(0.450)
Observations	255	280	282	280	277	280	307
R-squared	0.727	0.583	0.714	0.685	0.794	0.711	0.570

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

Table A-3.1: Continues …

Variables	Nigeria	Rwanda	South Africa	Tanzania	Uganda	Zambia	Zimbabwe
log of employment	0.201**	0.193***	0.566***	0.398***	0.367***	0.377***	0.472***
	(0.097)	(0.066)	(0.179)	(0.088)	(0.057)	(0.064)	(0.144)
log of ICT capital	0.029	0.136***	0.246***	0.085**	0.061***	0.034	0.135***
	(0.040)	(0.043)	(0.075)	(0.035)	(0.019)	(0.021)	(0.031)
log of capital	0.127***	0.114***	0.152**	0.150***	0.070***	0.070**	0.236***
	(0.043)	(0.030)	(0.072)	(0.054)	(0.023)	(0.028)	(0.082)
log of raw materials	0.238***	0.155***	0.141***	0.167***	0.342***	0.398***	0.115***
	(0.037)	(0.025)	(0.033)	(0.047)	(0.053)	(0.043)	(0.029)
sole proprietorship	-0.154	0.174	-0.152	-0.059	0.053	-0.010	-0.232
	(0.153)	(0.125)	(0.288)	(0.138)	(0.072)	(0.078)	(0.162)
sec. education	0.011	0.041	0.300	-0.118	-0.093	-0.193	0.177
	(0.145)	(0.166)	(0.354)	(0.143)	(0.187)	(0.293)	(0.327)
voc. education	-0.443**	0.098	-0.211	-0.176	0.013	-0.158	-0.101
	(0.189)	(0.231)	(0.336)	(0.148)	(0.197)	(0.287)	(0.540)
tertiary education	0.075	-0.054	0.440	-0.231	0.123	0.114	-0.235
	(0.177)	(0.203)	(0.329)	(0.175)	(0.183)	(0.286)	(0.305)
manufacturing	-0.115	-0.164	-0.727*	-0.190*	-0.091	-0.163	0.170
	(0.113)	(0.128)	(0.423)	(0.114)	(0.088)	(0.106)	(0.157)
construction	0.541*	0.282	-0.195	0.119	-0.039	0.121	-0.097
	(0.322)	(0.278)	(0.275)	(0.145)	(0.113)	(0.189)	(0.267)
formal	0.589***	1.117***	0.094	0.743***	0.519***	0.470***	0.250
	(0.196)	(0.204)	(0.458)	(0.139)	(0.108)	(0.112)	(0.248)
semi-formal	-0.001	0.746***	-0.168	0.531***	0.280***	0.181**	0.196
	(0.125)	(0.176)	(0.275)	(0.116)	(0.073)	(0.092)	(0.202)
managerial skills	0.299	0.052	0.172	0.043	0.131*	0.404***	0.022
	(0.182)	(0.125)	(0.276)	(0.117)	(0.070)	(0.093)	(0.185)
Constant	6.733***	7.315***	6.244***	6.258***	6.235***	5.164***	7.689***
	(0.406)	(0.338)	(0.773)	(0.366)	(0.487)	(0.419)	(1.087)
Observations	265	279	290	263	351	276	281
R-squared	0.721	0.676	0.528	0.719	0.769	0.864	0.621

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

Table A-3. 2: Estimation of Cobb-Douglas production with extent of ICT adoption indicators and ICT capital

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SAf	Tan	Uga	Zam	Zim
log of employment	0.384*** (0.096)	0.307*** (0.112)	0.410*** (0.084)	0.485*** (0.081)	0.366*** (0.083)	0.436*** (0.070)	0.495*** (0.132)	0.196** (0.091)	0.194*** (0.066)	0.580*** (0.183)	0.394*** (0.085)	0.366*** (0.057)	0.368*** (0.062)	0.488*** (0.145)
log of ICT capital	**0.112*** (0.036)**	**0.096 (0.072)**	**0.100** (0.049)**	**-0.042 (0.030)**	**0.073** (0.033)**	**0.040* (0.022)**	**0.061* (0.032)**	**-0.022 (0.047)**	**0.146*** (0.046)**	**0.231*** (0.078)**	**0.059* (0.032)**	**0.055** (0.024)**	**0.011 (0.024)**	**0.147*** (0.033)**
log of capital	0.058** (0.025)	0.130** (0.062)	0.131*** (0.048)	0.143*** (0.031)	0.171*** (0.046)	0.046** (0.019)	0.065* (0.034)	0.118*** (0.042)	0.117*** (0.031)	0.148** (0.072)	0.145*** (0.054)	0.069*** (0.023)	0.065** (0.027)	0.236*** (0.082)
log of raw materials	0.149*** (0.037)	0.247*** (0.051)	0.322*** (0.059)	0.289*** (0.042)	0.327*** (0.070)	0.150*** (0.022)	0.198*** (0.056)	0.249*** (0.036)	0.154*** (0.025)	0.147*** (0.033)	0.170*** (0.048)	0.343*** (0.054)	0.397*** (0.044)	0.114*** (0.029)
ICT possession	**0.063* (0.036)**	**0.045 (0.106)**	**0.042 (0.052)**	**0.087** (0.044)**	**0.014 (0.028)**	**0.165*** (0.031)**	**0.073 (0.052)**	**0.157*** (0.056)**	**-0.027 (0.046)**	**0.105* (0.061)**	**0.072 (0.046)**	**0.012 (0.028)**	**0.059** (0.025)**	**-0.060 (0.045)**
sole proprietorship	0.028 (0.087)	0.428 (0.373)	0.047 (0.182)	-0.331** (0.141)	0.053 (0.113)	-0.028 (0.139)	-0.058 (0.216)	-0.136 (0.151)	0.176 (0.126)	-0.025 (0.268)	-0.040 (0.143)	0.057 (0.074)	-0.007 (0.076)	-0.253 (0.165)
sec. education	0.068 (0.171)	0.028 (0.173)	-0.354** (0.169)	0.024 (0.173)	-0.162 (0.252)	0.112 (0.220)	-0.039 (0.205)	0.002 (0.142)	0.044 (0.166)	0.156 (0.351)	-0.101 (0.141)	-0.088 (0.187)	-0.196 (0.298)	0.171 (0.320)
voc. education	0.045 (0.168)	0.189 (0.230)	-0.282 (0.198)	-0.235 (0.209)	-0.113 (0.260)	0.135 (0.307)	-0.254 (0.242)	-0.463** (0.190)	0.098 (0.231)	-0.318 (0.328)	-0.174 (0.144)	0.016 (0.198)	-0.158 (0.293)	-0.140 (0.539)
tertiary education	0.034 (0.166)	0.016 (0.250)	-0.346* (0.199)	-0.017 (0.205)	-0.042 (0.242)	0.273 (0.254)	-0.370 (0.315)	-0.109 (0.185)	-0.035 (0.202)	0.236 (0.318)	-0.306* (0.182)	0.123 (0.183)	0.068 (0.292)	-0.213 (0.298)
manufacturing	-0.149 (0.126)	-0.123 (0.165)	-0.014 (0.122)	-0.229* (0.117)	-0.060 (0.097)	0.084 (0.153)	-0.595** (0.255)	-0.131 (0.111)	-0.170 (0.128)	-0.740* (0.420)	-0.177 (0.115)	-0.087 (0.088)	-0.144 (0.105)	0.172 (0.157)
construction	-0.162* (0.096)	0.437 (0.279)	0.336 (0.434)	0.830** (0.393)	-0.118 (0.111)	0.102 (0.224)	0.623 (0.388)	0.603* (0.334)	0.277 (0.281)	-0.253 (0.289)	0.132 (0.147)	-0.032 (0.115)	0.131 (0.184)	-0.060 (0.269)
formal sector	0.415** (0.171)	0.827** (0.320)	0.268 (0.354)	0.313 (0.233)	0.249 (0.192)	0.715*** (0.175)	0.853*** (0.255)	0.482** (0.194)	1.151*** (0.216)	-0.104 (0.459)	0.692*** (0.148)	0.511*** (0.110)	0.402*** (0.112)	0.342 (0.256)
semi-formal	0.449*** (0.158)	0.788*** (0.218)	0.059 (0.143)	-0.128 (0.149)	0.037 (0.108)	0.584*** (0.148)	0.372** (0.162)	-0.086 (0.124)	0.756*** (0.179)	-0.289 (0.264)	0.530*** (0.116)	0.273*** (0.075)	0.160* (0.093)	0.229 (0.203)
managerial skills	-0.009 (0.124)	0.117 (0.163)	0.062 (0.133)	0.142 (0.144)	-0.022 (0.091)	0.213* (0.121)	0.287 (0.182)	0.285 (0.181)	0.048 (0.126)	0.201 (0.271)	0.047 (0.116)	0.131* (0.071)	0.378*** (0.092)	0.031 (0.186)
Constant	7.636*** (0.322)	5.144*** (0.896)	5.837*** (0.894)	6.610*** (0.438)	5.331*** (0.712)	7.549*** (0.324)	7.589*** (0.443)	6.815*** (0.416)	7.283*** (0.337)	6.089*** (0.738)	6.295*** (0.360)	6.254*** (0.486)	5.247*** (0.426)	7.737*** (1.091)
Observations	240	275	276	275	273	266	287	256	274	270	252	348	275	279
R-squared	0.731	0.584	0.714	0.690	0.794	0.739	0.574	0.731	0.677	0.534	0.723	0.769	0.867	0.623

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SAf- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe.

Table A-3. 3: Cobb-Douglas production function with interaction terms and ICT adoption indicators

Variables	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
log of employment	0.384***(0.099)	0.288**(0.112)	0.436***(0.068)	0.490***(0.082)	0.364***(0.085)	0.408***(0.067)	0.554***(0.102)
log of ICT capital	0.101(0.088)	0.471**(0.232)	0.150*(0.090)	0.158(0.113)	0.179(0.141)	0.117*(0.069)	0.0001(0.080)
ICT possession	0.039(0.038)	0.045(0.089)	-0.005(0.066)	0.077*(0.044)	0.011(0.037)	0.179***(0.030)	0.043(0.060)
log of capital	0.049*(0.027)	0.089*(0.050)	0.098***(0.025)	0.126***(0.030)	0.168***(0.041)	0.046**(0.019)	0.058**(0.028)
log of raw materials	0.140***(0.039)	0.238***(0.049)	0.307***(0.055)	0.267***(0.042)	0.319***(0.066)	0.153***(0.023)	0.225***(0.051)
ICT-sole proprietorship	-0.044(0.075)	-0.314(0.195)	-0.005(0.073)	-0.006(0.062)	-0.103(0.109)	0.079*(0.044)	0.114*(0.060)
ICT-Secondary education	-0.042(0.066)	-0.061(0.085)	-0.070(0.059)	-0.266***(0.083)	0.049(0.083)	-0.083(0.054)	-0.081*(0.048)
ICT-vocational education	-0.152(0.101)	-0.234**(0.102)	-0.023(0.088)	-0.295***(0.090)	0.037(0.083)	-0.029(0.080)	-0.099(0.073)
ICT-tertiary education	-0.040(0.117)	-0.050(0.112)	-0.098(0.063)	-0.251***(0.081)	0.064(0.089)	-0.055(0.067)	0.155(0.129)
ICT-manufacturing	0.087(0.064)	0.043(0.074)	-0.007(0.047)	-0.130(0.084)	-0.118(0.093)	-0.041(0.062)	0.165**(0.070)
ICT-construction	0.011(0.089)	-0.084(0.112)	-0.160(0.326)	0.144(0.171)	0.091(0.147)	-0.020(0.063)	-0.285**(0.124)
ICT-formal sector	0.190*(0.109)	0.046(0.132)	0.467**(0.217)	0.175**(0.083)	-0.083(0.137)	-0.113**(0.056)	-0.101(0.069)
ICT-semi-formal	0.155(0.123)	-0.171(0.113)	0.022(0.073)	0.159**(0.069)	-0.090(0.068)	-0.135***(0.049)	-0.031(0.052)
ICT-managerial skills	-0.225*(0.123)	0.052(0.081)	-0.051(0.058)	-0.127**(0.051)	-0.081(0.084)	0.048(0.035)	0.026(0.056)
sole proprietorship	0.391(0.628)	2.670*(1.549)	0.146(0.563)	-0.298(0.499)	0.687(0.756)	-0.651*(0.343)	-0.661(0.465)
Secondary education	0.352(0.467)	0.367(0.395)	0.087(0.357)	1.897***(0.620)	-0.365(0.490)	0.340(0.386)	0.132(0.269)
vocational education	1.249(0.768)	1.632***(0.568)	-0.203(0.632)	1.838***(0.649)	-0.207(0.418)	-0.083(0.616)	0.058(0.444)
tertiary education	0.290(0.919)	0.359(0.647)	0.386(0.426)	1.751***(0.624)	-0.357(0.496)	0.308(0.504)	-1.426(0.981)
manufacturing	-0.831(0.543)	-0.292(0.412)	0.014(0.322)	0.772(0.642)	0.580(0.570)	0.241(0.394)	-1.276**(0.492)
construction	-0.206(0.729)	0.777(0.564)	1.710(3.194)	-0.177(1.263)	-0.659(0.817)	0.190(0.325)	2.210**(0.925)
formal sector	-0.905(0.799)	0.323(0.869)	-3.720*(1.962)	-0.864(0.651)	0.767(0.975)	1.281***(0.420)	1.388***(0.518)
semi-formal	-0.588(0.886)	1.939**(0.803)	0.063(0.481)	-1.153**(0.511)	0.604(0.404)	1.277***(0.322)	0.496(0.329)
managerial skills	1.911*(1.041)	-0.228(0.551)	0.491(0.420)	1.104***(0.401)	0.544(0.590)	-0.110(0.266)	0.100(0.406)
Constant	7.784***(0.757)	2.942*(1.716)	5.909***(0.785)	5.456***(0.862)	4.698***(1.128)	7.648***(0.520)	7.883***(0.536)
Observations	255	280	282	280	277	280	307
R-squared	0.745	0.623	0.749	0.718	0.804	0.757	0.640

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

Table A-3.3: Continues…

Variables	Nigeria	Rwanda	S. Africa	Tanzania	Uganda	Zambia	Zimbabwe
log of employment	0.203**(0.098)	0.202***(0.068)	0.618***(0.160)	0.399***(0.083)	0.362***(0.058)	0.358***(0.065)	0.393***(0.146)
log of ICT capital	0.022(0.085)	0.103*(0.057)	-0.168(0.203)	0.040(0.081)	0.114*(0.066)	0.214**(0.100)	0.268(0.218)
ICT possession	0.186***(0.058)	0.005(0.056)	0.108**(0.053)	0.031(0.053)	0.003(0.033)	0.060**(0.027)	-0.083*(0.045)
log of capital	0.096**(0.042)	0.120***(0.030)	0.168**(0.070)	0.154***(0.048)	0.068***(0.024)	0.061**(0.027)	0.199***(0.064)
log of raw materials	0.253***(0.035)	0.151***(0.025)	0.130***(0.026)	0.167***(0.048)	0.339***(0.055)	0.402***(0.041)	0.119***(0.028)
ICT-sole proprietorship	-0.149**(0.068)	0.103**(0.048)	-0.060(0.119)	-0.029(0.069)	-0.051(0.042)	-0.029(0.041)	-0.219**(0.097)
ICT-Secondary education	0.089(0.075)	-0.026(0.063)	0.201(0.154)	0.120*(0.071)	0.015(0.053)	-0.248**(0.097)	-0.009(0.184)
ICT-vocational education	0.272***(0.078)	0.081(0.116)	0.227(0.233)	0.037(0.062)	-0.020(0.106)	-0.014(0.099)	0.127(0.266)
ICT-tertiary education	-0.086(0.110)	0.109(0.098)	0.137(0.163)	0.035(0.095)	-0.005(0.052)	-0.148*(0.086)	0.031(0.207)
ICT-manufacturing	-0.015(0.053)	0.019(0.050)	0.367*(0.190)	-0.054(0.052)	-0.048(0.060)	-0.056(0.052)	0.011(0.066)
ICT-construction	0.118(0.114)	-0.099(0.067)	-0.291**(0.141)	-0.015(0.039)	0.135(0.124)	-0.016(0.044)	0.028(0.089)
ICT-formal sector	0.083(0.095)	-0.148(0.121)	0.285*(0.158)	0.062(0.079)	0.016(0.070)	0.031(0.059)	0.074(0.075)
ICT-semi-formal	0.023(0.065)	-0.260**(0.118)	0.136(0.141)	0.008(0.063)	-0.045(0.043)	-0.082(0.058)	0.035(0.058)
ICT-managerial skills	0.124(0.120)	-0.026(0.065)	0.032(0.136)	0.002(0.081)	0.019(0.040)	-0.033(0.062)	-0.066(0.082)
sole proprietorship	1.023**(0.507)	-0.552(0.360)	0.406(0.919)	0.155(0.422)	0.440(0.326)	0.192(0.266)	1.993*(1.048)
Secondary education	-0.503(0.442)	0.135(0.400)	-0.919(1.070)	-0.746*(0.403)	-0.149(0.376)	1.012*(0.528)	0.245(1.525)
vocational education	-1.943***(0.469)	-0.457(0.802)	-1.690(1.709)	-0.332(0.323)	0.226(0.774)	-0.272(0.588)	-1.486(2.542)
tertiary education	0.560(0.734)	-0.933(0.741)	-0.504(1.180)	-0.398(0.672)	0.209(0.392)	0.822*(0.481)	-0.469(1.790)
manufacturing	-0.069(0.311)	-0.331(0.370)	-3.125**(1.549)	0.111(0.289)	0.246(0.424)	0.187(0.318)	0.107(0.682)
construction	-0.321(0.739)	0.906**(0.368)	2.308*(1.253)	0.205(0.223)	-1.012(0.948)	0.364(0.263)	-0.329(0.937)
formal sector	-0.072(0.768)	2.290**(1.037)	-1.953(1.329)	0.340(0.492)	0.350(0.554)	0.048(0.440)	-0.251(0.794)
semi-formal	-0.131(0.418)	2.713***(0.937)	-0.977(1.076)	0.525(0.353)	0.614*(0.313)	0.670*(0.376)	0.027(0.557)
managerial skills	-0.707(0.963)	0.258(0.508)	-0.057(1.166)	0.017(0.556)	-0.026(0.299)	0.603(0.460)	0.787(0.908)
Constant	6.360***(0.599)	7.619***(0.427)	8.217***(1.529)	6.292***(0.468)	5.840***(0.614)	4.181***(0.605)	6.841***(2.048)
Observations	265	279	290	263	352	276	281
R-squared	0.761	0.697	0.601	0.732	0.771	0.876	0.660

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

Table A-3. 4: Quantile regression estimation

Variables	Botswana			Cameroon			Ethiopia			Ghana		
	0.25	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**
log of employment	0.388***	0.457***	0.395**	0.346***	0.384***	0.442***	0.386***	0.391***	0.438***	0.291***	0.299***	0.456***
	(0.112)	(0.109)	(0.161)	(0.131)	(0.120)	(0.134)	(0.052)	(0.072)	(0.118)	(0.070)	(0.098)	(0.127)
lag of ICT capital	0.088	0.112**	0.105*	0.050	0.035	0.098***	0.076***	0.051*	0.069***	0.017	-0.010	-0.037
	(0.056)	(0.044)	(0.053)	(0.044)	(0.034)	(0.036)	(0.016)	(0.028)	(0.025)	(0.027)	(0.029)	(0.048)
lag of capital	0.054	0.073**	0.079	0.094*	0.155***	0.110*	0.066***	0.060*	0.084**	0.061*	0.120***	0.116***
	(0.037)	(0.034)	(0.049)	(0.048)	(0.044)	(0.059)	(0.025)	(0.032)	(0.033)	(0.033)	(0.040)	(0.038)
log of raw materials	0.296***	0.197**	0.117	0.335***	0.209***	0.150***	0.451***	0.366***	0.261***	0.522***	0.438***	0.332***
	(0.084)	(0.084)	(0.078)	(0.078)	(0.034)	(0.033)	(0.049)	(0.059)	(0.067)	(0.044)	(0.079)	(0.067)
sole proprietorship	0.033	0.018	-0.090	0.232	-0.080	-0.533	0.134	-0.038	0.135	-0.066	-0.307**	-0.453**
	(0.086)	(0.078)	(0.118)	(0.322)	(0.394)	(0.498)	(0.097)	(0.147)	(0.299)	(0.113)	(0.142)	(0.202)
sec. education	0.111	0.046	0.232	0.249	0.092	0.190	-0.173	-0.422**	-0.331	0.122	-0.102	-0.139
	(0.221)	(0.166)	(0.304)	(0.181)	(0.192)	(0.197)	(0.149)	(0.196)	(0.244)	(0.146)	(0.243)	(0.207)
voc. education	0.166	-0.016	0.035	0.367	0.322	0.374	-0.085	-0.150	-0.441	0.026	-0.177	-0.344
	(0.221)	(0.147)	(0.290)	(0.317)	(0.266)	(0.256)	(0.266)	(0.279)	(0.307)	(0.171)	(0.243)	(0.283)
tertiary education	0.103	0.064	0.311	0.263	0.243	0.350	-0.209	-0.476**	-0.186	0.330**	0.050	-0.032
	(0.250)	(0.159)	(0.308)	(0.275)	(0.283)	(0.267)	(0.164)	(0.209)	(0.280)	(0.140)	(0.250)	(0.249)
manufacturing	0.033	-0.008	0.089	-0.119	-0.346*	-0.303	-0.019	-0.131	0.026	-0.016	-0.159	-0.46***
	(0.114)	(0.106)	(0.178)	(0.171)	(0.198)	(0.188)	(0.084)	(0.128)	(0.221)	(0.098)	(0.117)	(0.173)
construction	-0.097	-0.186**	-0.118	-0.071	0.114	0.112	0.235	0.269	-0.080	0.395	0.371	1.670*
	(0.099)	(0.091)	(0.152)	(0.290)	(0.275)	(0.345)	(0.394)	(0.688)	(0.731)	(0.453)	(0.683)	(0.951)
formal sector	0.380	0.347**	0.194	0.385	0.524	0.956**	0.471***	0.668***	0.968*	0.308**	0.358	0.445*
	(0.230)	(0.153)	(0.309)	(0.349)	(0.386)	(0.465)	(0.154)	(0.239)	(0.496)	(0.134)	(0.229)	(0.250)
semi-formal	0.311	0.510***	0.381	0.498**	0.493***	0.782***	0.247***	0.310**	0.125	-0.101	-0.162	-0.288
	(0.247)	(0.158)	(0.269)	(0.225)	(0.190)	(0.267)	(0.092)	(0.135)	(0.184)	(0.099)	(0.158)	(0.185)
managerial skills	-0.055	0.082	0.167	0.167	0.010	0.117	0.057	0.018	0.054	0.128	0.093	-0.029
	(0.126)	(0.125)	(0.178)	(0.195)	(0.214)	(0.228)	(0.102)	(0.134)	(0.179)	(0.109)	(0.158)	(0.202)
Observations	255			280			282			280		

Table A-3.5: Continue…

Variables	Kenya			Mozambique			Namibia			Nigeria		
	0.25	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**
log of employment	0.395***	0.360***	0.296***	0.395***	0.425***	0.548***	0.375***	0.489***	0.626***	0.161	0.169	0.286**
	(0.079)	(0.068)	(0.086)	(0.097)	(0.097)	(0.110)	(0.118)	(0.102)	(0.136)	(0.099)	(0.137)	(0.144)
lag of ICT capital	-0.051	0.015	-0.036	0.108***	0.089***	0.088**	0.080***	0.058**	0.044	0.061**	0.059	-0.042
	(0.565)	(0.392)	(0.446)	(0.039)	(0.029)	(0.036)	(0.020)	(0.023)	(0.032)	(0.031)	(0.050)	(0.064)
lag of capital	0.050	0.093***	0.128***	0.068**	0.076**	0.012	0.063**	0.052	0.047	0.045	0.080*	0.185***
	(0.031)	(0.030)	(0.049)	(0.034)	(0.030)	(0.025)	(0.028)	(0.032)	(0.036)	(0.039)	(0.046)	(0.061)
log of raw materials	0.511***	0.453***	0.399***	0.270**	0.175***	0.100***	0.325***	0.226***	0.132***	0.414***	0.311***	0.174***
	(0.052)	(0.041)	(0.072)	(0.110)	(0.063)	(0.036)	(0.082)	(0.060)	(0.048)	(0.073)	(0.055)	(0.044)
sole proprietorship	-0.100	-0.061	-0.480	-0.027	0.160	-0.318	-0.058	0.057	0.124	-0.168	-0.037	-0.257
	(0.588)	(0.295)	(0.422)	(0.149)	(0.180)	(0.294)	(0.136)	(0.162)	(0.188)	(0.166)	(0.218)	(0.232)
sec. education	-0.059	-0.001	0.195	0.111	0.155	0.162	0.133	-0.100	0.163	-0.241	0.052	0.192
	(2.850)	(1.966)	(2.132)	(0.287)	(0.283)	(0.370)	(0.226)	(0.183)	(0.220)	(0.168)	(0.135)	(0.180)
voc. education	-0.153	-0.114	0.137	0.065	0.492	0.382	0.129	-0.173	-0.109	-0.615***	-0.503**	-0.252
	(2.875)	(1.992)	(2.214)	(0.390)	(0.469)	(0.492)	(0.250)	(0.193)	(0.256)	(0.223)	(0.222)	(0.256)
tertiary education	-0.180	-0.082	-0.132	0.271	0.375	0.501	0.023	0.035	0.434	-0.225	0.054	0.114
	(2.848)	(1.988)	(2.190)	(0.308)	(0.322)	(0.452)	(0.263)	(0.226)	(0.278)	(0.181)	(0.158)	(0.250)
manufacturing	-0.246	-0.129	0.076	0.045	0.070	0.013	-0.201	0.001	-0.255	-0.104	-0.308*	-0.181
	(0.383)	(0.263)	(0.340)	(0.213)	(0.219)	(0.211)	(0.155)	(0.177)	(0.186)	(0.128)	(0.168)	(0.157)
construction	-0.164	-1.207	-1.313	0.375	0.313	0.082	0.280	0.191	0.388	0.166	0.302	0.196
	(1.167)	(1.237)	(1.684)	(0.491)	(0.364)	(0.350)	(0.271)	(0.287)	(0.588)	(0.259)	(0.275)	(0.599)
formal sector	-0.377	0.404	0.330	0.520**	0.933***	1.091***	0.579***	1.029***	1.332***	0.242	0.508*	0.996***
	(0.970)	(0.880)	(1.179)	(0.240)	(0.219)	(0.259)	(0.198)	(0.272)	(0.234)	(0.252)	(0.276)	(0.305)
semi-formal	0.055	-0.030	0.188	0.290	0.599***	0.814***	0.248**	0.364**	0.654***	0.100	0.071	0.053
	(0.354)	(0.318)	(0.401)	(0.191)	(0.202)	(0.231)	(0.118)	(0.153)	(0.186)	(0.127)	(0.141)	(0.204)
managerial skills	0.294	0.364	0.215	0.142	0.096	0.139	0.223	0.394**	0.108	0.192	0.237	0.319
	(0.463)	(0.401)	(0.419)	(0.160)	(0.170)	(0.217)	(0.169)	(0.197)	(0.217)	(0.231)	(0.220)	(0.286)
Observations	277			280			307			265		

Table A-3.5: Continue…

Variables	Rwanda			South Africa			Tanzania			Uganda		
	0.25	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**
log of employment	0.184***	0.130	0.237***	0.697***	0.818***	0.844***	0.254***	0.269***	0.314***	0.261***	0.304***	0.323***
	(0.067)	(0.087)	(0.090)	(0.142)	(0.131)	(0.137)	(0.049)	(0.084)	(0.107)	(0.062)	(0.070)	(0.080)
lag of ICT capital	0.112***	0.118***	0.151***	0.153*	0.125**	0.083*	0.034*	0.039	0.081	0.040**	0.042*	0.051*
	(0.041)	(0.044)	(0.039)	(0.089)	(0.054)	(0.050)	(0.020)	(0.031)	(0.051)	(0.020)	(0.026)	(0.028)
lag of capital	0.098***	0.111***	0.077*	0.149**	0.070	0.040	0.106***	0.137***	0.189***	0.011	0.033	0.059*
	(0.034)	(0.036)	(0.041)	(0.068)	(0.053)	(0.038)	(0.026)	(0.046)	(0.060)	(0.020)	(0.027)	(0.033)
log of raw materials	0.359***	0.170***	0.109***	0.093***	0.083***	0.071***	0.471***	0.358***	0.144**	0.567***	0.502***	0.405***
	(0.090)	(0.055)	(0.032)	(0.031)	(0.021)	(0.023)	(0.066)	(0.103)	(0.061)	(0.036)	(0.034)	(0.047)
sole proprietorship	-0.026	0.168	0.134	-0.106	-0.302	-0.327	0.102	0.023	-0.110	0.058	0.103	0.018
	(0.148)	(0.149)	(0.184)	(0.196)	(0.245)	(0.298)	(0.119)	(0.150)	(0.170)	(0.061)	(0.066)	(0.107)
sec. education	0.000	-0.000	-0.157	0.289	0.441	0.809**	-0.130	-0.136	-0.065	0.090	-0.069	0.068
	(0.184)	(0.178)	(0.149)	(0.263)	(0.288)	(0.316)	(0.088)	(0.135)	(0.179)	(0.105)	(0.143)	(0.299)
tertiary education	0.295	0.066	-0.182	0.245	0.320	0.181	-0.095	-0.148	-0.184	0.076	0.038	0.154
	(0.251)	(0.297)	(0.294)	(0.317)	(0.329)	(0.344)	(0.091)	(0.142)	(0.213)	(0.130)	(0.151)	(0.328)
voc. education	0.025	0.059	-0.104	0.405	0.536	0.805**	-0.039	-0.163	-0.261	0.203*	0.136	0.280
	(0.239)	(0.210)	(0.223)	(0.303)	(0.328)	(0.324)	(0.130)	(0.167)	(0.220)	(0.112)	(0.148)	(0.301)
manufacturing	-0.123	-0.069	-0.085	-0.161	-0.421	-0.323	-0.091	-0.171	-0.228	-0.149**	-0.239**	-0.097
	(0.138)	(0.155)	(0.140)	(0.237)	(0.270)	(0.309)	(0.109)	(0.123)	(0.172)	(0.064)	(0.092)	(0.121)
construction	0.170	0.164	0.141	0.210	-0.190	-0.615**	0.290**	0.144	0.109	0.025	-0.039	-0.142
	(0.210)	(0.347)	(0.481)	(0.276)	(0.242)	(0.285)	(0.139)	(0.130)	(0.228)	(0.114)	(0.093)	(0.152)
formal sector	0.740***	0.935***	1.247***	0.487*	0.633**	0.794**	0.335***	0.510***	0.762***	0.379***	0.545***	0.768***
	(0.224)	(0.225)	(0.313)	(0.293)	(0.306)	(0.359)	(0.122)	(0.164)	(0.198)	(0.099)	(0.127)	(0.196)
semi-formal	0.347**	0.528***	0.832***	-0.022	0.092	0.029	0.415***	0.425***	0.402***	0.241***	0.264***	0.262***
	(0.172)	(0.193)	(0.263)	(0.259)	(0.227)	(0.259)	(0.091)	(0.127)	(0.152)	(0.070)	(0.063)	(0.092)
managerial skills	-0.027	0.147	0.131	0.239	0.308	0.278	0.015	0.041	-0.057	0.158***	0.132*	0.049
	(0.133)	(0.137)	(0.129)	(0.214)	(0.228)	(0.238)	(0.085)	(0.111)	(0.173)	(0.058)	(0.067)	(0.102)
Observations	279			290			263			351		

Table A-3.5: Continue…

Variables	Zambia			Zimbabwe		
	0.25	**0.5**	**0.75**	**0.25**	**0.5**	**0.75**
log of employment	0.242***	0.296***	0.311***	0.188	0.378**	0.678***
	(0.064)	(0.068)	(0.085)	(0.180)	(0.162)	(0.138)
lag of ICT capital	0.048**	0.021	0.039*	0.092***	0.122***	0.144***
	(0.022)	(0.023)	(0.022)	(0.023)	(0.023)	(0.026)
lag of capital	0.058***	0.083***	0.055	0.225***	0.205***	0.135***
	(0.022)	(0.027)	(0.042)	(0.077)	(0.072)	(0.043)
log of raw materials	0.584***	0.510***	0.424***	0.215**	0.112**	0.072***
	(0.039)	(0.046)	(0.053)	(0.105)	(0.051)	(0.019)
sole proprietorship	0.005	0.084	0.118	-0.172	-0.306*	-0.472**
	(0.074)	(0.085)	(0.122)	(0.180)	(0.160)	(0.189)
sec. education	-0.049	-0.146	-0.029	0.158	0.246	-0.029
	(0.256)	(0.372)	(0.488)	(0.379)	(0.497)	(0.555)
tertiary education	0.105	-0.066	-0.015	-1.332*	-0.059	-0.989
	(0.253)	(0.368)	(0.495)	(0.775)	(0.825)	(0.692)
voc. education	0.129	0.160	0.236	-0.330	-0.187	-0.825
	(0.246)	(0.371)	(0.484)	(0.349)	(0.510)	(0.537)
manufacturing	-0.187*	-0.195*	-0.182	0.175	0.138	-0.036
	(0.095)	(0.104)	(0.137)	(0.202)	(0.181)	(0.194)
construction	-0.083	0.088	0.136	0.025	-0.418	0.054
	(0.174)	(0.244)	(0.316)	(0.280)	(0.390)	(0.425)
formal sector	0.155	0.351***	0.575***	0.274	0.649***	0.737***
	(0.133)	(0.107)	(0.179)	(0.238)	(0.234)	(0.233)
semi-formal	-0.055	0.052	0.196	0.314	0.459**	0.561***
	(0.073)	(0.093)	(0.133)	(0.241)	(0.204)	(0.214)
managerial skills	0.316***	0.274***	0.348***	0.304	0.021	0.142
	(0.078)	(0.101)	(0.115)	(0.222)	(0.184)	(0.194)
Observations		276			281	

Table A-3. 5: Technical efficiency ICT capital using a Cobb-Douglas production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	0.500	0.585	0.594	0.588	0.426	0.577	0.969	0.252	0.256	1.005	0.445	0.352	0.463	0.737
	(0.07)***	(0.08)***	(0.06)***	(0.07)***	(0.06)***	(0.07)***	(0.08)***	(0.08)***	(0.08)***	(0.09)***	(0.07)***	(0.06)***	(0.06)***	(0.11)***
log of capital	0.090	0.129	0.099	0.135	0.168	0.089	0.036	0.211	0.169	0.071	0.184	0.103	0.092	0.211
	(0.02)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.02)***	(0.020)*	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.02)***	(0.02)***	(0.03)***
log of raw materials	0.137	0.196	0.273	0.228	0.283	0.141	0.110	0.222	0.146	0.066	0.162	0.322	0.423	0.096
	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.02)***	(0.03)***	(0.02)***	(0.02)	(0.02)***	(0.02)***	(0.02)***	(0.02)** *
Technical inefficiency														
ICT capital	**-0.359**	**-0.127**	**-0.437**	**-0.049**	**-0.363**	**-0.242**	**-0.369**	**0.106**	**-0.440**	**-0.506**	**-0.232**	**-0.208**	**-0.118**	**-0.380**
	(0.197)*	**(0.107)**	**(0.11)*****	**(0.117)**	**(0.144)****	**(0.09)*****	**(0.09)*****	**(0.334)**	**(0.13)*****	**(0.08)*****	**(0.174)**	**(0.159)**	**(0.128)**	**(0.13)*****
sole proprietorship	-0.468	-2.360	-1.098	0.652	-1.109	1.049	-0.731	0.915	-0.537	0.349	0.112	-0.506	-0.391	-0.549
	(1.194)	(1.01)***	(1.105)	(0.765)	(0.831)	(1.285)	(0.651)	(1.980)	(0.679)	(0.575)	(0.976)	(0.710)	(0.639)	(0.930)
firm's age	-0.082	0.010	0.068	-0.053	-0.028	0.022	0.055	0.011	0.041	-0.038	-0.015	0.003	-0.044	-0.044
	(0.062)	(0.029)	(0.036)	(0.056	(0.083)	(0.027)	(0.054)	(0.075)	(0.063)	(0.043)	(0.090)	(0.061)	(0.054)	(0.071)
sec. education	-0.053	0.222	1.887	-0.673	1.192	0.019	-0.274	-0.490	0.040	-1.551	1.150	0.016	0.856	-0.879
	(1.087)	(0.590)	(1.06)*	(0.778)	(2.026)	(0.740)	(0.754)	(1.242)	(0.626)	(0.86)*	(1.200)	(0.999)	(1.595)	(2.778)
voc. education	-1.170	-0.911	1.586	0.308	0.663	-0.128	0.136	1.037	-0.224	-0.108	0.781	-0.465	1.056	0.450
	(2.122)	(1.053)	(2.173)	(0.882)	(2.375)	(1.375)	(1.026)	(1.385)	(1.114)	(1.055)	(1.388)	(1.250)	(1.606)	(2.608)
tertiary education	0.386	-0.299	1.449	-1.538	0.299	-1.024	1.011	-0.386	0.473	-1.494	2.456	-1.606	-0.341	0.777
	(2.047)	(0.887)	(1.192)	(1.184)	(2.162)	(1.205)	(0.914)	(1.461)	(0.851)	(0.86)*	(1.491)	(1.216)	(1.586)	(1.958)
manufacturing	0.310	-0.043	-0.376	0.957	-0.169	-0.208	1.721	0.341	0.443	1.327	0.824	0.336	0.860	-0.936
	(1.296)	(0.597)	(0.742)	(0.762)	(0.853)	(0.754)	0.598	(0.969)	(0.667)	(0.60)**	(0.954)	(0.636)	(0.702)	(1.172)
construction	1.184	-0.612	-4.087	0.588	0.402	-1.072	-0.834	-1.418	-1.169	-0.356	-1.171	0.061	-0.140	-0.286
	(1.867)	(0.842)	(7.839)	(1.150)	(1.490)	(1.607)	2.040	(2.264)	(1.538)	(1.431)	(2.453)	(1.051)	(1.099)	(1.776)
formal sector	-3.509	-3.713	-0.477	-0.907	-3.129	-3.325	-2.282	-3.895	-2.604	0.012	-4.300	-3.196	-1.944	-0.621
	(3.072)	(2.284)	(1.222)	(1.319)	(2.171)	(1.53)**	1.008	(2.799)	(1.44)*	(0.722)	(1.682)**	(1.54)**	(1.306)	(1.320)
semi-formal	-1.784	-2.877	-1.138	0.932	-0.923	-1.187	-0.574	0.231	-2.299	0.334	-2.751	-2.606	-0.845	-1.120
	(1.570)	(1.35)**	(0.944)	(0.804)	(1.031)	(0.693)	0.667	(1.020)	(1.26)*	(0.663)	(1.253)**	(1.20)**	(0.739)	(1.054)
managerial skills	-0.311	-2.088	-2.109	-1.295	-0.238	-0.412	-1.025	0.609	0.008	-0.779	-0.036	-0.559	-2.131	0.029
	(3.612)	(1.26)*	(1.586)	(1.165)	(1.164)	(0.841)	0.977	(1.461)	(0.655)	(0.618)	(1.132)	(0.851)	(1.423)	(0.961)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.088	0.303	0.203	0.186	0.115	0.214	0.333	0.083	0.318	0.418	0.079	0.115	0.171	0.117
$\gamma = \sigma_u^2/\sigma^2$	0.081	0.232	0.169	0.157	0.103	0.176	0.250	0.076	0.241	0.295	0.074	0.103	0.146	0.105
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe

Table A-3. 6: Technical efficiency computer accessibility using a Cobb-Douglas production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	0.496	0.590	0.617	0.589	0.420	0.550	1.027	0.263	0.257	1.024	0.454	0.382	0.466	0.797
	(0.071)***	(0.072)***	(0.067)***	(0.075)***	(0.061)	(0.070)***	(0.089)***	(0.081)***	(0.078)***	(0.099)***	(0.070)***	(0.060)***	(0.057)***	(0.111)***
log of capital	0.090	0.112	0.110	0.158	0.176	0.086	0.050	0.213	0.187	0.104	0.191	0.103	0.091	0.236
	(0.020)***	(0.027)***	(0.025)***	(0.023)***	(0.024)	(0.018)***	(0.020)**	(0.027)***	(0.030)***	(0.030)***	(0.027)***	(0.023)***	(0.022)***	(0.032)***
log of raw	0.137	0.169	0.281	0.263	0.288	0.137	0.114	0.227	0.154	0.077	0.174	0.347	0.428	0.093
materials	(0.020)***	(0.022)***	(0.020)***	(0.022)***	(0.021)	(0.019)***	(0.024)***	(0.025)***	(0.018)***	(0.017)***	(0.022)***	(0.019)***	(0.022)***	(0.018)***
Technical inefficiency														
computer access	**-0.312**	**0.394**	**-0.404**	**-0.507**	**-0.596**	**-4.270**	**-0.400**	**0.768**	**-0.640**	**-1.245**	**-1.360**	**-0.605**	**-1.394**	**0.496**
	(1.020)	**(0.859)**	**(0.733)**	**(0.936)**	**(0.976)**	**(1.838)****	**(0.855)**	**(1.160)**	**(1.062)**	**(0.511)****	**(1.368)**	**(0.934)**	**(1.083)**	**(0.657)**
sole proprietorship	-1.046	-2.431	-1.542	0.732	-1.395	1.057	-0.880	0.418	-0.526	-0.066	0.081	-0.515	-0.234	0.342
	(1.088)	(0.900)***	(0.853)	(0.817)	(0.709)**	(0.961)	(0.918)	(1.352)	(0.713)	(0.477)	(0.946)	(0.690)	(0.658)	(0.563)
firm's age	-0.043	0.043	0.058	-0.058	-0.055	0.025	0.080	0.016	0.030	-0.034	-0.014	-0.008	-0.047	-0.032
	(0.055)	(0.027)	(0.036)	(0.051)	(0.085)	(0.023)	(0.055)	(0.054)	(0.066)	(0.030)	(0.086)	(0.058)	(0.054)	(0.039)
sec. education	-0.298	0.076	1.591	-0.493	1.073	-0.546	-0.148	-0.412	-0.627	-0.718	0.472	-0.153	0.657	0.111
	(1.034)	(0.537)	(1.479)	(0.814)	(1.916)	(0.669)	(1.325)	(1.085)	(0.568)	(0.769)	(0.997)	(0.956)	(1.633)	(1.614)
voc. education	-2.384	-1.231	1.155	0.230	0.077	-0.155	-0.824	0.869	-0.509	-0.748	0.492	-0.778	0.808	-0.662
	(2.445)	(1.003)	(2.483)	(0.879)	(2.230)	(1.178)	(1.891)	(1.248)	(1.100)	(1.087)	(1.213)	(1.194)	(1.646)	(2.325)
tertiary education	-0.898	-0.472	1.269	-0.981	-0.223	-0.771	1.370	-0.390	-0.556	-0.648	1.533	-1.656	-0.286	0.502
	(1.645)	(0.878)	(1.491)	(1.010)	(1.996)	(1.004)	(0.936)	(1.339)	(0.851)	(0.813)	(1.167)	(1.104)	(1.641)	(1.580)
manufacturing	1.394	0.222	-0.553	0.731	0.113	-0.581	2.891	0.266	0.050	1.775	0.445	0.265	0.940	-0.902
	(1.122)	(0.548)	(0.732)	(0.620)	(0.735)	(0.637)	(1.184)**	(0.888)	(0.666)	(0.467)***	(0.881)	(0.635)	(0.706)	(0.875)
construction	0.380	-0.574	-5.734	-2.027	0.180	-0.265	-2.115	-2.521	-1.070	-1.153	-1.498	-0.226	-0.119	-0.813
	(2.255)	(0.763)	(6.267)	(3.229)	(1.493)	(1.171)	(5.524)	(2.876)	(1.466)	(1.237)	(2.199)	(1.069)	(1.154)	(1.362)
formal sector	-4.393	-3.808	-0.301	-0.672	-3.409	-2.065	-2.673	-2.636	-4.904	0.661	-3.627	-3.889	-1.160	-0.433
	(2.598)*	(1.654)**	(0.894)	(1.207)	(1.991)*	(1.014)**	(1.031)**	(2.195)	(2.192)**	(0.646)	(1.452)**	(1.858)**	(1.455)	(0.719)
semi-formal	-2.486	-2.942	-1.594	0.953	-1.340	-0.995	-1.133	-0.023	-3.511	1.121	-2.355	-2.170	-0.530	-0.576
	(1.304)**	(1.142)**	(0.831)*	(0.665)	(0.952)	(0.600)*	(0.777)	(0.868)	(1.543)**	(0.625)*	(0.931)**	(0.966)**	(0.725)	(0.852)
managerial skills	0.314	-1.849	-2.889	-0.967	-0.487	-0.061	-1.611	-0.016	-0.365	-1.330	-0.319	-0.856	-1.871	0.509
	(2.012)	(0.960)*	(1.833)	(0.898)	(1.015)	(0.687)	(1.675)	(1.384)	(0.708)	(0.528)**	(1.026)	(0.850)	(1.345)	(0.550)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.089	0.438	0.245	0.157	0.127	0.303	0.260	0.115	0.225	0.712	0.094	0.125	0.145	0.284
$\gamma = \sigma_u^2/\sigma^2$	0.082	0.305	0.197	0.135	0.113	0.232	0.207	0.103	0.184	0.416	0.086	0.111	0.126	0.221
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe

Table A-3. 7: Technical efficiency Internet accessibility using a Cobb-Douglas production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	0.497	0.592	0.647	0.593	0.426	0.563	1.024	0.263	0.265	1.019	0.457	0.398	0.469	0.78
	(0.071)***	(0.073)***	(0.067)***	(0.075)***	(0.060)***	(0.070)***	(0.088)***	(0.081)***	(0.077)***	(0.101)***	(0.070)***	(0.059)***	(0.057)***	(0.11)***
log of capital	0.091	0.116	0.066	0.158	0.174	0.083	0.047	0.211	0.187	0.113	0.191	0.105	0.093	0.23
	(0.020)***	(0.028)***	(0.025)***	(0.023)***	(0.024)***	(0.018)***	(0.020)**	(0.027)***	(0.030)***	(0.030)***	(0.027)***	(0.022)***	(0.022)***	(0.03)***
log of raw materials	0.135	0.176	0.224	0.263	0.289	0.140	0.115	0.228	0.153	0.078	0.174	0.349	0.427	0.09
	(0.020)***	(0.022)***	(0.020)***	(0.022)***	(0.021)***	(0.019)***	(0.024)***	(0.026)***	(0.018)***	(0.018)***	(0.022)***	(0.019)***	(0.023)***	(0.02)***
Technical inefficiency														
internet access	**0.613**	**-0.108**	**-3.501**	**-0.682**	**-1.935**	**-3.409**	**0.460**	**0.052**	**-0.767**	**-0.160**	**-2.355**	**-1.968**	**-0.548**	**-0.31**
	(1.350)	**(0.853)**	**(1.644)****	**(1.290)**	**(1.681)**	**(1.543)****	**(0.976)**	**(1.269)**	**(1.361)**	**(0.486)**	**(2.830)**	**(1.463)**	**(1.136)**	**(0.58)**
sole proprietorship	-1.025	-2.639	-0.987	0.715	-1.367	1.006	-0.859	0.372	-0.491	0.231	0.168	-0.385	-0.345	0.22
	(1.071)	(0.924)***	(0.757)	(0.786)	(0.670)**	(0.894)	(0.924)	(1.256)	(0.702)	(0.473)	(0.946)	(0.617)	(0.673)	(0.56)
firm's age	-0.051	0.036	0.038	-0.056	-0.032	0.038	0.079	0.015	0.030	-0.040	-0.009	-0.006	-0.040	-0.03
	(0.054)	(0.027)	(0.027)	(0.049)	(0.073)	(0.023)	(0.057)	(0.051)	(0.066)	(0.030)	(0.086)	(0.055)	(0.056)	(0.04)
sec. education	-0.380	0.078	1.257	-0.510	1.092	-0.393	-0.229	-0.375	-0.643	-0.722	0.586	-0.142	0.621	0.10
	(1.015)	(0.544)	(0.803)	(0.797)	(1.847)	(0.641)	(1.350)	(1.073)	(0.570)	(0.751)	(1.012)	(0.896)	(1.659)	(1.65)
voc. education	-2.456	-1.187	0.788	0.245	0.113	-0.540	-0.735	0.842	-0.498	-0.900	0.562	-0.744	0.743	-0.49
	(2.428)	(1.024)	(1.689)	(0.865)	(2.174)	(1.185)	(1.810)	(1.239)	(1.100)	(1.064)	(1.219)	(1.116)	(1.667)	(2.24)
tertiary education	-1.176	-0.280	0.823	-1.018	-0.068	-1.009	0.820	-0.100	-0.648	-0.965	1.474	-1.227	-0.349	0.68
	(1.555)	(0.811)	(0.895)	(0.950)	(1.916)	(0.950)	(1.061)	(1.198)	(0.830)	(0.789)	(1.160)	(0.984)	(1.677)	(1.62)
manufacturing	1.456	0.154	0.038	0.749	0.076	-0.361	2.718	0.303	0.054	1.999	0.554	0.273	1.025	-0.85
	(1.154)	(0.555)	(0.560)	(0.612)	(0.708)	(0.596)	(1.180)**	(0.869)	(0.664)	(0.465)***	(0.874)	(0.564)	(0.724)	(0.83)
construction	0.420	-0.577	-1.651	-1.920	0.181	-0.115	-2.180	-2.425	-0.999	-1.102	-1.388	-0.227	-0.062	-0.66
	(2.176)	(0.765)	(2.641)	(2.857)	(1.526)	(1.139)	(5.009)	(2.787)	(1.450)	(1.235)	(2.218)	(0.952)	(1.178)	(1.28)
formal sector	-4.601	-3.798	0.256	-0.658	-2.506	-2.453	-2.869	-2.344	-4.963	0.422	-3.638	-3.009	-2.052	-0.22
	(2.520)*	(1.717)**	(0.971)	(1.152)	(1.969)	(0.950)**	(0.996)***	(2.192)	(2.062)**	(0.631)	(1.507)**	(1.459)**	(1.400)	(0.68)
semi-formal	-2.593	-3.123	-1.298	0.867	-1.206	-1.291	-1.259	0.138	-3.472	0.803	-2.386	-1.885	-0.785	-0.48
	(1.279)**	(1.261)**	(0.657)**	(0.646)	(0.849)	(0.561)**	(0.756)*	(0.815)	(1.523)**	(0.593)	(0.941)**	(0.774)**	(0.749)	(0.82)
managerial skills	0.501	-1.944	-1.953	-0.890	-0.667	-0.233	-1.676	0.056	-0.361	-1.179	-0.261	-0.880	-2.173	0.45
	(1.658)	(1.031)*	(0.868)**	(0.875)	(0.984)	(0.649)	(1.692)	(1.498)	(0.691)	(0.515)**	(1.036)	(0.732)	(1.557)	(0.55)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.099	0.415	0.410	0.165	0.133	0.372	0.258	0.118	0.226	0.716	0.095	0.168	0.133	0.280
$\gamma = \sigma_u^2/\sigma^2$	0.090	0.293	0.291	0.142	0.117	0.271	0.205	0.106	0.184	0.417	0.087	0.144	0.117	0.219
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe

Table A-3. 8: Technical efficiency ICT capital using a Translog production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.386	0.338	0.831	0.700	0.358	0.972	2.189	0.643	0.506	0.827	0.360	1.259	0.739	-0.283
	(0.37)***	(0.294)	(0.31)***	(0.304)**	(0.230)	(0.22)***	(0.217)***	(0.227)***	(0.262)*	(0.268)***	(0.219)	(0.261)***	(0.236)***	(0.342)
log of capital	0.038	-0.144	0.085	0.275	0.722	0.083	-0.016	-0.280	0.304	-0.214	0.289	-0.017	0.209	-0.069
	(0.092)	(0.102)	(0.117)	(0.09)***	(0.05)***	(0.047)*	(0.055)	(0.102)***	(0.103)***	(0.074)***	(0.081)***	(0.117)	(0.118)*	(0.097)
log of raw materials	-0.112	-0.204	-0.205	-0.006	0.426	-0.216	-0.110	-0.263	-0.224	-0.399	-0.154	-0.308	0.053	-0.382
	(0.070)	(0.08)***	(0.083)**	(0.077)	(0.05)***	(0.05)***	(0.062)*	(0.080)***	(0.050)***	(0.053)***	(0.060)**	(0.073)***	(0.089)	(0.098)***
labour square	0.073	0.336	0.092	0.176	0.236	0.172	0.064	-0.226	-0.031	0.010	-0.037	-0.071	0.083	0.059
	(0.128)	(0.11)***	(0.090)	(0.102)*	(0.102)**	(0.096)*	(0.113)	(0.092)**	(0.082)	(0.109)	(0.079)	(0.081)	(0.099)	(0.169)
capital square	0.036	0.034	0.015	0.013	0.030	0.016	0.037	0.042	0.008	0.040	0.017	0.034	0.025	0.015
	(0.01)***	(0.01)***	(0.009)	(0.005)**	(0.01)***	(0.01)***	(0.008)***	(0.012)***	(0.013)	(0.009)***	(0.009)**	(0.010)***	(0.099)**	(0.008)**
raw material square	0.077	0.054	0.082	0.089	0.093	0.097	0.079	0.081	0.100	0.096	0.100	0.102	0.097	0.088
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.008)***	(0.009)***	(0.006)***	(0.008)***	(0.007)***	(0.007)***	(0.011)***	(0.006)***
labour *x* capital	-0.046	-0.050	-0.022	-0.002	-0.002	-0.006	-0.063	0.028	0.007	0.006	0.004	-0.014	0.014	0.075
	(0.023)**	(0.03)**	(0.029)	(0.02)***	(0.033)	(0.017)	(0.017)***	(0.028)	(0.026)	(0.019)**	(0.020)	(0.028)	(0.024)	(0.032)**
labour *x* raw material	-0.070	-0.001	-0.034	-0.065	-0.046	-0.088	-0.136	-0.029	-0.028	-0.037	-0.017	-0.065	-0.074	-0.034
	(0.034)**	(0.025)	(0.023)	(0.024)	(0.022)**	(0.02)***	(0.025)***	(0.023)	(0.018)	(0.016)**	(0.020)	(0.022)***	(0.026)***	(0.020)*
capital *x* raw material	-0.012	0.012	-0.012	-0.026	-0.087	-0.013	-0.005	-0.004	-0.027	-0.003	-0.031	-0.018	-0.035	-0.010
	(0.008)	(0.010)	(0.011)	(0.01)***	(0.01)***	(0.004)***	(0.004)	(0.009)	(0.007)***	(0.004)	(0.006)***	(0.011)	(0.011)***	(0.008)
Technical inefficiency														
ICT capital	**0.054**	**-0.135**	**-0.428**	**-0.167**	**-0.064**	**-0.307**	**-0.387**	**-0.203**	**-0.301**	**-0.562**	**-0.119**	**-0.079**	**-0.215**	**-0.286**
	(0.172)	**(0.111)**	**(0.09)*** **	**(0.106)**	**(0.152)**	**(0.108)*** **	**(0.093)**	**(0.292)**	**(0.120)** **	**(0.090)*** **	**(0.174)**	**(0.147)**	**(0.164)**	**(0.068)*** **
sole proprietorship	-0.931	-2.943	-1.616	-0.654	-1.007	0.431	-0.885	-0.054	-0.022	0.260	0.298	-0.724	-0.540	-0.283
	(0.989)	(1.05)***	(0.963)**	(0.752	(1.007)	(1.388)	(0.636)	(1.102)	(0.869)	(0.601)	(0.990)	(0.596)	(0.834)	(0.574)
firm's age	-0.075	0.008	0.078	-0.066	-0.049	-0.006	0.112	-0.098	-0.009	0.033	-0.046	0.027	-0.022	0.014
	(0.176)	(0.029)	(0.032)**	(0.066)	(0.090)	(0.040)	(0.047)**	(0.096)	(0.070)	(0.043)	(0.090)	(0.061)	(0.066)	(0.039)
sec. education	-0.665	0.336	1.118	-0.639	-0.568	-0.090	0.363	-0.675	-0.125	-0.375	0.794	-0.174	1.137	1.166
	(1.414)	(0.598)	(0.915)	(1.123)	(1.558)	(0.919)	(0.837)	(0.975)	(0.677)	(1.029)	(1.090)	(0.748)	(1.993)	(1.903)
voc. education	-0.365	-0.382	-0.633	-0.244	-0.823	0.079	-0.015	1.209	0.339	0.047	0.758	-1.150	1.823	2.084
	(1.393)	(0.938)	(2.656)	(1.120)	(1.971)	(1.815)	(0.685)	(1.077)	(1.126)	(1.327)	(1.271)	(0.908)	(2.041)	(2.143)
tertiary education	-1.490	-0.248	1.056	-0.744	-1.105	-0.500	2.338	-0.939	-1.246	-0.299	1.324	-1.793	0.162	1.282
	(1.830)	(0.897)	(1.059)	(1.118)	(1.739)	(1.290)	(0.984)**	(1.298)	(1.271)	(1.067)	(1.508)	(1.234)	(2.018)	(1.892)
manufacturing	-0.420	-0.348	-0.705	0.618	0.400	-0.716	1.420	-0.027	0.118	1.463	0.499	0.805	0.887	-0.781
	(1.758)	(0.630)	(0.705)	(0.757)	(0.891)	(0.975)	(0.571)**	(0.783)	(0.756)	(0.635)**	(1.001)	(0.573)	(0.845)	(0.750)
construction	-0.804	-0.827	0.048	-2.153	0.716	-1.320	-1.184	-1.258	-0.006	0.580	-2.234	-0.007	0.276	-1.363
	(1.830)	(0.862)	(1.421)	(2.795)	(1.493)	(2.417)	(2.064)	(2.150)	(1.347)	(1.187)	(2.927)	(0.889)	(1.208)	(1.780)
formal sector	-0.508	-3.295	-1.351	-0.793	-3.046	-3.035	-2.141	-0.676	-1.551	0.339	-3.417	-4.196	-2.097	0.242
	(1.347)	(2.276)	(0.984)	(1.624)	(2.183)	(1.792)*	(1.029)**	(1.899)	(1.710)	(0.742)	(1.833)*	(2.660)	(1.685)	(0.680)
semi-formal	-1.589	-3.574	-2.378	1.930	-0.646	-1.202	-0.124	0.531	-1.553	0.667	-2.464	-2.097	-0.837	-1.804
	(2.510)	(1.32)***	(0.993)**	(1.040)*	(1.023)	(0.866)	(0.681)	(0.800)	(1.249)	(0.710)	(1.305)*	(1.754)	(0.966)	(1.133)
managerial skills	-1.247	-2.150	-2.063	-1.210	-1.049	-0.566	0.502	-0.181	-0.759	-0.947	-0.771	-0.990	-1.732	0.007
	(2.270)	(1.213)**	(1.340)	(0.985)	(1.298)	(1.000)	(0.720)	(0.971)	(0.880)	(0.666)	(1.162)	(0.942)	(1.792)	(0.564)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.092	0.332	0.427	0.111	0.086	0.110	0.372	0.147	0.181	0.472	0.098	0.270	0.082	0.353
$\gamma = \sigma_u^2/\sigma^2$	0.084	0.249	0.299	0.100	0.079	0.099	0.271	0.128	0.153	0.321	0.089	0.213	0.076	0.261
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe.

Table A-3. 9: Technical efficiency computer accessibility using a Translog production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.133	0.429	0.354	0.729	1.071	0.778	2.106	0.608	0.457	0.807	0.363	1.210	0.680	-0.337
	(0.296)***	(0.294)	(0.349)	(0.302)**	(0.230)***	(0.205)***	(0.220)***	(0.207)	(0.262)*	(0.295)	(0.217)*	(0.296)***	(0.235)***	(0.329)
log of capital	-0.029	-0.184	0.371	0.279	0.203	0.101	0.017	-0.092	0.324	-0.150	0.303	0.017	0.211	0.113
	(0.076)	(0.100)*	(0.126)***	(0.085)***	(0.086)**	(0.045)**	(0.055)	(0.083)***	(0.105)***	(0.079)*	(0.080)***	(0.131)	(0.118)*	(0.103)
log of raw materials	-0.071	-0.234	-0.059	-0.001	-0.094	-0.231	-0.146	-0.398	-0.214	-0.402	-0.149	-0.304	0.048	-0.212
	(0.052)	(0.075)***	(0.086)	(0.077)	(0.081)	(0.052)***	(0.064)**	(0.078)**	(0.050)***	(0.062)***	(0.059)**	(0.083)***	(0.088)	(0.081)***
labour square	0.213	0.335	0.002	0.177	0.262	0.159	0.053	-0.229	-0.060	-0.034	-0.035	-0.024	0.086	0.094
	(0.098)***	(0.109)***	(0.098)	(0.102)*	(0.102)	(0.091)*	(0.116)	(0.093)**	(0.083)	(0.121)	(0.079)	(0.093)	(0.097)	(0.177)
capital square	0.042	0.038	0.007	0.012	0.032	0.013	0.034	0.015	0.009	0.036	0.016	0.028	0.023	0.019
	(0.008)***	(0.012)***	(0.010)	(0.005)**	(0.009)***	(0.005)**	(0.008)***	(0.011)	(0.013)	(0.010)***	(0.009)*	(0.011)**	(0.010)**	(0.007)***
raw material square	0.064	0.055	0.091	0.089	0.093	0.094	0.084	0.092	0.101	0.099	0.099	0.101	0.093	0.093
	(0.007)***	(0.011)***	(0.006)***	(0.006)***	(0.007)***	(0.007)***	(0.008)***	(0.009)***	(0.006)***	(0.009)***	(0.007)***	(0.008)***	(0.010)***	(0.009)***
labour *x* capital	-0.056	-0.059	0.021	-0.002	-0.056	-0.005	-0.063	0.035	0.009	0.010	0.005	-0.018	0.009	0.082
	(0.017)***	(0.025)**	(0.032)	(0.017)	(0.033)*	(0.016)	(0.017)***	(0.026)	(0.026)	(0.021)	(0.020)	(0.031)	(0.023)	(0.032)**
labour *x* raw material	-0.068	-0.005	-0.014	-0.069	-0.072	-0.069	-0.124	-0.035	-0.020	-0.026	-0.016	-0.065	-0.064	-0.035
	(0.024)***	(0.024)	(0.026)	(0.024)***	(0.021)***	(0.020)***	(0.025)***	(0.024)	(0.017)	(0.019)	(0.020)	(0.025)***	(0.025)**	(0.022)
capital *x* raw material	-0.010	0.015	-0.037	-0.026	-0.026	-0.012	-0.005	0.004	-0.030	-0.007	-0.032	-0.016	-0.032	-0.027
	(0.006)*	(0.009)	(0.012)	(0.007)***	(0.010)***	(0.004)***	(0.004)	(0.008)	(0.007)***	(0.005)	(0.006)***	(0.013)	(0.011)***	(0.009)***
Technical inefficiency														
computer access	**0.141**	**0.528**	**-0.958**	**-1.209**	**-0.620**	**-4.073**	**0.168**	**0.857**	**-0.707**	**-0.705**	**-1.284**	**-0.308**	**-1.450**	**1.897**
	(0.902)	**(0.859)**	**(0.753)**	**(0.878)**	**(0.932)**	**(1.739)****	**(0.788)**	**(1.302)**	**(1.501)**	**(0.481)**	**(1.172)**	**(0.865)**	**(0.967)**	**(3.820)**
sole proprietorship	-1.833	-3.153	-1.959	-0.738	-1.832	0.906	-0.873	0.510	0.034	-0.153	0.128	-0.749	-0.188	-0.167
	(0.929)**	(0.948)***	(0.915)**	(0.707)	(0.725)**	(0.895)	(0.665)	(1.351)	(1.010)	(0.453)	(0.823)	(0.650)	(0.632)	(0.736)
firm's age	-0.012	0.005	0.074	-0.061	-0.031	0.006	0.146	-0.070	-0.008	-0.007	-0.104	-0.030	-0.053	0.012
	(0.055)	(0.029)	(0.032)**	(0.061)	(0.054)	(0.025)	(0.052)***	(0.089)	(0.083)	(0.031)	(0.091)	(0.058)	(0.059)	(0.037)
sec. education	-0.416	0.304	0.478	-0.274	0.096	-0.602	0.673	-0.759	-0.905	0.105	0.349	-0.230	0.911	2.061
	(0.867)	(0.592)	(0.750)	(0.994)	(1.289)	(0.714)	(0.961)	(1.117)	(0.674)	(0.771)	(0.800)	(0.905)	(1.783)	(4.957)
voc. education	-2.944	-0.501	-1.208	-0.018	-0.690	1.029	-0.339	1.324	-0.130	-0.570	0.648	-1.034	1.334	-0.370
	(1.903)	(0.905)	(3.274)	(1.020)	(1.629)	(1.185)	(1.245)	(1.276)	(1.238)	(1.091)	(0.972)	(1.156)	(1.829)	(4.270)
tertiary education	-1.373	-0.217	0.459	-0.151	-1.136	0.372	2.495	-1.404	-2.531	0.070	1.126	-1.750	0.287	1.173
	(1.146)	(0.913)	(0.900)	(1.042)	(1.432)	(1.001)	(1.151)**	(1.435)	(1.547)	(0.793)	(0.963)	(1.059)*	(1.808)	(3.395)
manufacturing	1.454	-0.283	-1.317	0.468	0.186	-0.890	2.513	-0.166	-0.118	1.756	0.039	0.760	0.856	-2.097
	(0.908)	(0.623)	(0.874)	(0.700)	(0.661)	(0.705)	(0.702)***	(0.932)	(0.842)	(0.450)***	(0.728)	(0.620)	(0.670)	(4.376)
construction	-0.770	-0.699	-1.010	-1.931	0.219	-1.475	-1.649	-2.514	-0.142	-1.072	-1.712	-0.090	0.199	-1.288
	(2.320)	(0.824)	(1.373)	(2.323)	(1.310)	(1.512)	(2.732)	(3.519)	(1.515)	(1.025)	(1.802)	(1.070)	(1.020)	(2.060)
formal sector	-3.684	-4.252	-0.633	-1.186	-3.205	-2.432	-2.970	-0.906	-2.023	0.623	-2.446	-3.860	-0.940	-0.335
	(1.416)***	(1.884)**	(0.876)	(1.714)	(1.891)*	(1.051)**	(1.117)***	(1.931)	(2.168)	(0.648)	(1.096)**	(1.701)**	(1.242)	(0.894)
semi-formal	-1.897	-3.630	-2.710	1.782	-1.313	-0.933	-0.868	0.247	-1.943	1.063	-2.014	-1.865	-0.557	-2.503
	(1.034)*	(1.093)***	(0.988)***	(0.844)**	(0.860)	(0.625)	(0.734)	(0.852)	(1.549)	(0.609)*	(0.778)**	(0.838)**	(0.687)	(8.456)
managerial skills	0.058	-2.070	-3.198	-1.201	-1.279	-0.356	0.605	0.323	-1.221	-1.083	-0.730	-0.961	-1.207	1.037
	(1.100)	(0.986)**	(1.685)*	(0.948)	(1.151)	(0.705)	(0.769)	(1.348)	(1.106)	(0.484)**	(0.853)	(0.801)	(1.037)	(1.926)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.173	0.379	0.410	0.134	0.214	0.383	0.349	0.105	0.113	1.191	0.197	0.146	0.177	0.240
$\gamma = \sigma_u^2/\sigma^2$	0.148	0.275	0.291	0.118	0.177	0.277	0.259	0.095	0.102	0.544	0.164	0.127	0.150	0.193
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe

Table A-3. 10: Technical efficiency Internet accessibility using a Translog production function specification

Variables	Bot	Cam	Eth	Gha	Ken	Moz	Nam	Nig	Rwa	SA	Tan	Uga	Zam	Zim
Production frontier														
log of employment	1.087	0.434	0.541	0.774	1.061	0.838	0.377	0.622	0.477	0.674	0.377	1.233	0.711	-0.285
	(0.300)***	(0.297)	(0.325)*	(0.304)**	(0.226)***	(0.205)***	(0.222)*	(0.213)***	(0.262)*	(0.311)**	(0.222)*	(0.295)***	(0.228)***	(0.333)
log of capital	-0.019	-0.194	0.263	0.270	0.203	0.096	0.290	-0.118	0.320	-0.160	0.290	0.025	0.236	0.098
	(0.081)	(0.103)*	(0.123)**	(0.085)***	(0.085)**	(0.045)**	(0.082)***	(0.090)	(0.104)**	(0.081)**	(0.082)***	(0.129)	(0.115)**	(0.097)
log of raw materials	-0.074	-0.265	-0.136	0.0003	-0.088	-0.218	-0.153	-0.396	-0.217	-0.409	-0.153	-0.306	0.060	-0.198
	(0.051)	(0.076)	(0.087)	(0.077)	(0.080)	(0.053)***	(0.061)**	(0.080)	(0.051)***	(0.061)***	(0.061)**	(0.082)***	(0.086)	(0.089)**
labour square	0.226	0.348	0.050	0.170	0.264	0.102	-0.037	-0.233	-0.049	0.00007	-0.037	-0.024	0.082	0.065
	(0.101)**	(0.110)***	(0.095)	(0.103)*	(0.101)***	(0.092)	(0.081)	(0.092)**	(0.084)	(0.125)	(0.081)	(0.093)	(0.096)	(0.179)
capital square	0.041	0.035	0.010	0.012	0.032	0.015	0.016	0.019	0.009	0.040	0.016	0.026	0.022	0.021
	(0.009)***	(0.012)***	(0.009)	(0.005)**	(0.009)***	(0.005)***	(0.009)*	(0.013)	(0.013)	(0.011)***	(0.009)*	(0.011)**	(0.010)**	(0.008)***
raw material square	0.064	0.059	0.088	0.088	0.092	0.091	0.100	0.091	0.102	0.101	0.100	0.100	0.093	0.091
	(0.006)***	(0.012)***	(0.006)***	(0.006)***	(0.006)***	(0.008)***	(0.007)***	(0.009)***	(0.006)***	(0.009)***	(0.007)***	(0.008)	(0.010)***	(0.006)***
labour *x* capital	-0.056	-0.060	-0.002	-0.002	-0.058	-0.013	0.005	0.033	0.008	0.010	0.005	-0.019	0.008	0.081
	(0.016)***	(0.025)**	(0.030)	(0.017)	(0.032)*	(0.016)	(0.021)	(0.027)	(0.026)	(0.022)	(0.021)	(0.031)	(0.023)	(0.033)**
labour *x* raw material	-0.066	-0.011	-0.019	-0.071	-0.070	-0.058	-0.019	-0.034	-0.023	-0.021	-0.019	-0.065	-0.067	-0.033
	(0.024)***	(0.025)	(0.025)	(0.024)***	(0.021)***	(0.020)***	(0.020)	(0.023)	(0.018)	(0.019)	(0.020)	(0.025)***	(0.025)***	(0.022)
capital *x* raw material	-0.010	0.018	-0.027	-0.025	-0.026	-0.013	-0.030	0.004	-0.030	-0.008	-0.030	-0.014	-0.034	-0.028
	(0.006)*	(0.010)*	(0.011)**	(0.007)***	(0.010)***	(0.004)	(0.006)***	(0.008)	(0.007)***	(0.005)	(0.006)***	(0.013)	(0.011)***	(0.008)***
Technical inefficiency														
ICT capital	**0.621**	**0.048**	**-3.201**	**-1.565**	**-0.920**	**-3.250**	**-2.141**	**1.193**	**-0.353**	**0.593**	**-2.141**	**-1.981**	**-0.827**	**0.363**
	(1.133)	**(0.864)**	**(1.059)*** **	**(1.452)**	**(1.337)**	**(1.700)***	**(2.563)**	**(1.251)**	**(1.513)**	**(0.480)**	**(2.563)**	**(1.351)**	**(1.116)**	**(0.464)**
sole proprietorship	-1.745	-3.334	-1.592	-0.614	-1.844	1.249	0.275	0.402	-0.028	0.231	0.275	-0.672	-0.278	-0.192
	(0.961)*	(0.913)***	(0.775)**	(0.673)	(0.700)***	(1.277)	(0.936)	(1.174)	(0.988)	(0.448)	(0.936)	(0.575)	(0.673)	(0.545)
firm's age	-0.020	0.000	0.050	-0.056	-0.025	-0.003	-0.056	-0.090	-0.007	-0.005	-0.056	-0.037	-0.046	0.011
	(0.081)	(0.030)	(0.027)*	(0.056)	(0.054)	(0.038)	(0.086)	(0.090)	(0.082)	(0.031)	(0.086)	(0.054)	(0.063)	(0.031)
sec. education	-0.420	0.285	0.508	-0.298	0.165	-0.703	0.476	-0.696	-0.872	0.033	0.476	-0.145	0.793	1.545
	(0.828)	(0.612)	(0.671)	(0.954)	(1.302)	(0.796)	(0.920)	(1.087)	(0.663)	(0.809)	(0.920)	(0.861)	(1.799)	(2.146)
voc. education	-2.832	-0.491	-1.167	0.074	-0.619	-0.377	0.676	1.295	-0.123	-0.820	0.676	-0.813	1.211	0.791
	(1.866)	(0.942)	(2.253)	(0.995)	(1.642)	(1.499)	(1.152)	(1.266)	(1.220)	(1.130)	(1.152)	(1.087)	(1.837)	(2.687)
tertiary education	-1.484	0.145	0.372	-0.337	-1.085	-0.274	1.042	-1.287	-2.585	-0.279	1.042	-1.193	0.185	1.345
	(1.192)	(0.846)	(0.798)	(0.992)	(1.421)	(1.032)	(1.083)	(1.286)	(1.532)*	(0.828)	(1.083)	(0.938)	(1.829)	(2.104)
manufacturing	1.466	-0.309	-0.658	0.556	0.190	-0.824	0.181	-0.113	-0.140	1.938	0.181	0.682	1.003	-1.117
	(0.897)	(0.637)	(0.683)	(0.679)	(0.646)	(0.881)	(0.835)	(0.915)	(0.827)	(0.440)***	(0.835)	(0.546)	(0.706)	(0.918)
construction	-0.776	-0.780	-0.283	-1.727	0.280	-1.671	-2.163	-2.428	-0.092	-1.170	-2.163	-0.103	0.279	-0.996
	(2.507)	(0.867)	(1.400)	(2.162)	(1.335)	(1.974)	(2.314)	(3.349)	(1.468)	(1.162)	(2.314)	(0.954)	(1.052)	(1.153)
formal sector	-3.770	-4.175	-0.148	-1.112	-3.053	-2.011	-3.200	-0.057	-2.468	0.284	-3.200	-2.775	-1.962	0.134
	(1.458)**	(1.716)	(0.872)	(1.492)	(1.908)	(1.097)*	(1.391)**	(1.717)	(2.148)	(0.581)	(1.391)**	(1.274)**	(1.294)	(0.696)
semi-formal	-1.993	-3.428	-1.959	1.501	-1.329	-1.816	-2.304	0.321	-2.138	0.751	-2.304	-1.508	-0.859	-0.939
	(1.270)	(0.993)***	(0.714)***	(0.786)*	(0.825)	(0.814)**	(0.953)**	(0.802)	(1.575)	(0.538)	(0.953)**	(0.662)**	(0.741)	(0.918)
managerial skills	0.212	-2.077	-1.890	-1.077	-1.367	-0.617	-0.804	0.045	-1.250	-0.840	-0.804	-0.888	-1.620	0.658
	(1.135)	(0.963)**	(0.846)**	(0.907)	(1.109)	(0.951)	(1.033)	(1.209)	(1.088)	(0.445)*	(1.033)	(0.673)	(1.308)	(0.517)
$\lambda = \sigma_u^2 / \sigma_v^2$	0.192	0.342	0.475	0.143	0.215	0.145	0.352	0.122	0.122	1.185	0.127	0.190	0.147	0.450
$\gamma = \sigma_u^2/\sigma^2$	0.161	0.255	0.322	0.125	0.177	0.127	0.260	0.109	0.109	0.542	0.113	0.160	0.128	0.310
Observations	255	280	282	280	277	280	307	265	279	290	263	351	276	281

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables. Bot – Botswana; Cam – Cameroon; Eth- Ethiopia; Gha- Ghana; Ken- Kenya; Moz- Mozambique; Nam- Namibia; Nig- Nigeria; Rwa- Rwanda; SA- South Africa; Tan- Tanzania; Uga- Uganda; Zam- Zambia; Zim- Zimbabwe

Table A-3. 11: Coefficient of elasticities and returns to scale calculated from stochastic frontier estimation

Country	Log values of ICT capital				Computer Accessibility				Internet Accessibility			
	log of capital	employment	raw material	Return to scale	log of capital	employment	raw material	Return to scale	log of capital	employment	raw material	Return to scale
Botswana	0.179	0.379	0.394	0.952	0.163	0.277	0.325	0.765	0.171	0.341	0.330	0.843
Cameroon	0.153	0.343	0.286	0.781	0.155	0.332	0.286	0.773	0.142	0.301	0.297	0.740
Ethiopia	0.071	0.449	0.430	0.951	0.080	0.424	0.419	0.923	0.215	0.388	0.477	1.081
Ghana	0.150	0.391	0.467	1.009	0.107	0.375	0.433	0.915	0.145	0.397	0.462	1.004
Kenya	0.142	0.333	0.471	0.946	0.074	0.380	0.382	0.836	0.127	0.361	0.442	0.930
Mozambique	0.092	0.415	0.407	0.914	0.087	0.374	0.386	0.847	0.084	0.372	0.402	0.859
Namibia	0.142	0.605	0.339	1.085	0.124	0.672	0.331	1.127	0.158	0.601	0.372	1.131
Nigeria	0.094	0.285	0.329	0.709	0.127	0.257	0.326	0.710	0.132	0.255	0.340	0.727
Rwanda	0.135	0.261	0.424	0.819	0.135	0.261	0.422	0.818	0.133	0.261	0.429	0.823
South Africa	0.139	0.618	0.237	0.995	0.180	0.644	0.250	1.073	0.162	0.606	0.248	1.016
Tanzania	0.169	0.188	0.424	0.780	0.182	0.211	0.438	0.830	0.172	0.196	0.430	0.797
Uganda	0.096	0.338	0.466	0.899	0.087	0.278	0.463	0.828	0.095	0.343	0.485	0.923
Zambia	0.134	0.336	0.497	0.966	0.155	0.364	0.495	1.014	0.134	0.317	0.488	0.939
Zimbabwe	0.147	0.354	0.428	0.928	0.172	0.418	0.379	0.969	0.194	0.448	0.430	1.072

Source: Own estimates, obtained from estimation of Translog production for various countries.

Table A-3. 12: Results of hypothesis tests of stochastic frontier model

Country	ICT capital	Computer Access	Internet Access
	LR statistics	LR statistics	LR statistics
Botswana	91.52	167.12	167.42
Cameroon	57.76	65.18	57.19
Ethiopia	181.27	179.37	196.39
Ghana	219.61	199.1	198.48
Kenya	122.97	179.25	177.57
Mozambique	158.28	138.31	148.11
Namibia	200.94	193.8	195.12
Nigeria	126.43	135.53	136.22
Rwanda	261.89	251.12	251.96
South A.	170.14	140.93	146.48
Tanzania	242.77	242.7	244.76
Uganda	175.64	203.47	203.66
Zambia	106.87	103.64	104.33
Zimbabwe	204.9	217.58	213.04

Note: All critical values are obtained from a chi-square distribution with the test statistic indicated by ***, ** and * presenting 1%, 5% and 10% level of significance respectively. In all specifications for the all countries the critical value is 16.8. The decision for all the countries is to reject the null hypothesis.

Appendix 4: Mean and quantile decomposition of turnover

Figure A-4. 1: Distribution of turnover by computer access

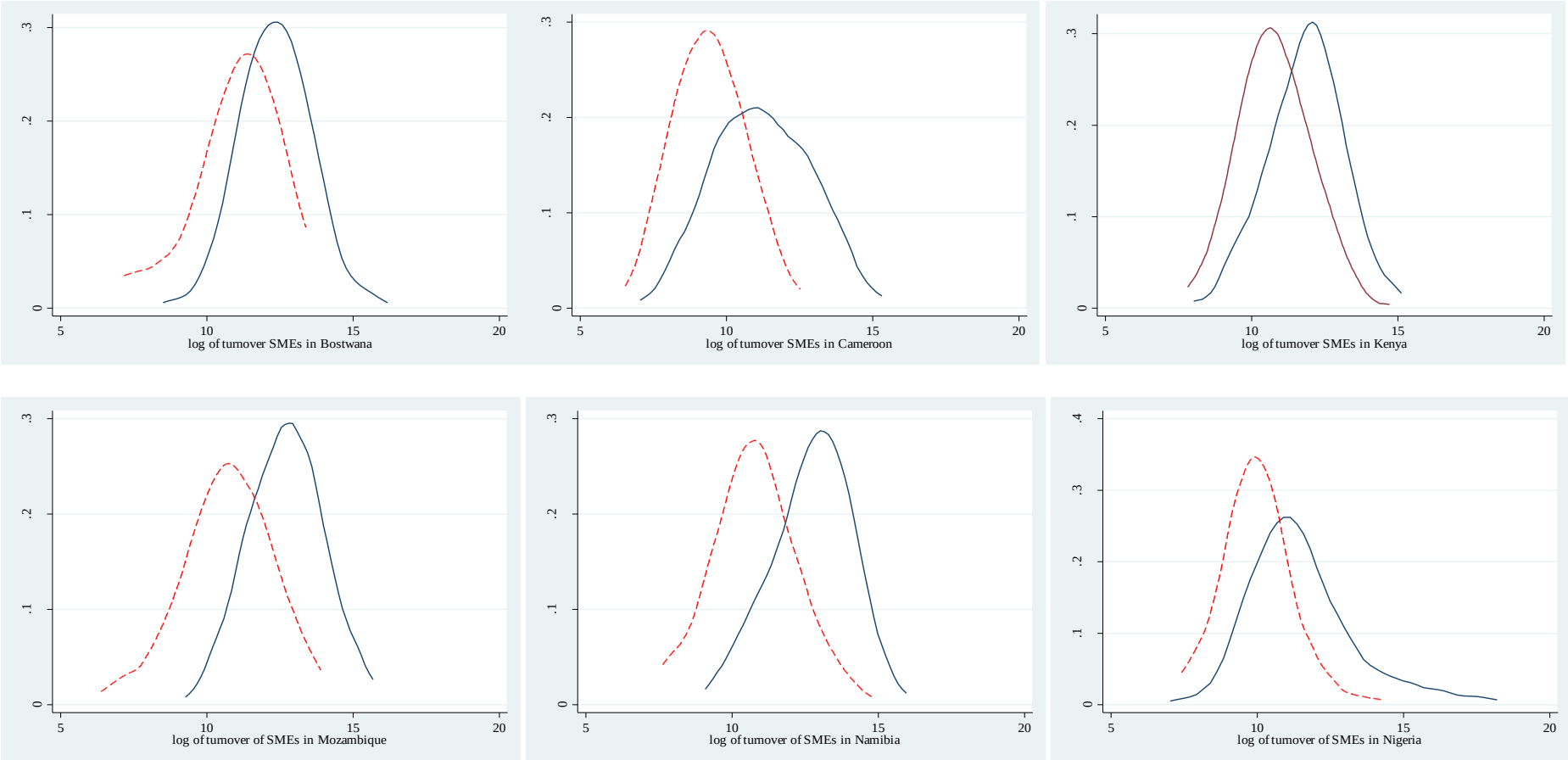

Figure A-4.1: Continue…

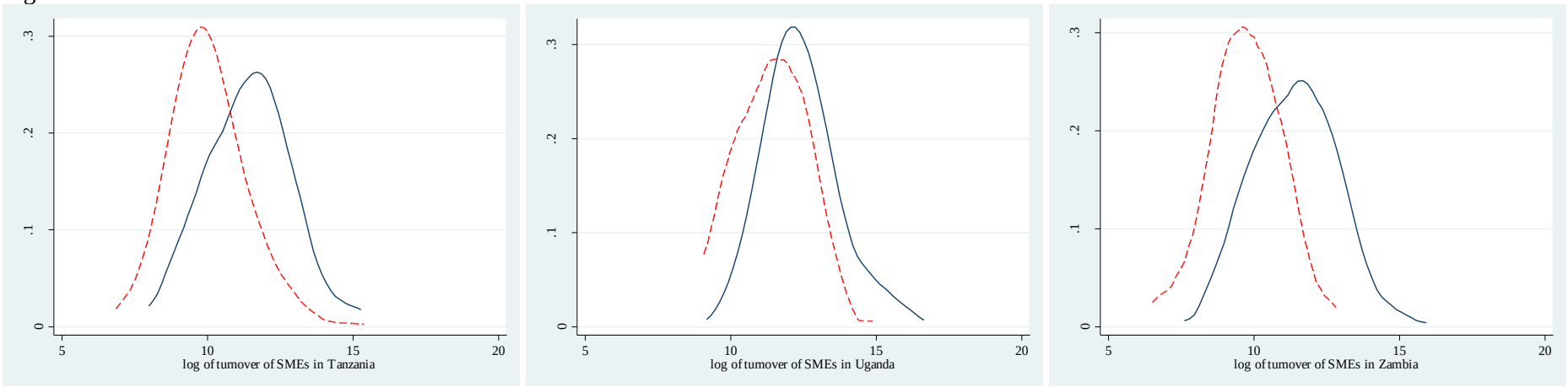

Figure A-4. 2: Distribution of turnover by Internet access

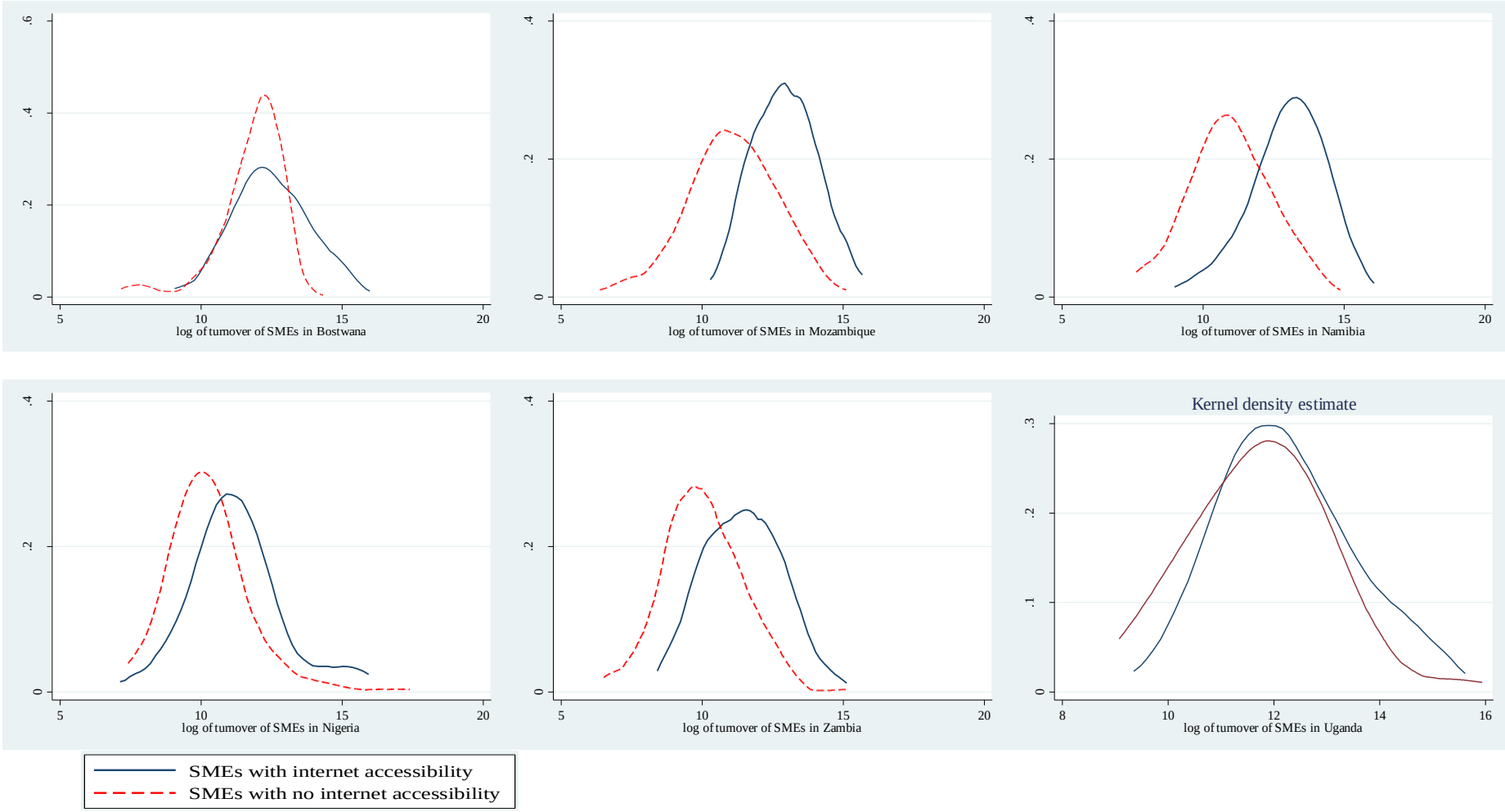

Table A-4.2: Oaxaca mean decomposition of turnover by computer accessibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	**Botswana**	**Cameroon**	**Ethiopia**	**Ghana**	**Kenya**	**Mozambique**	**Namibia**
overall							
computer access	12.325***	10.897***	12.548***	12.322***	11.841***	12.619***	12.175***
	(0.070)	(0.286)	(0.209)	(0.139)	(0.122)	(0.094)	(0.245)
no computer access	11.056***	9.398***	11.258***	10.939***	10.720***	10.682***	10.743***
	(0.163)	(0.098)	(0.125)	(0.115)	(0.117)	(0.110)	(0.097)
mean turnover gap	1.269***	1.499***	1.290***	1.383***	1.120***	1.937***	1.433***
	(0.166)	(0.322)	(0.265)	(0.203)	(0.172)	(0.153)	(0.255)
endowments	1.284***	1.223***	1.389***	1.084***	1.107***	1.438***	0.962***
	(0.277)	(0.237)	(0.295)	(0.310)	(0.188)	(0.209)	(0.205)
coefficients	-0.468	-0.775	-1.790*	0.246	-0.107	0.700***	0.128
	(0.325)	(0.819)	(0.934)	(0.242)	(0.283)	(0.239)	(0.494)
interaction	0.453	1.050	1.690*	0.053	0.120	-0.201	0.343
	(0.397)	(0.784)	(0.907)	(0.315)	(0.270)	(0.257)	(0.513)
endowments							
log of employees	**0.259**	0.238***	0.360***	0.282***	0.277***	0.422***	0.515***
	(0.192)	(0.091)	(0.114)	(0.079)	(0.092)	(0.099)	(0.103)
log ICT capital	**0.358***	0.042	**0.341*****	-0.081	**0.212****	**0.236****	**0.223*****
	(0.198)	(0.099)	(0.096)	(0.090)	(0.090)	(0.116)	(0.072)
log of non-ICT capital	0.074	0.125	0.144***	0.182**	0.249***	0.119	0.068
	(0.150)	(0.151)	(0.053)	(0.081)	(0.085)	(0.076)	(0.064)
log of raw materials	0.198**	0.274***	0.332**	0.364***	0.355**	0.261***	0.147***
	(0.085)	(0.104)	(0.164)	(0.111)	(0.165)	(0.067)	(0.051)
firm age	0.005	0.000	0.001	0.004	-0.002	-0.001	-0.037
	(0.019)	(0.013)	(0.010)	(0.019)	(0.019)	(0.008)	(0.027)
ownership form	0.029	0.108	0.011	0.148	-0.000	0.085	-0.089**
	(0.092)	(0.111)	(0.077)	(0.121)	(0.042)	(0.073)	(0.045)
secondary education	-0.029	-0.039	0.151	-0.012	0.018	-0.063	-0.002
	(0.073)	(0.049)	(0.096)	(0.032)	(0.075)	(0.068)	(0.067)
vocational education	0.046	-0.027	0.002	0.017	0.006	0.009	0.021
	(0.054)	(0.028)	(0.008)	(0.048)	(0.031)	(0.021)	(0.029)
tertiary education	-0.058	0.240**	-0.068	0.044	-0.004	0.160	-0.181
	(0.113)	(0.113)	(0.133)	(0.139)	(0.110)	(0.114)	(0.125)
manufacturing	0.007	0.039	0.007	0.034	0.008	-0.043	-0.005
	(0.028)	(0.025)	(0.018)	(0.023)	(0.017)	(0.034)	(0.012)
construction	0.003	-0.009	0.018	-0.026	0.011	0.000	-0.001
	(0.028)	(0.021)	(0.041)	(0.023)	(0.011)	(0.007)	(0.031)
formal sector	0.325**	0.031	0.081	0.037	-0.015	0.256**	0.281***
	(0.131)	(0.067)	(0.130)	(0.166)	(0.094)	(0.128)	(0.076)
semi-formal	-0.059	0.161**	0.013	0.010	-0.005	-0.024	0.012
	(0.052)	(0.063)	(0.018)	(0.018)	(0.020)	(0.024)	(0.028)
full-time manager	0.126	0.041	-0.003	0.081	-0.003	0.018	0.009
	(0.080)	(0.038)	(0.017)	(0.071)	(0.043)	(0.038)	(0.023)
coefficients							
log of employees	0.322	0.179	0.010	0.160	-0.324	-0.065	-0.753*
	(0.316)	(0.290)	(0.299)	(0.235)	(0.269)	(0.216)	(0.432)
log ICT capital	0.595	1.946**	2.761**	0.267	0.202	-0.158	0.091
	(0.551)	(0.938)	(1.336)	(0.430)	(0.523)	(0.181)	(0.433)
log of non-ICT capital	0.288	0.481	0.649	-0.678	-0.740	0.361	-1.207**
	(0.611)	(1.060)	(0.901)	(0.589)	(0.689)	(0.327)	(0.508)
log of raw materials	-0.597	1.268*	-0.856	-0.187	0.180	-1.002**	2.121*
	(1.161)	(0.736)	(1.062)	(0.722)	(1.284)	(0.405)	(1.098)
firm age	0.493	0.732	0.995*	-0.145	-0.003	0.026	-0.128
	(0.308)	(0.721)	(0.555)	(0.419)	(0.288)	(0.370)	(0.547)
ownership form	0.100	1.492***	0.203	-0.039	0.076	0.274	-0.544*
	(0.245)	(0.504)	(0.328)	(0.246)	(0.154)	(0.258)	(0.316)
secondary education	0.047	-0.373	0.262	0.014	0.036	-1.173**	0.178
	(0.146)	(0.506)	(0.452)	(0.169)	(0.172)	(0.474)	(0.530)
vocational education	-0.029	-0.289*	0.020	0.037	0.020	-0.095	0.161
	(0.080)	(0.164)	(0.023)	(0.117)	(0.048)	(0.059)	(0.222)
tertiary education	0.088	-0.155	0.029	-0.002	0.117	-0.224*	0.023
	(0.099)	(0.133)	(0.186)	(0.077)	(0.186)	(0.121)	(0.094)
manufacturing	0.021	0.161	0.091	0.005	-0.002	-0.124	-0.288
	(0.078)	(0.155)	(0.125)	(0.089)	(0.041)	(0.083)	(0.201)
construction	-0.005	0.152	-0.008	0.022	0.045**	0.057**	-0.060
	(0.016)	(0.180)	(0.013)	(0.065)	(0.022)	(0.029)	(0.058)
formal sector	-0.017	0.053	0.004	0.025	0.038	0.073	0.147
	(0.057)	(0.040)	(0.029)	(0.058)	(0.027)	(0.062)	(0.161)
semi-formal	-0.064	-0.035	0.018	-0.013	0.067	0.301**	0.049
	(0.129)	(0.088)	(0.092)	(0.167)	(0.068)	(0.147)	(0.245)
full-time manager	-0.035	0.011	-0.028	-0.080	-0.002	0.040	0.087
	(0.022)	(0.069)	(0.050)	(0.064)	(0.045)	(0.070)	(0.082)
interaction							
log of employees	0.217	0.163	0.005	0.062	-0.121	-0.040	-0.422*

	(0.238)	(0.265)	(0.154)	(0.097)	(0.100)	(0.126)	(0.251)
log ICT capital	0.377	1.362**	1.895**	0.125	0.109	-0.133	0.092
	(0.359)	(0.654)	(0.903)	(0.206)	(0.294)	(0.148)	(0.417)
log of non-ICT capital	0.099	0.134	0.114	-0.072	-0.113	0.130	-0.086
	(0.241)	(0.313)	(0.139)	(0.068)	(0.107)	(0.120)	(0.081)
log of raw materials	-0.070	0.246	-0.081	-0.027	0.021	-0.147***	0.366
	(0.121)	(0.167)	(0.119)	(0.109)	(0.160)	(0.053)	(0.231)
firm age	-0.017	-0.006	-0.010	-0.002	-0.000	0.000	-0.012
	(0.032)	(0.059)	(0.045)	(0.021)	(0.028)	(0.014)	(0.061)
ownership form	-0.039	-0.477***	-0.075	0.021	-0.024	-0.099	0.206
	(0.097)	(0.149)	(0.128)	(0.130)	(0.050)	(0.095)	(0.132)
secondary education	-0.027	0.248	-0.179	-0.007	-0.018	0.414**	-0.100
	(0.078)	(0.342)	(0.319)	(0.083)	(0.084)	(0.189)	(0.311)
vocational education	-0.023	0.098	-0.006	-0.030	-0.015	-0.054	-0.096
	(0.059)	(0.128)	(0.015)	(0.098)	(0.036)	(0.069)	(0.165)
tertiary education	0.120	-0.659	0.069	-0.006	0.089	-0.501*	0.080
	(0.119)	(0.584)	(0.442)	(0.231)	(0.141)	(0.258)	(0.359)
manufacturing	-0.003	-0.101	-0.053	-0.002	0.001	0.107	-0.042
	(0.030)	(0.108)	(0.076)	(0.043)	(0.026)	(0.072)	(0.105)
construction	-0.011	-0.098	-0.013	-0.010	-0.039**	-0.036*	0.001
	(0.032)	(0.136)	(0.039)	(0.042)	(0.017)	(0.020)	(0.044)
formal sector	-0.053	0.166	0.030	0.111	0.201	0.187	0.265
	(0.191)	(0.139)	(0.215)	(0.247)	(0.145)	(0.183)	(0.307)
semi-formal	0.018	-0.041	0.011	0.002	0.030	-0.058	0.004
	(0.043)	(0.104)	(0.065)	(0.026)	(0.039)	(0.058)	(0.041)
full-time manager	-0.135*	0.016	-0.018	-0.112	-0.002	0.028	0.089
	(0.082)	(0.103)	(0.036)	(0.090)	(0.073)	(0.059)	(0.087)
Constant	-1.674	-6.398***	-5.940*	0.860	0.183	2.408**	0.251
	(1.234)	(2.327)	(3.194)	(0.963)	(1.504)	(0.978)	(1.686)
Observations	255	280	282	280	277	280	307

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.2: continue…

	8	(9)	(10)	(11)	(12)	(1)	(2)
VARIABLES	**Nigeria**	**Rwanda**	**S Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
overall							
computer access	11.468***	12.564***	12.260***	11.452***	12.397***	11.389***	14.479***
	(0.200)	(0.170)	(0.146)	(0.161)	(0.111)	(0.117)	(0.155)
no computer access	9.974***	11.197***	10.625***	9.992***	11.423***	9.744***	13.471***
	(0.072)	(0.094)	(0.166)	(0.103)	(0.095)	(0.085)	(0.120)
mean turnover gap	1.495***	1.367***	1.635***	1.460***	0.974***	1.645***	1.007***
	(0.195)	(0.201)	(0.198)	(0.189)	(0.153)	(0.124)	(0.188)
endowments	1.446***	1.438***	0.869***	1.191***	0.914***	1.214***	1.002***
	(0.214)	(0.277)	(0.311)	(0.244)	(0.151)	(0.172)	(0.174)
coefficients	-0.314	-0.142	0.302	-0.475	-0.085	-0.111	-0.892***
	(0.569)	(0.434)	(0.306)	(0.450)	(0.168)	(0.173)	(0.290)
interaction	0.363	0.072	0.464	0.745	0.146	0.542***	0.897***
	(0.558)	(0.494)	(0.400)	(0.462)	(0.160)	(0.196)	(0.302)
endowments							
log of employees	0.233**	0.177***	**0.074**	0.338***	0.181***	0.294***	**0.158**
	(0.118)	(0.053)	(0.134)	(0.077)	(0.056)	(0.109)	(0.105)
log ICT capital	0.076	**0.472*** **	**0.618** **	0.142	**0.142** **	-0.079	**0.383*** **
	(0.115)	(0.168)	(0.288)	(0.098)	(0.071)	(0.077)	(0.112)
log of non-ICT capital	0.347**	0.208***	0.134	0.409***	0.115**	0.172**	0.169
	(0.140)	(0.061)	(0.201)	(0.135)	(0.051)	(0.077)	(0.111)
log of raw materials	0.325***	0.089	0.061	0.148	0.277***	0.589***	0.047
	(0.087)	(0.089)	(0.052)	(0.100)	(0.075)	(0.101)	(0.032)
firm age	-0.004	-0.008	-0.007	0.023	-0.001	-0.010	0.012
	(0.011)	(0.018)	(0.023)	(0.023)	(0.005)	(0.013)	(0.029)
ownership form	-0.027	-0.025	0.009	-0.005	-0.061	0.008	0.079
	(0.064)	(0.024)	(0.210)	(0.027)	(0.043)	(0.023)	(0.090)
secondary education	-0.009	0.038	-0.015	0.008	0.028	0.055	-0.034
	(0.071)	(0.039)	(0.099)	(0.015)	(0.054)	(0.102)	(0.063)
vocational education	0.046*	0.001	0.006	0.022	-0.001	0.003	-0.001
	(0.026)	(0.007)	(0.021)	(0.023)	(0.009)	(0.031)	(0.028)
tertiary education	0.080	-0.102	0.328	-0.099	0.046	-0.006	-0.074
	(0.137)	(0.102)	(0.201)	(0.110)	(0.069)	(0.136)	(0.097)
manufacturing	0.017	0.014	0.022	0.023	0.005	0.022	0.004
	(0.011)	(0.016)	(0.049)	(0.023)	(0.019)	(0.016)	(0.012)
construction	-0.004	-0.023	0.012	-0.004	0.001	0.000	-0.010
	(0.009)	(0.017)	(0.053)	(0.017)	(0.009)	(0.007)	(0.022)
formal sector	0.215*	0.377**	-0.360	0.231***	0.101***	0.042	0.206*
	(0.112)	(0.153)	(0.297)	(0.060)	(0.038)	(0.101)	(0.116)

semi-formal	0.021	0.205***	-0.018	-0.066	0.058**	-0.003	-0.009
	(0.033)	(0.075)	(0.058)	(0.050)	(0.024)	(0.008)	(0.029)
full-time manager	0.130	0.015	0.004	0.020	0.022	0.125***	0.071
	(0.107)	(0.042)	(0.057)	(0.030)	(0.025)	(0.042)	(0.045)
coefficients							
log of employees	-0.122	-0.169	0.596	0.325	-0.154	-0.136	0.175
	(0.374)	(0.198)	(0.478)	(0.301)	(0.199)	(0.209)	(0.486)
log ICT capital	0.386	0.147	-0.348	0.846	0.114	0.984***	0.852
	(0.829)	(0.852)	(0.933)	(0.966)	(0.432)	(0.335)	(0.615)
log of non-ICT capital	0.187	0.223	0.681	-0.898	-0.450	-0.489	3.038**
	(1.055)	(0.688)	(1.246)	(1.297)	(0.498)	(0.459)	(1.223)
log of raw materials	0.623	-0.116	-0.084	-1.222	0.353	-0.169	0.280
	(0.980)	(0.739)	(0.447)	(0.895)	(1.419)	(0.683)	(0.498)
firm age	0.758	0.303	-0.180	-0.051	0.114	-0.285	-0.107
	(0.556)	(0.340)	(0.617)	(0.370)	(0.192)	(0.210)	(0.339)
ownership form	-0.515	-0.142	-0.109	-0.483	-0.227*	-0.019	0.015
	(0.426)	(0.257)	(0.449)	(0.312)	(0.126)	(0.120)	(0.200)
secondary education	-0.010	0.685**	0.570*	-0.288	0.243*	-0.103	0.153
	(0.232)	(0.294)	(0.297)	(0.222)	(0.129)	(0.159)	(0.227)
vocational education	0.085	0.073	0.053	0.018	0.049	-0.033	0.035
	(0.057)	(0.060)	(0.062)	(0.165)	(0.043)	(0.145)	(0.060)
tertiary education	0.001	0.152**	-0.031	-0.054	0.207	-0.097	0.424
	(0.118)	(0.065)	(0.217)	(0.054)	(0.148)	(0.312)	(0.318)
manufacturing	0.004	-0.044	0.161	-0.290*	-0.090*	0.033	0.040
	(0.116)	(0.083)	(0.104)	(0.149)	(0.049)	(0.057)	(0.060)
construction	0.052	-0.023	-0.026	-0.045**	-0.012	0.045	-0.000
	(0.093)	(0.017)	(0.036)	(0.022)	(0.029)	(0.029)	(0.012)
formal sector	-0.004	-0.003	0.228	0.261*	0.010	0.025	-0.035
	(0.040)	(0.021)	(0.163)	(0.154)	(0.019)	(0.022)	(0.128)
semi-formal	0.009	-0.102	0.016	0.280	-0.042	-0.007	-0.001
	(0.100)	(0.088)	(0.097)	(0.260)	(0.062)	(0.070)	(0.096)
full-time manager	-0.017	-0.013	0.053	-0.059	0.025	0.001	-0.115
	(0.036)	(0.051)	(0.145)	(0.071)	(0.050)	(0.023)	(0.080)
interaction							
log of employees	-0.071	-0.092	0.194	0.218	-0.048	-0.077	0.055
	(0.229)	(0.111)	(0.170)	(0.206)	(0.068)	(0.126)	(0.167)
log ICT capital	0.215	0.074	-0.127	0.571	0.044	0.600***	0.369
	(0.439)	(0.421)	(0.346)	(0.654)	(0.168)	(0.225)	(0.265)
log of non-ICT capital	0.072	0.046	0.128	-0.303	-0.065	-0.115	0.497**
	(0.412)	(0.141)	(0.243)	(0.423)	(0.075)	(0.101)	(0.224)
log of raw materials	0.118	-0.007	-0.005	-0.097	0.030	-0.029	0.014
	(0.223)	(0.069)	(0.040)	(0.087)	(0.126)	(0.122)	(0.029)
firm age	0.040	0.021	0.006	-0.006	0.003	0.015	-0.010
	(0.048)	(0.037)	(0.027)	(0.050)	(0.007)	(0.016)	(0.033)
ownership form	0.176	0.018	0.068	0.079	0.114*	0.006	-0.008
	(0.171)	(0.041)	(0.277)	(0.064)	(0.066)	(0.042)	(0.112)
secondary education	0.009	-0.298*	-0.249*	0.083	-0.173*	0.085	-0.094
	(0.212)	(0.164)	(0.147)	(0.075)	(0.095)	(0.134)	(0.144)
vocational education	-0.073	-0.019	-0.015	-0.015	-0.012	0.002	0.002
	(0.045)	(0.041)	(0.030)	(0.139)	(0.022)	(0.033)	(0.031)
tertiary education	0.002	0.475**	-0.039	-0.239	0.158	-0.048	0.222
	(0.404)	(0.226)	(0.255)	(0.250)	(0.115)	(0.160)	(0.156)
manufacturing	-0.002	0.024	-0.019	0.236*	0.059*	-0.017	-0.008
	(0.070)	(0.059)	(0.046)	(0.130)	(0.032)	(0.034)	(0.018)
construction	-0.018	0.023	-0.028	0.009	0.009	-0.027	-0.001
	(0.063)	(0.017)	(0.054)	(0.025)	(0.025)	(0.025)	(0.030)
formal sector	-0.021	-0.033	0.527	0.324	0.025	0.144	-0.047
	(0.210)	(0.215)	(0.321)	(0.221)	(0.052)	(0.129)	(0.166)
semi-formal	0.010	-0.144	0.007	-0.079	-0.021	0.000	0.000
	(0.101)	(0.121)	(0.066)	(0.092)	(0.026)	(0.012)	(0.028)
full-time manager	-0.094	-0.015	0.016	-0.038	0.023	0.002	-0.094
	(0.208)	(0.069)	(0.065)	(0.056)	(0.049)	(0.051)	(0.064)
Constant	-1.753	-1.115	-1.278	1.185	-0.224	0.138	-5.646***
	(2.123)	(1.385)	(1.503)	(1.529)	(1.483)	(1.022)	(1.600)
Observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.3: Oaxaca mean decomposition of turnover by Internet accessibility

VARIABLES	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
overall							
computer access	12.451***	10.837***	12.841***	12.330***	11.986***	12.844***	12.270***
	(0.147)	(0.456)	(0.228)	(0.209)	(0.163)	(0.130)	(0.500)
no computer access	11.836***	9.631***	11.354***	11.231***	10.906***	11.052***	10.893***
	(0.089)	(0.107)	(0.134)	(0.104)	(0.103)	(0.118)	(0.101)
mean turnover gap	0.615***	1.206***	1.487***	1.099***	1.081***	1.792***	1.377***
	(0.165)	(0.460)	(0.264)	(0.234)	(0.205)	(0.163)	(0.513)
endowments	0.421***	1.139***	1.087***	1.015***	0.857***	1.309***	1.053***
	(0.153)	(0.301)	(0.349)	(0.220)	(0.216)	(0.260)	(0.285)
coefficients	0.298	-0.442	0.205	0.425	0.328	0.960***	0.974
	(0.385)	(5.141)	(0.364)	(0.409)	(0.365)	(0.314)	(0.966)
interaction	-0.103	0.510	0.195	-0.341	-0.104	-0.477	-0.650
	(0.392)	(5.101)	(0.394)	(0.424)	(0.316)	(0.290)	(0.943)
endowments							
log of employees	0.115**	0.192**	0.298***	0.216**	0.151***	0.388***	0.525***
	(0.057)	(0.092)	(0.084)	(0.085)	(0.051)	(0.095)	(0.121)
log ICT capital	0.150**	0.219	0.291***	-0.056	0.099	0.292***	0.181**
	(0.073)	(0.149)	(0.110)	(0.075)	(0.065)	(0.085)	(0.085)
log of non-ICT capital	0.059	0.163	0.225***	0.078	0.196**	0.075	0.027
	(0.056)	(0.111)	(0.087)	(0.078)	(0.080)	(0.066)	(0.060)
log of raw materials	-0.029	0.268*	0.364	0.273**	0.318*	0.140	0.131
	(0.068)	(0.153)	(0.239)	(0.130)	(0.188)	(0.103)	(0.081)
firm age	0.012	0.002	0.006	0.005	0.001	0.001	-0.055
	(0.016)	(0.020)	(0.017)	(0.018)	(0.017)	(0.010)	(0.034)
ownership form	0.017	-0.014	-0.085	0.126	-0.028	0.047	-0.066*
	(0.036)	(0.121)	(0.068)	(0.090)	(0.040)	(0.048)	(0.038)
secondary education	-0.012	-0.014	0.095	-0.012	0.044	-0.051	0.010
	(0.022)	(0.053)	(0.068)	(0.027)	(0.092)	(0.057)	(0.070)
vocational education	-0.021	-0.016	0.003	0.011	0.012	0.001	0.051
	(0.041)	(0.021)	(0.008)	(0.029)	(0.026)	(0.018)	(0.037)
tertiary education	0.020	0.079	-0.098	0.108	-0.030	0.159*	-0.123
	(0.069)	(0.133)	(0.103)	(0.095)	(0.118)	(0.090)	(0.135)
manufacturing	-0.006	0.015	-0.003	0.025	0.011	-0.017	0.005
	(0.014)	(0.018)	(0.016)	(0.026)	(0.016)	(0.030)	(0.018)
construction	0.011	-0.027	0.049	-0.028	0.003	0.001	-0.003
	(0.011)	(0.027)	(0.057)	(0.032)	(0.006)	(0.006)	(0.024)
formal sector	0.050	0.064	-0.063	0.143	0.074	0.311***	0.333***
	(0.047)	(0.075)	(0.192)	(0.111)	(0.080)	(0.095)	(0.111)
semi-formal	0.051	0.198**	0.004	0.045	0.001	-0.060	0.019
	(0.048)	(0.092)	(0.012)	(0.036)	(0.014)	(0.039)	(0.045)
full-time manager	0.003	0.009	0.000	0.080	0.005	0.020	0.017
	(0.013)	(0.051)	(0.009)	(0.063)	(0.017)	(0.033)	(0.025)
coefficients							
log of employees	0.170	0.191	0.017	0.240	0.148	-0.232	-0.931
	(0.512)	(7.434)	(0.319)	(0.387)	(0.462)	(0.241)	(0.606)
log ICT capital	1.019	1.241	0.382	0.526	0.439	-0.148	-0.294
	(1.050)	(5.631)	(0.871)	(0.513)	(0.732)	(0.235)	(0.807)
log of non-ICT capital	0.934	0.137	-0.420	-0.688	-0.817	0.313	-0.593
	(1.214)	(15.807)	(1.053)	(0.493)	(1.159)	(0.532)	(0.750)
log of raw materials	0.173	2.434	-2.152**	-0.940	-1.745	-1.067*	2.741*
	(0.947)	(7.975)	(1.012)	(1.353)	(1.554)	(0.580)	(1.633)
firm age	0.077	1.560	0.488	-0.340	0.158	0.227	-0.311
	(0.367)	(15.115)	(0.557)	(0.575)	(0.342)	(0.463)	(0.829)
ownership form	0.257	2.211	-0.178	-0.179	-0.166	0.271	-0.720
	(0.248)	(7.386)	(0.375)	(0.204)	(0.215)	(0.266)	(0.522)
secondary education	0.081	-0.082	-0.292	-0.022	0.079	-1.292**	1.347
	(0.152)	(2.363)	(0.353)	(0.194)	(0.183)	(0.584)	(1.052)
vocational education	0.367	-0.250	-0.014	-0.130	0.025	-0.165*	0.051
	(0.262)	(1.030)	(0.023)	(0.111)	(0.041)	(0.084)	(0.037)
tertiary education	0.286	-0.151	-0.307	-0.276	-0.066	-0.412*	0.052
	(0.212)	(1.251)	(0.226)	(0.196)	(0.219)	(0.211)	(0.202)
manufacturing	-0.104**	0.161	0.012	0.043	-0.072	0.116	-0.701**
	(0.049)	(2.791)	(0.110)	(0.109)	(0.081)	(0.131)	(0.316)
construction	-0.007	-0.080	-0.011	-0.049	0.008	0.029	-0.050
	(0.034)	(0.391)	(0.020)	(0.046)	(0.023)	(0.031)	(0.089)
formal sector	-0.899	0.131	0.069	0.006	-0.019	0.155	0.042
	(0.787)	(0.746)	(0.057)	(0.069)	(0.050)	(0.175)	(0.282)
semi-formal	-0.493*	-0.091	0.063	0.052	-0.042	0.411	-0.064
	(0.292)	(1.696)	(0.127)	(0.158)	(0.109)	(0.313)	(0.308)
full-time manager	-0.066	0.168	0.012	-0.108	-0.021	-0.041	0.121
	(0.068)	(0.392)	(0.078)	(0.086)	(0.058)	(0.105)	(0.109)
interaction							
log of employees	0.026	0.099	0.008	0.061	0.037	-0.116	-0.492
	(0.076)	(3.667)	(0.137)	(0.090)	(0.132)	(0.119)	(0.320)

log ICT capital	0.187	0.682	0.215	0.176	0.184	-0.095	-0.235
	(0.238)	(3.631)	(0.514)	(0.199)	(0.317)	(0.155)	(0.652)
log of non-ICT capital	0.144	0.025	-0.069	-0.032	-0.111	0.111	-0.025
	(0.219)	(3.758)	(0.181)	(0.035)	(0.165)	(0.200)	(0.109)
log of raw materials	-0.003	0.403	-0.192	-0.094	-0.145	-0.084	0.358
	(0.049)	(1.619)	(0.118)	(0.168)	(0.159)	(0.068)	(0.335)
firm age	0.008	0.021	-0.023	-0.005	0.014	-0.010	-0.051
	(0.038)	(0.414)	(0.049)	(0.027)	(0.033)	(0.034)	(0.139)
ownership form	-0.169	-0.723	0.075	0.099	0.062	-0.098	0.282
	(0.184)	(2.151)	(0.153)	(0.113)	(0.082)	(0.094)	(0.189)
secondary education	-0.038	0.053	0.134	0.012	-0.044	0.461*	-0.916
	(0.092)	(1.814)	(0.190)	(0.104)	(0.107)	(0.242)	(0.707)
vocational education	-0.251	0.111	0.007	0.102	-0.021	-0.009	-0.051
	(0.195)	(0.386)	(0.014)	(0.081)	(0.034)	(0.067)	(0.037)
tertiary education	0.368	-0.342	-0.319	-0.476	-0.045	-0.654**	0.186
	(0.274)	(3.095)	(0.251)	(0.336)	(0.150)	(0.317)	(0.783)
manufacturing	-0.037	-0.062	-0.004	-0.014	0.042	-0.100	0.105
	(0.053)	(1.161)	(0.058)	(0.054)	(0.052)	(0.110)	(0.228)
construction	0.006	0.055	-0.041	0.022	-0.003	-0.006	0.004
	(0.026)	(0.196)	(0.057)	(0.032)	(0.016)	(0.027)	(0.049)
formal sector	-0.150	0.149	0.384	0.017	-0.056	0.271	0.059
	(0.227)	(0.607)	(0.307)	(0.209)	(0.148)	(0.315)	(0.368)
semi-formal	-0.178	-0.103	0.018	-0.029	-0.009	-0.129	-0.007
	(0.266)	(1.917)	(0.064)	(0.098)	(0.029)	(0.102)	(0.098)
full-time manager	-0.014	0.143	0.004	-0.181	-0.010	-0.019	0.134
	(0.034)	(0.382)	(0.019)	(0.135)	(0.032)	(0.063)	(0.164)
Constant	-1.499	-8.023	2.538	2.288	2.419	2.793*	0.284
	(1.532)	(18.706)	(1.658)	(1.752)	(2.271)	(1.499)	(2.578)
Observations	255	280	282	280	277	280	307

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.3: Continue…

VARIABLES	**Nigeria**	**Rwanda**	**S Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
overall							
computer access	11.171***	12.624***	12.157***	11.419***	12.227***	11.446***	14.544***
	(0.332)	(0.233)	(0.246)	(0.251)	(0.176)	(0.106)	(0.169)
no computer access	10.229***	11.371***	11.140***	10.211***	11.724***	10.042***	13.783***
	(0.097)	(0.080)	(0.133)	(0.101)	(0.063)	(0.101)	(0.142)
mean turnover gap	0.942***	1.253***	1.017***	1.208***	0.503**	1.404***	0.761***
	(0.345)	(0.244)	(0.282)	(0.287)	(0.197)	(0.153)	(0.223)
endowments	0.844**	1.278***	0.753***	0.792***	0.281	1.305***	0.791***
	(0.405)	(0.271)	(0.237)	(0.294)	(0.234)	(0.171)	(0.206)
coefficients	-0.076	-0.078	0.312	-0.509	0.542	0.029	-0.327
	(8.673)	(0.465)	(0.334)	(5.963)	(0.388)	(0.125)	(0.303)
interaction	0.174	0.053	-0.048	0.925	-0.320	0.070	0.297
	(8.676)	(0.467)	(0.342)	(5.907)	(0.394)	(0.142)	(0.351)
endowments							
log of employees	0.089	0.081**	0.219**	0.251**	-0.006	0.215***	0.231*
	(0.065)	(0.036)	(0.097)	(0.118)	(0.055)	(0.056)	(0.133)
log ICT capital	0.207	0.394***	0.236*	0.206**	0.082*	0.031	0.331***
	(0.134)	(0.129)	(0.131)	(0.095)	(0.047)	(0.066)	(0.094)
log of non-ICT capital	0.326**	0.212***	0.130	0.285**	0.033	0.196***	0.239*
	(0.155)	(0.071)	(0.091)	(0.122)	(0.039)	(0.068)	(0.133)
log of raw materials	0.106	0.059	-0.073	-0.061	-0.050	0.490***	0.029
	(0.186)	(0.111)	(0.093)	(0.167)	(0.133)	(0.070)	(0.056)
firm age	0.003	0.002	0.010	0.017	-0.006	0.001	-0.005
	(0.013)	(0.021)	(0.024)	(0.021)	(0.012)	(0.007)	(0.029)
ownership form	0.009	-0.006	0.120	0.004	-0.002	-0.001	0.027
	(0.028)	(0.017)	(0.165)	(0.045)	(0.014)	(0.033)	(0.062)
secondary education	-0.003	0.014	-0.023	0.042	0.025	0.047	-0.030
	(0.059)	(0.035)	(0.087)	(0.044)	(0.058)	(0.100)	(0.092)
vocational education	0.008	0.001	0.008	0.032	0.001	0.029	0.042
	(0.024)	(0.022)	(0.025)	(0.026)	(0.018)	(0.074)	(0.048)
tertiary education	0.020	-0.064	0.134	-0.197*	0.036	0.039	-0.129
	(0.114)	(0.069)	(0.117)	(0.113)	(0.084)	(0.167)	(0.127)
manufacturing	0.017	0.017	-0.000	0.020	0.022	0.013	-0.000
	(0.018)	(0.017)	(0.040)	(0.019)	(0.019)	(0.015)	(0.011)
construction	-0.031*	-0.002	-0.006	-0.006	0.002	-0.000	0.009
	(0.018)	(0.006)	(0.032)	(0.014)	(0.008)	(0.009)	(0.017)
formal sector	0.061	0.442***	-0.006	0.285***	0.132***	0.180***	0.082
	(0.060)	(0.137)	(0.270)	(0.090)	(0.048)	(0.067)	(0.136)
semi-formal	-0.017	0.127*	0.002	-0.090	0.006	-0.012	-0.048

	(0.037)	(0.067)	(0.024)	(0.058)	(0.024)	(0.012)	(0.039)
full-time manager	0.047	0.001	0.002	0.002	0.006	0.079**	0.013
	(0.052)	(0.015)	(0.034)	(0.017)	(0.012)	(0.036)	(0.027)
coefficients							
log of employees	0.001	0.026	-0.318	0.148	-0.241	-0.152	0.393
	(11.798)	(0.553)	(0.652)	(1.929)	(0.517)	(0.167)	(0.503)
log ICT capital	-1.084	0.052	1.010	1.140	0.299	0.518**	-0.130
	(4.705)	(1.410)	(0.913)	(11.143)	(0.868)	(0.252)	(0.603)
log of non-ICT capital	-0.997	0.446	0.112	0.632	0.036	-0.832**	0.504
	(12.283)	(0.973)	(1.352)	(5.107)	(0.490)	(0.411)	(1.832)
log of raw materials	0.248	-0.536	0.325	-1.488	-0.545	0.561	-0.286
	(16.515)	(1.328)	(0.441)	(1.942)	(1.520)	(0.643)	(0.704)
firm age	0.879	0.265	1.064	-0.841	-0.164	0.298	0.256
	(18.568)	(0.543)	(0.759)	(3.185)	(0.611)	(0.250)	(0.424)
ownership form	-0.474	-0.318	0.104	-0.060	0.068	-0.076	-0.167
	(1.665)	(0.531)	(0.395)	(0.870)	(0.215)	(0.116)	(0.172)
secondary education	-0.003	0.958	0.262	0.372	0.025	0.047	-0.154
	(0.059)	(0.597)	(0.618)	(1.116)	(0.058)	(0.100)	(0.282)
vocational education	0.040	0.091	0.012	0.244	0.026	-0.061	0.249
	(1.217)	(0.096)	(0.105)	(0.609)	(0.031)	(0.130)	(0.173)
tertiary education	0.402*	0.332	0.158	0.093	-0.040	-0.083	0.260
	(0.221)	(0.222)	(0.377)	(0.398)	(0.115)	(0.233)	(0.402)
manufacturing	0.174	-0.060	-0.032	-0.101	0.249*	0.000	0.062
	(2.477)	(0.182)	(0.140)	(0.557)	(0.135)	(0.060)	(0.063)
construction	-0.031*	0.145*	-0.006	-0.024	0.002	0.028	-0.020
	(0.018)	(0.080)	(0.021)	(0.083)	(0.008)	(0.023)	(0.031)
formal sector	0.189	-0.067	-0.067	-0.014	-0.057	-0.011	-0.009
	(2.250)	(0.084)	(0.202)	(0.381)	(0.064)	(0.043)	(0.196)
semi-formal	0.116	-0.056	-0.195	-0.248	-0.210	0.007	-0.138
	(3.032)	(0.221)	(0.186)	(0.234)	(0.164)	(0.082)	(0.119)
full-time manager	-0.020	0.059	0.016	-0.043	0.050	0.059	-0.099
	(1.382)	(0.157)	(0.157)	(0.432)	(0.087)	(0.045)	(0.103)
interaction							
log of employees	0.001	0.007	-0.071	0.056	0.002	-0.064	0.139
	(3.993)	(0.163)	(0.141)	(0.580)	(0.052)	(0.077)	(0.189)
log ICT capital	-0.541	0.022	0.255	0.646	0.097	0.220**	-0.032
	(2.509)	(0.613)	(0.242)	(6.674)	(0.313)	(0.110)	(0.152)
log of non-ICT capital	-0.240	0.088	0.011	0.188	0.001	-0.159*	0.045
	(1.718)	(0.194)	(0.157)	(1.569)	(0.029)	(0.094)	(0.159)
log of raw materials	0.013	-0.022	-0.025	0.047	0.007	0.086	-0.006
	(0.730)	(0.170)	(0.052)	(0.174)	(0.054)	(0.108)	(0.031)
firm age	-0.047	0.029	-0.065	-0.069	0.016	-0.001	0.023
	(0.533)	(0.079)	(0.069)	(0.144)	(0.088)	(0.021)	(0.043)
ownership form	0.120	0.014	-0.063	0.017	-0.021	0.030	0.093
	(0.515)	(0.056)	(0.251)	(0.273)	(0.072)	(0.053)	(0.099)
secondary education	0.003	-0.399	-0.105	-0.249	-0.025	-0.047	0.113
	(0.059)	(0.252)	(0.263)	(0.933)	(0.058)	(0.100)	(0.198)
vocational education	-0.008	0.055	-0.007	-0.193	-0.021	0.041	-0.223
	(1.104)	(0.119)	(0.060)	(0.431)	(0.025)	(0.087)	(0.147)
tertiary education	0.680**	0.600	0.166	0.360	-0.036	-0.071	0.141
	(0.346)	(0.382)	(0.405)	(1.699)	(0.102)	(0.195)	(0.218)
manufacturing	-0.138	0.039	-0.000	0.052	-0.228*	-0.000	-0.008
	(0.883)	(0.114)	(0.069)	(0.431)	(0.120)	(0.037)	(0.028)
construction	0.031*	-0.052	-0.010	0.010	-0.002	-0.016	-0.014
	(0.018)	(0.067)	(0.040)	(0.033)	(0.008)	(0.017)	(0.026)
formal sector	0.166	-0.294	-0.120	-0.018	-0.108	-0.023	-0.008
	(1.405)	(0.375)	(0.372)	(0.536)	(0.116)	(0.085)	(0.168)
semi-formal	0.162	-0.052	-0.016	0.090	-0.009	-0.001	0.072
	(2.769)	(0.223)	(0.043)	(0.142)	(0.052)	(0.020)	(0.070)
full-time manager	-0.027	0.019	0.001	-0.011	0.007	0.074	-0.036
	(0.720)	(0.066)	(0.034)	(0.315)	(0.025)	(0.056)	(0.041)
Constant	0.482	-1.416	-2.134	-0.320	1.042	-0.276	-1.048
	(22.045)	(2.202)	(2.093)	(13.716)	(1.775)	(0.772)	(1.554)
Observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.4: Oaxaca decomposition of turnover by firm size

VARIABLES	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
overall							
computer access	12.286***	10.609***	12.380***	11.904***	11.768***	12.250***	11.887***
	(0.072)	(0.201)	(0.116)	(0.126)	(0.064)	(0.108)	(0.153)
no computer access	10.638***	9.318***	10.679***	10.595***	10.106***	10.426***	10.474***
	(0.208)	(0.087)	(0.155)	(0.159)	(0.150)	(0.154)	(0.090)
mean turnover gap	1.648***	1.291***	1.701***	1.309***	1.662***	1.824***	1.413***
	(0.210)	(0.228)	(0.207)	(0.206)	(0.163)	(0.185)	(0.183)
endowments	1.496**	0.928***	1.703***	1.246***	1.839***	1.732***	1.391***
	(0.705)	(0.178)	(0.572)	(0.357)	(0.416)	(0.419)	(0.253)
coefficients	-0.403*	-1.406**	0.015	0.026	0.127	0.082	-0.023
	(0.219)	(0.680)	(0.237)	(0.271)	(0.150)	(0.162)	(0.487)
interaction	0.555	1.769***	-0.016	0.037	-0.303	0.011	0.044
	(0.626)	(0.637)	(0.508)	(0.387)	(0.409)	(0.434)	(0.517)
endowments							
log of employees	0.277	0.174	0.533	0.583**	0.464	0.642	0.703***
	(0.656)	(0.213)	(0.361)	(0.265)	(0.325)	(0.415)	(0.169)
log ICT capital	0.060	0.056	0.091**	-0.030	0.097	0.296***	0.165***
	(0.196)	(0.051)	(0.045)	(0.049)	(0.067)	(0.111)	(0.051)
log of non-ICT capital	-0.012	0.129*	0.203**	0.191***	0.545**	0.148	0.070
	(0.203)	(0.073)	(0.097)	(0.067)	(0.230)	(0.090)	(0.050)
log of raw materials	0.447***	0.166***	0.527**	0.347***	0.529***	0.330***	0.218**
	(0.156)	(0.063)	(0.238)	(0.131)	(0.181)	(0.077)	(0.086)
firm age	0.010	0.018	0.016	0.060	-0.042	-0.020	-0.042
	(0.041)	(0.022)	(0.042)	(0.038)	(0.069)	(0.039)	(0.037)
ownership form	0.181	0.068	0.071	0.198***	-0.189	-0.076	-0.047
	(0.184)	(0.074)	(0.107)	(0.073)	(0.137)	(0.078)	(0.067)
secondary education	-0.057	-0.024	0.016	-0.001	-0.031	0.002	-0.005
	(0.069)	(0.017)	(0.042)	(0.018)	(0.043)	(0.022)	(0.016)
vocational education	0.138	-0.007	0.003	0.010	0.006	-0.002	-0.004
	(0.169)	(0.019)	(0.005)	(0.022)	(0.029)	(0.029)	(0.014)
tertiary education	0.146	0.077	-0.014	0.017	0.062	0.076	0.040
	(0.141)	(0.050)	(0.060)	(0.025)	(0.042)	(0.091)	(0.068)
manufacturing	0.027	0.002	-0.009	-0.063*	0.001	0.004	-0.008
	(0.095)	(0.025)	(0.019)	(0.036)	(0.017)	(0.016)	(0.016)
construction	-0.016	-0.000	0.000	-0.003	-0.000	0.003	-0.044
	(0.035)	(0.009)	(0.000)	(0.023)	(0.011)	(0.011)	(0.055)
formal sector	0.128	0.031	0.130*	-0.034	0.308	0.234*	0.276***
	(0.212)	(0.088)	(0.075)	(0.074)	(0.222)	(0.129)	(0.082)
semi-formal	0.119	0.233**	0.132	-0.027	0.056	0.006	0.057**
	(0.090)	(0.095)	(0.104)	(0.029)	(0.050)	(0.030)	(0.029)
full-time manager	0.047	0.006	0.004	-0.002	0.033	0.089*	0.013
	(0.125)	(0.035)	(0.013)	(0.015)	(0.053)	(0.051)	(0.038)
coefficients							
log of employees	0.315	0.603**	-0.049	0.051	0.063	0.103	0.182
	(0.267)	(0.307)	(0.233)	(0.252)	(0.263)	(0.195)	(0.386)
log ICT capital	0.796	0.476	1.013**	0.251	-0.041	-0.335	-0.347
	(0.560)	(0.717)	(0.467)	(0.349)	(0.269)	(0.271)	(0.223)
log of non-ICT capital	0.426	0.974	1.358	-0.482	-1.122	-0.189	-0.302
	(0.463)	(1.082)	(0.841)	(0.477)	(0.726)	(0.365)	(0.584)
log of raw materials	-1.545	1.386	-1.037	-0.752	0.323	-0.187	0.240
	(1.127)	(0.996)	(1.369)	(0.605)	(1.257)	(0.394)	(0.840)
firm age	-0.399	0.221	0.012	-0.401	0.201	0.240	-0.117
	(0.497)	(0.481)	(0.379)	(0.321)	(0.262)	(0.314)	(0.360)
ownership form	0.519	1.138*	0.441	0.690***	-0.634	-0.567	-0.341
	(0.399)	(0.614)	(0.485)	(0.227)	(0.388)	(0.360)	(0.357)
secondary education	-0.054	-0.341	-0.224	-0.087	-0.040	0.198	-0.266
	(0.163)	(0.302)	(0.253)	(0.093)	(0.158)	(0.289)	(0.320)
vocational education	-0.105	-0.117	-0.020	-0.091*	-0.006	0.030	-0.240**
	(0.132)	(0.112)	(0.016)	(0.047)	(0.027)	(0.077)	(0.104)
tertiary education	-0.064	-0.136	-0.200	-0.001	-0.191	0.032	-0.222*
	(0.129)	(0.142)	(0.191)	(0.095)	(0.149)	(0.086)	(0.120)
manufacturing	0.075	0.090	-0.078	0.083**	-0.023	-0.080	-0.133
	(0.180)	(0.102)	(0.063)	(0.039)	(0.058)	(0.057)	(0.136)
construction	0.000	0.132	0.000	0.078	-0.018	-0.012	0.016*
	(0.033)	(0.107)	(0.000)	(0.050)	(0.023)	(0.019)	(0.009)
formal sector	0.023	0.029	-0.018	0.089*	-0.044	-0.029	-0.105
	(0.087)	(0.032)	(0.019)	(0.053)	(0.031)	(0.113)	(0.116)
semi-formal	-0.080	0.035	-0.070	0.145	-0.038	0.051	-0.059
	(0.102)	(0.105)	(0.043)	(0.092)	(0.051)	(0.136)	(0.139)
full-time manager	-0.029	0.023	-0.074	0.083	-0.033	-0.251**	0.010
	(0.074)	(0.067)	(0.053)	(0.079)	(0.041)	(0.103)	(0.024)
interaction							
log of employees	0.765	1.222*	-0.084	0.074	0.090	0.229	0.279
	(0.589)	(0.626)	(0.389)	(0.354)	(0.376)	(0.444)	(0.594)

log ICT capital	0.359	0.156	0.332**	0.047	-0.012	-0.138	-0.124
	(0.239)	(0.241)	(0.142)	(0.076)	(0.083)	(0.119)	(0.090)
log of non-ICT capital	0.208	0.257	0.357*	-0.054	-0.319	-0.077	-0.035
	(0.247)	(0.281)	(0.216)	(0.053)	(0.232)	(0.140)	(0.076)
log of raw materials	-0.272*	0.195	-0.151	-0.086	0.066	-0.047	0.032
	(0.155)	(0.199)	(0.208)	(0.065)	(0.248)	(0.104)	(0.115)
firm age	-0.007	0.023	0.002	-0.057	0.051	0.036	-0.018
	(0.038)	(0.059)	(0.060)	(0.045)	(0.076)	(0.049)	(0.053)
ownership form	-0.215	-0.252*	-0.111	-0.188**	0.207	0.125	0.122
	(0.186)	(0.143)	(0.115)	(0.078)	(0.138)	(0.099)	(0.126)
secondary education	0.027	0.092	0.032	0.001	0.015	-0.017	0.034
	(0.084)	(0.102)	(0.063)	(0.026)	(0.056)	(0.041)	(0.059)
vocational education	-0.127	0.013	-0.012	-0.024	-0.005	-0.006	0.023
	(0.174)	(0.049)	(0.016)	(0.035)	(0.031)	(0.031)	(0.059)
tertiary education	-0.096	-0.154	-0.083	-0.000	-0.051	0.050	-0.232
	(0.152)	(0.164)	(0.080)	(0.041)	(0.048)	(0.128)	(0.141)
manufacturing	-0.023	-0.002	0.014	0.051	0.005	-0.006	-0.017
	(0.091)	(0.044)	(0.027)	(0.036)	(0.019)	(0.030)	(0.042)
construction	0.001	-0.006	0.008	0.023	0.001	-0.004	0.145**
	(0.039)	(0.062)	(0.013)	(0.051)	(0.015)	(0.015)	(0.072)
formal sector	0.060	0.136	-0.137	0.205	-0.249	-0.038	-0.144
	(0.237)	(0.170)	(0.130)	(0.126)	(0.226)	(0.142)	(0.161)
semi-formal	-0.069	0.070	-0.174	0.029	-0.052	0.002	-0.033
	(0.080)	(0.221)	(0.121)	(0.031)	(0.061)	(0.022)	(0.078)
full-time manager	-0.058	0.019	-0.009	0.016	-0.050	-0.098*	0.014
	(0.118)	(0.063)	(0.018)	(0.027)	(0.061)	(0.056)	(0.044)
Constant	-0.280	-5.918***	-1.038	0.369	1.729	1.077	1.661
	(1.364)	(1.743)	(1.848)	(0.975)	(1.981)	(1.073)	(1.191)
Observations	255	280	282	280	277	280	307

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.4: Continues…

VARIABLES	**Nigeria**	**Rwanda**	**S Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
overall							
computer access	11.028***	12.304***	12.326***	11.087***	12.278***	11.206***	14.578***
	(0.086)	(0.109)	(0.227)	(0.124)	(0.072)	(0.106)	(0.128)
no computer access	9.622***	10.935***	10.738***	9.613***	11.109***	9.688***	13.062***
	(0.098)	(0.111)	(0.136)	(0.110)	(0.092)	(0.069)	(0.125)
mean turnover gap	1.406***	1.368***	1.588***	1.474***	1.169***	1.518***	1.516***
	(0.128)	(0.170)	(0.287)	(0.177)	(0.116)	(0.126)	(0.177)
endowments	1.646***	1.463***	1.665***	1.334***	1.254***	1.502***	1.780***
	(0.281)	(0.320)	(0.634)	(0.248)	(0.162)	(0.194)	(0.478)
coefficients	0.094	0.184	0.407	-0.411**	0.100	0.051	-0.776**
	(0.214)	(0.208)	(0.433)	(0.205)	(0.129)	(0.146)	(0.313)
interaction	-0.334	-0.278	-0.484	0.550*	-0.185	-0.035	0.512
	(0.370)	(0.315)	(0.693)	(0.302)	(0.197)	(0.213)	(0.566)
endowments							
log of employees	0.319	0.664**	0.847	0.525**	0.668***	0.485**	0.793
	(0.249)	(0.265)	(0.558)	(0.226)	(0.160)	(0.196)	(0.634)
log ICT capital	0.057	0.211**	0.156	0.141	0.048	-0.023	0.300**
	(0.104)	(0.096)	(0.098)	(0.092)	(0.030)	(0.047)	(0.131)
log of non-ICT capital	0.549***	0.168**	0.107	0.289**	0.064	0.196***	0.039
	(0.154)	(0.067)	(0.102)	(0.122)	(0.044)	(0.072)	(0.154)
log of raw materials	0.322***	0.263***	0.150**	0.274***	0.389***	0.523***	0.175
	(0.073)	(0.079)	(0.064)	(0.067)	(0.077)	(0.087)	(0.110)
firm age	-0.013	0.000	0.041	0.028	0.026	0.003	0.042
	(0.024)	(0.011)	(0.069)	(0.044)	(0.036)	(0.009)	(0.049)
ownership form	0.188	-0.079	-0.003	0.090	-0.017	0.044	-0.012
	(0.133)	(0.060)	(0.053)	(0.086)	(0.044)	(0.043)	(0.071)
secondary education	-0.063	0.008	-0.067	0.005	0.029	0.058	-0.026
	(0.045)	(0.027)	(0.067)	(0.018)	(0.044)	(0.073)	(0.046)
vocational education	0.026	-0.001	-0.008	0.002	-0.005	-0.013	0.125
	(0.023)	(0.014)	(0.026)	(0.010)	(0.021)	(0.044)	(0.081)
tertiary education	0.118	-0.084	0.151	-0.105	0.020	-0.008	-0.097
	(0.080)	(0.059)	(0.099)	(0.088)	(0.056)	(0.055)	(0.079)
manufacturing	0.002	-0.046*	-0.040	0.000	-0.031*	0.018	-0.001
	(0.007)	(0.026)	(0.051)	(0.007)	(0.017)	(0.019)	(0.026)
construction	-0.006	-0.013	-0.008	-0.001	-0.022	0.003	0.001
	(0.011)	(0.019)	(0.030)	(0.010)	(0.024)	(0.012)	(0.015)
formal sector	0.177*	0.257***	0.303*	0.182**	0.063	0.151**	0.410**
	(0.092)	(0.086)	(0.171)	(0.084)	(0.061)	(0.062)	(0.184)
semi-formal	-0.003	0.110	0.037	-0.112**	0.019	0.001	0.020
	(0.029)	(0.070)	(0.051)	(0.054)	(0.015)	(0.008)	(0.048)

full-time manager	-0.028	0.004	0.000	0.015	0.002	0.064**	0.012
	(0.070)	(0.017)	(0.032)	(0.039)	(0.013)	(0.028)	(0.024)
coefficients							
log of employees	-0.032	-0.397**	-0.317	0.205	-0.217*	-0.041	0.116
	(0.221)	(0.202)	(0.465)	(0.182)	(0.128)	(0.198)	(0.550)
log ICT capital	0.186	0.052	1.538	0.243	-0.031	0.465**	-0.314
	(0.470)	(0.564)	(0.977)	(0.490)	(0.360)	(0.217)	(0.599)
log of non-ICT capital	-1.008	0.080	0.261	0.265	0.525	-0.460	3.212**
	(0.640)	(0.560)	(1.394)	(0.769)	(0.344)	(0.434)	(1.318)
log of raw materials	0.614	0.654	0.569	-0.732	-0.205	0.556	1.314**
	(0.602)	(0.459)	(0.387)	(0.900)	(1.213)	(0.773)	(0.555)
firm age	0.252	-0.248	0.064	-0.167	-0.152	-0.098	-0.242
	(0.347)	(0.339)	(0.524)	(0.318)	(0.176)	(0.182)	(0.405)
ownership form	0.489	-0.189	-0.094	0.246	0.006	0.164	-0.150
	(0.410)	(0.290)	(0.269)	(0.348)	(0.150)	(0.154)	(0.186)
secondary education	-0.238	0.128	-0.343	0.034	0.090	0.134	0.022
	(0.151)	(0.163)	(0.294)	(0.124)	(0.109)	(0.137)	(0.208)
vocational education	0.005	0.040	-0.094	-0.055	0.012	0.075	0.425**
	(0.067)	(0.028)	(0.078)	(0.056)	(0.025)	(0.115)	(0.200)
tertiary education	-0.079	0.120*	-0.327	0.031	0.019	0.209	0.512
	(0.065)	(0.062)	(0.238)	(0.043)	(0.149)	(0.321)	(0.340)
manufacturing	-0.045	0.055**	-0.035	-0.090	0.054	0.072**	0.008
	(0.053)	(0.027)	(0.057)	(0.057)	(0.033)	(0.035)	(0.090)
construction	0.030	0.023	0.004	-0.012	0.007	0.045	-0.008
	(0.068)	(0.017)	(0.022)	(0.026)	(0.005)	(0.030)	(0.025)
formal sector	-0.008	-0.004	-0.160	-0.038	0.019	0.012	-0.438**
	(0.022)	(0.008)	(0.140)	(0.088)	(0.020)	(0.030)	(0.190)
semi-formal	0.006	-0.023	0.216	-0.113	0.052	0.070	-0.147
	(0.055)	(0.058)	(0.232)	(0.100)	(0.050)	(0.060)	(0.095)
full-time manager	0.037	0.022	-0.176	-0.004	-0.065	-0.045	-0.111
	(0.034)	(0.062)	(0.156)	(0.047)	(0.049)	(0.049)	(0.135)
interaction							
log of employees	-0.044	-0.685**	-0.458	0.477	-0.316	-0.052	0.143
	(0.308)	(0.341)	(0.684)	(0.412)	(0.194)	(0.246)	(0.676)
log ICT capital	0.066	0.012	0.263	0.085	-0.004	0.136	-0.075
	(0.159)	(0.129)	(0.186)	(0.172)	(0.048)	(0.085)	(0.149)
log of non-ICT capital	-0.371	0.014	0.031	0.103	0.105	-0.107	0.581**
	(0.239)	(0.100)	(0.180)	(0.306)	(0.066)	(0.102)	(0.289)
log of raw materials	0.139	0.166	0.141	-0.122	-0.024	0.100	0.527**
	(0.174)	(0.141)	(0.122)	(0.108)	(0.137)	(0.148)	(0.232)
firm age	0.031	-0.003	0.014	-0.023	-0.037	-0.004	-0.036
	(0.046)	(0.020)	(0.103)	(0.051)	(0.043)	(0.012)	(0.056)
ownership form	-0.169	0.049	0.039	-0.059	-0.003	-0.073	0.065
	(0.148)	(0.075)	(0.106)	(0.086)	(0.066)	(0.070)	(0.085)
secondary education	0.120	-0.023	0.092	-0.004	-0.039	-0.079	-0.006
	(0.079)	(0.036)	(0.094)	(0.025)	(0.050)	(0.083)	(0.090)
vocational education	-0.003	0.004	0.027	0.015	0.008	0.016	-0.349*
	(0.049)	(0.025)	(0.055)	(0.018)	(0.027)	(0.046)	(0.184)
tertiary education	-0.175	0.130*	-0.170	0.069	0.007	0.041	0.176
	(0.143)	(0.077)	(0.143)	(0.095)	(0.061)	(0.064)	(0.151)
manufacturing	0.009	0.051	-0.043	0.004	0.032	-0.018	-0.002
	(0.016)	(0.033)	(0.096)	(0.024)	(0.022)	(0.024)	(0.036)
construction	-0.008	0.054	0.003	0.001	0.025	-0.007	-0.003
	(0.050)	(0.038)	(0.034)	(0.011)	(0.027)	(0.027)	(0.017)
formal sector	-0.040	-0.037	-0.349	-0.035	0.046	0.034	-0.459**
	(0.112)	(0.090)	(0.318)	(0.078)	(0.060)	(0.074)	(0.234)
semi-formal	0.006	-0.019	-0.075	0.043	0.016	0.002	-0.022
	(0.050)	(0.055)	(0.092)	(0.045)	(0.017)	(0.012)	(0.053)
full-time manager	0.107	0.007	-0.000	-0.005	-0.001	-0.023	-0.028
	(0.086)	(0.022)	(0.038)	(0.051)	(0.010)	(0.026)	(0.036)
Constant	-0.116	-0.129	-0.700	-0.225	-0.016	-1.107	-4.976***
	(1.063)	(0.899)	(1.902)	(0.971)	(1.061)	(1.001)	(1.771)
Observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.5: Oaxaca decomposition of turnover by managerial type control

VARIABLES	Botswana	Cameroon	Ethiopia	Ghana	Kenya	Mozambique	Namibia
overall							
computer access	12.400***	10.681***	12.427***	12.275***	11.781***	12.190***	11.943***
	(0.111)	(0.166)	(0.179)	(0.180)	(0.094)	(0.144)	(0.226)
no computer access	11.892***	9.475***	11.558***	11.128***	10.845***	11.119***	10.992***
	(0.074)	(0.127)	(0.128)	(0.107)	(0.102)	(0.157)	(0.113)
mean turnover gap	0.508***	1.206***	0.869***	1.147***	0.936***	1.071***	0.952***
	(0.136)	(0.221)	(0.216)	(0.217)	(0.134)	(0.190)	(0.253)
endowments	0.515***	1.133***	0.877***	1.019***	0.946***	0.870***	0.645**
	(0.131)	(0.266)	(0.266)	(0.230)	(0.153)	(0.237)	(0.272)
coefficients	0.204	0.189	0.026	0.184	0.039	0.378**	0.384
	(0.311)	(0.301)	(0.191)	(0.334)	(0.123)	(0.177)	(0.277)
interaction	-0.211	-0.116	-0.034	-0.056	-0.049	-0.177	-0.077
	(0.299)	(0.325)	(0.206)	(0.365)	(0.147)	(0.161)	(0.295)
endowments							
log of employees	0.174**	0.080	0.130	0.065	0.263***	0.243**	0.226**
	(0.076)	(0.062)	(0.093)	(0.049)	(0.092)	(0.097)	(0.112)
log ICT capital	0.115***	0.150*	0.136**	0.009	0.098***	0.088*	0.070
	(0.041)	(0.090)	(0.057)	(0.016)	(0.038)	(0.050)	(0.057)
log of non-ICT capital	0.038	0.189	0.230*	0.200**	0.294***	0.101**	0.061
	(0.032)	(0.116)	(0.133)	(0.091)	(0.111)	(0.044)	(0.061)
log of raw materials	0.095*	0.340***	0.395***	0.402***	0.249***	0.147**	0.076
	(0.050)	(0.098)	(0.131)	(0.085)	(0.082)	(0.062)	(0.134)
firm age	0.006	0.000	-0.012	-0.010	0.009	-0.000	-0.003
	(0.016)	(0.014)	(0.031)	(0.028)	(0.009)	(0.008)	(0.021)
ownership form	0.020	-0.197	-0.047	0.163*	-0.057	0.020	0.007
	(0.039)	(0.173)	(0.068)	(0.090)	(0.048)	(0.072)	(0.038)
secondary education	-0.002	-0.018	0.093	-0.027	0.039	0.002	-0.003
	(0.016)	(0.042)	(0.070)	(0.038)	(0.067)	(0.023)	(0.030)
vocational education	-0.005	-0.019	0.002	0.003	0.013	0.010	0.029
	(0.028)	(0.024)	(0.009)	(0.018)	(0.019)	(0.028)	(0.022)
tertiary education	-0.025	0.083	-0.071	0.081	-0.005	0.026	-0.022
	(0.046)	(0.123)	(0.077)	(0.078)	(0.086)	(0.030)	(0.041)
manufacturing	0.004	0.031	0.001	0.033	0.001	0.003	0.029
	(0.008)	(0.025)	(0.011)	(0.034)	(0.012)	(0.009)	(0.047)
construction	0.003	-0.038	-0.009	-0.049*	0.001	-0.007	-0.014
	(0.011)	(0.030)	(0.012)	(0.028)	(0.005)	(0.011)	(0.037)
formal sector	0.096**	0.303**	0.031	0.149*	0.031	0.251***	0.203*
	(0.048)	(0.131)	(0.099)	(0.080)	(0.084)	(0.081)	(0.108)
semi-formal	-0.003	0.227**	-0.003	0.000	0.009	-0.013	-0.015
	(0.030)	(0.093)	(0.020)	(0.011)	(0.023)	(0.043)	(0.038)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
coefficients							
log of employees	-0.127	0.312	-0.045	0.137	-0.133	-0.603***	0.479
	(0.667)	(0.319)	(0.341)	(0.354)	(0.275)	(0.221)	(0.615)
log ICT capital	-1.990**	-0.117	0.410	-0.257	-0.202	0.358	-0.217
	(0.994)	(0.522)	(0.514)	(0.424)	(0.348)	(0.278)	(0.525)
log of non-ICT capital	2.059	-0.639	-1.461*	-0.409	-0.234	-0.105	-0.738
	(1.710)	(0.937)	(0.886)	(0.500)	(0.821)	(0.370)	(0.731)
log of raw materials	-0.052	1.070*	-0.752	1.651	-0.904	-0.153	-0.817
	(2.545)	(0.625)	(1.303)	(1.464)	(1.075)	(0.446)	(1.065)
firm age	-0.369	-0.025	0.716*	-0.397	-0.371*	0.295	-0.247
	(0.505)	(0.425)	(0.425)	(0.378)	(0.218)	(0.338)	(0.618)
ownership form	0.164	-1.165	-0.355	-0.019	-0.288*	-0.004	0.382
	(0.219)	(0.784)	(0.390)	(0.264)	(0.151)	(0.217)	(0.435)
secondary education	0.037	-0.088	0.101	0.174	0.075	-0.907**	-0.188
	(0.209)	(0.212)	(0.237)	(0.226)	(0.158)	(0.353)	(0.463)
vocational education	0.124	-0.110	-0.003	0.088	0.021	-0.089	-0.041
	(0.291)	(0.099)	(0.013)	(0.106)	(0.038)	(0.059)	(0.209)
tertiary education	0.349	-0.080	0.031	0.031	0.006	-0.375*	0.108
	(0.327)	(0.089)	(0.210)	(0.158)	(0.169)	(0.206)	(0.252)
manufacturing	-0.012	0.088	0.011	-0.088	-0.033	0.005	0.237
	(0.051)	(0.131)	(0.077)	(0.107)	(0.039)	(0.055)	(0.148)
construction	0.013	-0.091	-0.009	-0.047	-0.018	-0.092*	-0.038
	(0.041)	(0.090)	(0.012)	(0.048)	(0.017)	(0.050)	(0.050)
formal sector	-0.790	-0.093**	0.017	-0.284**	0.032	0.003	0.093
	(0.592)	(0.040)	(0.079)	(0.132)	(0.030)	(0.083)	(0.144)
semi-formal	-0.397	-0.136	0.020	-0.296	0.009	0.011	0.262
	(0.250)	(0.093)	(0.085)	(0.191)	(0.062)	(0.124)	(0.242)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
interaction							
log of employees	-0.024	0.104	-0.007	0.010	-0.051	-0.135*	0.136
	(0.128)	(0.130)	(0.058)	(0.034)	(0.110)	(0.074)	(0.197)

log ICT capital	-0.196**	-0.029	0.071	-0.010	-0.045	0.078	-0.039
	(0.096)	(0.136)	(0.096)	(0.035)	(0.082)	(0.060)	(0.143)
log of non-ICT capital	0.226	-0.123	-0.190	-0.052	-0.046	-0.030	-0.092
	(0.197)	(0.201)	(0.138)	(0.068)	(0.157)	(0.106)	(0.118)
log of raw materials	-0.004	0.237	-0.089	0.323	-0.069	-0.017	-0.032
	(0.234)	(0.151)	(0.150)	(0.332)	(0.085)	(0.054)	(0.083)
firm age	-0.008	0.001	0.069	0.010	-0.024	0.004	-0.002
	(0.040)	(0.032)	(0.049)	(0.040)	(0.020)	(0.014)	(0.037)
ownership form	-0.108	0.265	0.103	0.009	0.102*	0.001	-0.079
	(0.153)	(0.193)	(0.117)	(0.141)	(0.058)	(0.068)	(0.119)
secondary education	-0.009	0.040	-0.048	-0.116	-0.036	-0.011	-0.031
	(0.080)	(0.111)	(0.110)	(0.149)	(0.086)	(0.103)	(0.177)
vocational education	-0.057	0.049	0.001	-0.011	-0.013	-0.059	0.020
	(0.155)	(0.063)	(0.009)	(0.051)	(0.024)	(0.059)	(0.113)
tertiary education	0.252	-0.165	0.019	0.039	0.004	-0.083	0.026
	(0.274)	(0.204)	(0.151)	(0.221)	(0.107)	(0.074)	(0.075)
manufacturing	0.002	-0.068	-0.004	0.050	0.012	-0.001	-0.050
	(0.023)	(0.109)	(0.037)	(0.068)	(0.017)	(0.020)	(0.089)
construction	-0.002	0.057	0.009	0.039	0.007	0.073*	0.011
	(0.021)	(0.063)	(0.012)	(0.039)	(0.011)	(0.043)	(0.034)
formal sector	-0.295	-0.308*	0.026	-0.354*	0.107	0.004	0.087
	(0.217)	(0.160)	(0.124)	(0.186)	(0.127)	(0.104)	(0.149)
semi-formal	0.012	-0.176	0.006	0.006	0.005	-0.001	-0.031
	(0.066)	(0.113)	(0.034)	(0.060)	(0.038)	(0.024)	(0.094)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	1.195	1.263	1.346	-0.101	2.078*	2.033**	1.109
	(2.110)	(1.633)	(1.557)	(1.467)	(1.250)	(0.837)	(1.545)
Observations	255	280	282	280	277	280	307

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.5: continues…

VARIABLES	**Nigeria**	**Rwanda**	**S Africa**	**Tanzania**	**Uganda**	**Zambia**	**Zimbabwe**
overall							
computer access	11.769***	12.085***	12.232***	10.936***	12.256***	11.465***	14.491***
	(0.298)	(0.173)	(0.277)	(0.160)	(0.110)	(0.147)	(0.212)
no computer access	10.058***	11.323***	11.361***	10.002***	11.531***	10.027***	13.911***
	(0.074)	(0.086)	(0.146)	(0.091)	(0.094)	(0.086)	(0.114)
mean turnover gap	1.711***	0.762***	0.871***	0.934***	0.724***	1.438***	0.580**
	(0.317)	(0.213)	(0.298)	(0.187)	(0.136)	(0.164)	(0.244)
endowments	1.162***	0.751***	0.680**	0.852***	0.528***	1.035***	0.617***
	(0.202)	(0.191)	(0.270)	(0.159)	(0.128)	(0.168)	(0.199)
coefficients	-0.097	0.095	0.202	-0.138	0.016	0.535***	0.099
	(0.681)	(0.185)	(0.432)	(0.211)	(0.089)	(0.159)	(0.214)
interaction	0.646	-0.084	-0.011	0.219	0.180**	-0.132	-0.136
	(0.705)	(0.188)	(0.355)	(0.230)	(0.088)	(0.152)	(0.252)
endowments							
log of employees	0.166***	0.032	0.036	0.196***	0.069	0.228***	0.210**
	(0.062)	(0.036)	(0.082)	(0.065)	(0.051)	(0.070)	(0.103)
log ICT capital	0.103	0.222**	0.263**	0.088**	0.052**	0.031	0.125***
	(0.095)	(0.086)	(0.122)	(0.045)	(0.022)	(0.026)	(0.044)
log of non-ICT capital	0.214*	0.143***	0.173	0.213***	0.051**	0.109**	0.114*
	(0.126)	(0.053)	(0.117)	(0.081)	(0.022)	(0.048)	(0.064)
log of raw materials	0.343***	0.127**	0.118	0.155***	0.245***	0.507***	0.012
	(0.102)	(0.064)	(0.098)	(0.055)	(0.071)	(0.114)	(0.064)
firm age	0.007	0.001	0.003	-0.004	-0.001	-0.001	0.030
	(0.026)	(0.008)	(0.024)	(0.014)	(0.005)	(0.011)	(0.037)
ownership form	-0.019	-0.046	0.004	0.031	-0.068***	-0.013	0.073*
	(0.053)	(0.039)	(0.065)	(0.024)	(0.025)	(0.031)	(0.044)
secondary education	-0.002	0.006	-0.027	-0.044	0.017	0.034	-0.080
	(0.039)	(0.023)	(0.054)	(0.041)	(0.035)	(0.052)	(0.068)
vocational education	0.057**	0.000	0.015	0.008	-0.000	0.021	0.017
	(0.028)	(0.009)	(0.024)	(0.016)	(0.009)	(0.029)	(0.038)
tertiary education	0.045	-0.024	0.044	-0.008	0.021	-0.002	0.032
	(0.077)	(0.064)	(0.058)	(0.019)	(0.046)	(0.087)	(0.053)
manufacturing	0.013	0.010	0.049	0.017	0.007	0.000	-0.003
	(0.014)	(0.015)	(0.052)	(0.018)	(0.017)	(0.011)	(0.017)
construction	-0.005	-0.021	-0.003	-0.006	0.000	-0.006	-0.001
	(0.009)	(0.016)	(0.013)	(0.011)	(0.005)	(0.010)	(0.012)
formal sector	0.247**	0.179***	0.005	0.234***	0.097**	0.112**	0.128
	(0.107)	(0.065)	(0.087)	(0.078)	(0.039)	(0.053)	(0.081)
semi-formal	-0.007	0.121*	-0.000	-0.028	0.040	0.014	-0.039
	(0.013)	(0.070)	(0.016)	(0.041)	(0.024)	(0.016)	(0.039)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

coefficients							
log of employees	-0.612	0.019	-0.249	0.188	-0.435**	-0.233	-1.213**
	(0.437)	(0.235)	(0.616)	(0.319)	(0.188)	(0.216)	(0.598)
log ICT capital	0.293	-0.369	0.336	0.575	-0.120	0.167	-0.814
	(1.140)	(0.678)	(1.466)	(0.577)	(0.299)	(0.473)	(0.586)
log of non-ICT capital	1.678	-1.051	-0.330	-0.492	0.381	-0.308	6.353***
	(1.096)	(0.782)	(1.403)	(0.856)	(0.411)	(0.398)	(1.875)
log of raw materials	1.108	0.888	-0.221	-0.122	0.169	-0.443	-0.027
	(1.433)	(1.022)	(0.673)	(0.883)	(1.138)	(0.652)	(0.612)
firm age	0.407	0.020	0.071	-0.357	0.023	-0.043	-0.212
	(1.424)	(0.355)	(0.632)	(0.297)	(0.197)	(0.222)	(0.426)
ownership form	-0.366	0.051	-0.184	0.046	-0.352***	-0.134	-0.007
	(0.416)	(0.232)	(0.483)	(0.260)	(0.133)	(0.140)	(0.138)
secondary education	-0.144	-0.014	0.199	0.006	-0.005	0.044	-0.011
	(0.375)	(0.271)	(0.380)	(0.143)	(0.128)	(0.085)	(0.257)
vocational education	0.057**	0.014	0.063	-0.174	-0.012	0.075	-0.092*
	(0.028)	(0.060)	(0.073)	(0.122)	(0.041)	(0.099)	(0.052)
tertiary education	-0.126	0.003	-0.025	-0.050	0.005	0.189	-0.866*
	(0.300)	(0.096)	(0.323)	(0.092)	(0.193)	(0.234)	(0.475)
manufacturing	-0.075	0.030	0.011	-0.031	-0.075	0.022	0.051
	(0.191)	(0.090)	(0.213)	(0.068)	(0.046)	(0.041)	(0.102)
construction	0.087	-0.057*	-0.096	-0.026	-0.011	0.025	-0.058
	(0.065)	(0.032)	(0.071)	(0.026)	(0.013)	(0.025)	(0.037)
formal sector	-0.043	0.018	-0.010	-0.044	-0.011	-0.019	0.338**
	(0.070)	(0.046)	(0.430)	(0.110)	(0.023)	(0.065)	(0.151)
semi-formal	-0.222	-0.043	-0.167	-0.086	0.042	-0.150**	0.400***
	(0.201)	(0.062)	(0.256)	(0.145)	(0.066)	(0.076)	(0.133)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
interaction							
log of employees	-0.211	0.003	-0.009	0.076	-0.036	-0.070	-0.215*
	(0.179)	(0.043)	(0.056)	(0.118)	(0.034)	(0.064)	(0.129)
log ICT capital	0.118	-0.081	0.050	0.160	-0.013	0.042	-0.093
	(0.463)	(0.135)	(0.199)	(0.173)	(0.033)	(0.132)	(0.074)
log of non-ICT capital	0.616	-0.125	-0.039	-0.080	0.042	-0.054	0.510**
	(0.438)	(0.113)	(0.159)	(0.143)	(0.046)	(0.073)	(0.211)
log of raw materials	0.235	0.096	-0.024	-0.014	0.013	-0.064	-0.000
	(0.350)	(0.173)	(0.096)	(0.101)	(0.089)	(0.088)	(0.035)
firm age	0.069	-0.001	0.001	0.007	0.000	-0.004	-0.033
	(0.265)	(0.019)	(0.034)	(0.022)	(0.008)	(0.024)	(0.065)
ownership form	0.178	-0.016	0.070	-0.008	0.118***	0.052	0.004
	(0.237)	(0.068)	(0.203)	(0.043)	(0.044)	(0.062)	(0.076)
secondary education	0.101	0.003	-0.065	0.005	0.002	-0.034	0.008
	(0.254)	(0.057)	(0.143)	(0.118)	(0.066)	(0.070)	(0.183)
vocational education	-0.057**	-0.001	-0.032	0.100	0.001	-0.028	-0.086
	(0.028)	(0.032)	(0.046)	(0.077)	(0.015)	(0.036)	(0.088)
tertiary education	-0.181	0.004	-0.005	-0.011	0.002	0.101	-0.260*
	(0.467)	(0.113)	(0.066)	(0.033)	(0.089)	(0.124)	(0.150)
manufacturing	0.035	-0.013	-0.004	0.012	0.041	-0.000	-0.018
	(0.119)	(0.048)	(0.100)	(0.030)	(0.030)	(0.013)	(0.061)
construction	-0.044	0.042*	0.048	0.010	0.004	-0.020	0.007
	(0.037)	(0.025)	(0.066)	(0.019)	(0.008)	(0.019)	(0.030)
formal sector	-0.261	0.037	-0.005	-0.048	-0.016	-0.028	0.313*
	(0.390)	(0.095)	(0.254)	(0.143)	(0.033)	(0.097)	(0.167)
semi-formal	0.048	-0.033	0.003	0.009	0.022	-0.026	-0.274**
	(0.077)	(0.054)	(0.058)	(0.036)	(0.034)	(0.035)	(0.107)
full-time manager	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-2.140	0.586	0.803	0.429	0.417	1.343	-3.741**
	(2.623)	(1.366)	(1.632)	(1.139)	(1.156)	(0.832)	(1.777)
Observations	265	279	290	263	351	276	281

Note: Standard errors in parentheses are obtained using Bootstrap inference based on 200 replications. *** p<0.01, ** p<0.05, * p<0.1. All country specifications include control variables.

Table A-4.5: Detailed quantile decomposition of turnover of low and low-middle income countries (low-income countries are the reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms		No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms		No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.377***	0.218**	-0.142	-0.293***	-0.212**	-0.118	0.0405	-0.384***	-0.444***	-0.542***	-0.188	-0.728***
	(0.0868)	(0.0931)	(0.0904)	(0.0691)	(0.0976)	(0.113)	(0.105)	(0.0979)	(0.132)	(0.132)	(0.148)	(0.101)
log of employee	-0.172***	1.137***	-0.132***	-1.033***	-0.0896***	0.268	-0.0690***	0.107	0.128***	-1.045***	0.0987***	-0.555*
	(0.0337)	(0.263)	(0.0338)	(0.252)	(0.0222)	(0.326)	(0.0204)	(0.353)	(0.0289)	(0.361)	(0.0274)	(0.304)
log of ICT capital	-0.00707	-0.729***	-0.0237	0.666***	0.00754	-2.238***	0.0252	1.418***	0.0563**	-2.802***	0.188***	4.057***
	(0.00740)	(0.280)	(0.0223)	(0.257)	(0.00763)	(0.358)	(0.0227)	(0.368)	(0.0285)	(0.393)	(0.0399)	(0.334)
log of non-ICT capital	0.0213	1.089***	0.0566***	-0.491*	0.0230	-0.117	0.0612***	1.136***	0.0748	-0.0393	0.199***	2.629***
	(0.0150)	(0.308)	(0.0200)	(0.263)	(0.0162)	(0.393)	(0.0212)	(0.383)	(0.0508)	(0.432)	(0.0590)	(0.355)
log of raw materials	-0.423***	-0.472	-0.351***	-0.801**	-0.550***	-4.562***	-0.456***	-1.396***	-0.809***	-1.115**	-0.671***	1.310***
	(0.0496)	(0.397)	(0.0463)	(0.389)	(0.0565)	(0.486)	(0.0544)	(0.538)	(0.0750)	(0.538)	(0.0743)	(0.452)
sole proprietorship	0.0569***	-0.344***	0.0967***	0.262***	0.00575	-0.336***	0.00977	0.0699	-0.0961***	0.263**	-0.163***	-0.339***
	(0.0203)	(0.0929)	(0.0323)	(0.0823)	(0.0183)	(0.111)	(0.0312)	(0.114)	(0.0266)	(0.124)	(0.0404)	(0.0969)
sec. education	0.172***	-0.289**	0.231***	0.459***	0.407***	-0.567***	0.546***	-0.0682	0.0192	-0.811***	0.0257	0.477***
	(0.0493)	(0.114)	(0.0656)	(0.108)	(0.0597)	(0.141)	(0.0771)	(0.150)	(0.0557)	(0.157)	(0.0748)	(0.130)
voc. education	-0.0515***	-0.0369*	-0.0388*	0.0140	-0.107***	-0.104***	-0.0802**	0.0127	-0.0381**	-0.180***	-0.0286*	0.127***
	(0.0189)	(0.0192)	(0.0201)	(0.0190)	(0.0359)	(0.0264)	(0.0399)	(0.0268)	(0.0162)	(0.0321)	(0.0161)	(0.0267)
tertiary education	-0.0944***	-0.466***	-0.138***	0.601***	-0.340***	-1.002***	-0.498***	0.0400	-0.308***	-1.984***	-0.452***	1.256***
	(0.0344)	(0.153)	(0.0491)	(0.151)	(0.0565)	(0.194)	(0.0712)	(0.211)	(0.0565)	(0.216)	(0.0733)	(0.185)
manufacturing	0.0248*	0.0978	0.0141	-0.0730	0.0882***	0.0801	0.0502**	0.108	0.132***	-0.900***	0.0751**	0.708***
	(0.0138)	(0.0639)	(0.00927)	(0.0560)	(0.0221)	(0.0770)	(0.0214)	(0.0782)	(0.0306)	(0.0897)	(0.0313)	(0.0703)
construction	0.0783***	0.169***	0.124***	-0.194***	0.147***	0.308***	0.232***	-0.400***	0.207***	0.380***	0.327***	-0.317***
	(0.0222)	(0.0332)	(0.0321)	(0.0371)	(0.0293)	(0.0430)	(0.0378)	(0.0532)	(0.0384)	(0.0485)	(0.0475)	(0.0432)
Managerial control	0.0181	-0.0143	0.0203	-0.156**	0.195***	0.547***	0.219***	-0.514***	0.191***	0.835***	0.213***	-0.499***
type	(0.0255)	(0.0714)	(0.0285)	(0.0649)	(0.0340)	(0.0861)	(0.0382)	(0.0902)	(0.0369)	(0.0973)	(0.0415)	(0.0755)
constant		0.0749		0.452		7.605***		-0.897		6.856***		-9.584***
		(0.493)		(0.474)		(0.604)		(0.657)		(0.669)		(0.558)
Raw Gap	low income	low-middle income	total Gap		low income	low-middle income	total Gap		low income	low-middle income	total Gap	
	12.53***	12.37***	-0.159*		13.91***	13.58***	-0.330**		15.91***	14.93***	-0.986***	
	(0.0517)	(0.0775)	(0.0931)		(0.0967)	(0.0874)	(0.130)		(0.108)	(0.116)	(0.159)	
Observations	3,112				3,112				3,112			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. +

Table A-4.6: Detailed quantile decomposition of turnover of low and upper-middle income countries (low-income countries are the reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms		No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms		No reweighting small-medium sized firms as reference group		F(x) for small-medium sized firms to micro sized firms	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.219***	0.455***	-0.107	-0.494***	-0.284***	0.344***	-0.155*	-0.326***	-0.467***	-0.224	-0.233**	0.170
	(0.0619)	(0.0897)	(0.0650)	(0.0698)	(0.0750)	(0.110)	(0.0810)	(0.0881)	(0.112)	(0.149)	(0.118)	(0.135)
log of employee	-0.0155	0.0893	0.0278	0.556**	-0.00923	-0.177	0.0165	0.580*	-0.0200	2.522***	0.0359	-2.670***
	(0.0201)	(0.269)	(0.0240)	(0.270)	(0.0121)	(0.319)	(0.0146)	(0.311)	(0.0261)	(0.432)	(0.0312)	(0.484)
log of ICT capital	0.00493	-0.193	0.0107	0.646**	0.0111	-1.820***	0.0240*	2.826***	0.0222	-3.346***	0.0480*	5.179***
	(0.00580)	(0.272)	(0.00929)	(0.263)	(0.0109)	(0.341)	(0.0141)	(0.329)	(0.0216)	(0.440)	(0.0272)	(0.470)
log of non-ICT capital	0.0142	-0.328	0.0111	-0.836**	-0.0245	-1.032***	-0.0191	1.354***	-0.0284	-3.800***	-0.0222	5.682***
	(0.0155)	(0.301)	(0.0122)	(0.349)	(0.0151)	(0.375)	(0.0122)	(0.398)	(0.0244)	(0.487)	(0.0194)	(0.628)
log of raw materials	-0.116***	-2.711***	-0.0690***	-1.376***	-0.178***	-7.145***	-0.106***	1.863***	-0.299***	-4.454***	-0.178***	-4.865***
	(0.0273)	(0.349)	(0.0207)	(0.467)	(0.0316)	(0.432)	(0.0272)	(0.501)	(0.0529)	(0.562)	(0.0458)	(0.843)
sole proprietorship	0.0181	-0.141	0.0209	-0.0953	0.0743***	-0.521***	0.0859***	0.500***	0.0712	-0.368**	0.0823	0.611***
	(0.0285)	(0.0932)	(0.0329)	(0.0862)	(0.0279)	(0.107)	(0.0323)	(0.0988)	(0.0449)	(0.149)	(0.0520)	(0.155)
sec. education	0.0569	-0.0801	0.0623	0.228**	0.0294	0.174	0.0322	-0.0101	-0.197**	-0.306	-0.216**	0.560***
	(0.0482)	(0.130)	(0.0530)	(0.113)	(0.0447)	(0.147)	(0.0490)	(0.131)	(0.0778)	(0.206)	(0.0863)	(0.203)
voc. education	-0.139***	-0.0274	-0.129***	0.0254	-0.152***	-0.00922	-0.142***	0.0128	-0.0526	-0.145***	-0.0490	0.137***
	(0.0357)	(0.0202)	(0.0355)	(0.0203)	(0.0354)	(0.0243)	(0.0358)	(0.0239)	(0.0458)	(0.0353)	(0.0429)	(0.0386)
tertiary education	-0.0163	-0.210	-0.0190	0.381**	0.0237	0.467**	0.0275	-0.265	0.0462	-0.485*	0.0537	0.693**
	(0.0242)	(0.183)	(0.0282)	(0.165)	(0.0231)	(0.208)	(0.0269)	(0.189)	(0.0390)	(0.291)	(0.0455)	(0.295)
manufacturing	-0.0105	0.294***	0.000296	-0.266***	-0.000241	0.456***	6.83e-06	-0.329***	0.0184	-0.502***	-0.000522	0.735***
	(0.00807)	(0.0653)	(0.00582)	(0.0584)	(0.00598)	(0.0755)	(0.000216)	(0.0681)	(0.0132)	(0.104)	(0.0102)	(0.106)
construction	-3.73e-05	0.0576*	0.000185	-0.0613**	-0.00121	0.0635	0.00599	-0.151***	-0.00814	-0.165***	0.0404	0.338***
	(0.000895)	(0.0331)	(0.00440)	(0.0298)	(0.00403)	(0.0389)	(0.00637)	(0.0364)	(0.0266)	(0.0535)	(0.0336)	(0.0561)
Managerial control	-0.0161	0.0202	-0.0228	-0.0264	-0.0571***	0.348***	-0.0809***	-0.140**	-0.0191	0.461***	-0.0271	-0.630***
type	(0.0128)	(0.0692)	(0.0179)	(0.0591)	(0.0178)	(0.0797)	(0.0232)	(0.0700)	(0.0195)	(0.111)	(0.0274)	(0.107)
constant		3.685***		0.331		9.540***		-6.568***		10.36***		-5.599***
		(0.472)		(0.521)		(0.564)		(0.583)		(0.757)		(0.938)
Raw Gap	low income	upper-middle income		total Gap	low income	upper-middle income		total Gap	low income	upper-middle income		total Gap
	12.53***	12.77***		0.236***	13.91***	13.97***		0.0599	15.91***	15.22***		-0.691***
	(0.0517)	(0.0716)		(0.0883)	(0.0967)	(0.0788)		(0.125)	(0.108)	(0.121)		(0.162)
Observations	2,863				2,863				2,863			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. +

Table A-4.7: Detailed quantile decomposition of turnover of low-middle and upper-middle income countries[+]

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting Firms in low-middle income countries are reference group		F(x) for low-middle income countries firms to firms in upper-middle income countries		No reweighting Firms in low-middle income countries are reference group		F(x) for low-middle income countries firms to firms in upper-middle income countries		No reweighting Firms in low-middle income countries are reference group		F(x) for low-middle income countries firms to firms in upper-middle income countries	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	0.0221	0.373***	0.00247	-0.146*	-0.162*	0.551***	-0.120	0.0808	0.264**	0.0311	0.378***	0.576***
	(0.0689)	(0.106)	(0.0784)	(0.0864)	(0.0841)	(0.104)	(0.0909)	(0.0942)	(0.121)	(0.168)	(0.136)	(0.118)
log of employee	0.0818***	-0.973***	0.0664**	0.932***	0.0487***	-0.413	0.0396**	0.161	0.106***	3.313***	0.0858**	-2.292***
	(0.0252)	(0.289)	(0.0261)	(0.288)	(0.0178)	(0.282)	(0.0174)	(0.310)	(0.0346)	(0.403)	(0.0351)	(0.309)
log of ICT capital	-0.00398	0.551*	0.0107	-0.766**	-0.00894	0.430	0.0241*	-0.463	-0.0179	-0.560	0.0483*	0.0531
	(0.00616)	(0.313)	(0.00909)	(0.344)	(0.0126)	(0.307)	(0.0133)	(0.372)	(0.0251)	(0.430)	(0.0255)	(0.364)
log of non-ICT capital	0.0182	-1.442***	0.0104	0.469	-0.0313*	-0.931***	-0.0180	-0.208	-0.0362	-3.828***	-0.0208	4.912***
	(0.0197)	(0.344)	(0.0115)	(0.439)	(0.0190)	(0.337)	(0.0116)	(0.480)	(0.0309)	(0.474)	(0.0183)	(0.455)
log of raw materials	0.0476**	-1.979***	0.0518**	1.902***	0.0729***	-2.284***	0.0794***	2.133***	0.123***	-2.952***	0.134***	4.276***
	(0.0188)	(0.383)	(0.0202)	(0.393)	(0.0266)	(0.378)	(0.0284)	(0.419)	(0.0447)	(0.516)	(0.0478)	(0.429)
sole proprietorship	0.00659	0.157*	0.0162	-0.160**	0.0270**	-0.144*	0.0666**	-0.0182	0.0259	-0.490***	0.0638	0.0603
	(0.0106)	(0.0884)	(0.0256)	(0.0811)	(0.0135)	(0.0864)	(0.0259)	(0.0861)	(0.0184)	(0.124)	(0.0408)	(0.0886)
sec. education	-0.0105	0.104	0.00855	-0.132**	-0.00542	0.370***	0.00442	-0.264***	0.0364	0.252**	-0.0297	-0.0148
	(0.0112)	(0.0735)	(0.0105)	(0.0620)	(0.00896)	(0.0749)	(0.00779)	(0.0676)	(0.0275)	(0.105)	(0.0289)	(0.0671)
voc. education	-0.0929***	0.0151	-0.122***	-0.0892***	-0.102***	0.151***	-0.134***	-0.152***	-0.0352	0.0554	-0.0462	-0.0462
	(0.0302)	(0.0348)	(0.0346)	(0.0341)	(0.0312)	(0.0373)	(0.0350)	(0.0386)	(0.0315)	(0.0490)	(0.0406)	(0.0356)
tertiary education	0.0119	0.322	0.00289	-0.393*	-0.0172	1.849***	-0.00418	-1.649***	-0.0336	1.887***	-0.00816	-1.835***
	(0.0179)	(0.253)	(0.00664)	(0.207)	(0.0175)	(0.248)	(0.00842)	(0.223)	(0.0300)	(0.363)	(0.0159)	(0.229)
manufacturing	0.0110	0.150**	0.0170	-0.0926	0.000254	0.287***	0.000393	-0.310***	-0.0194	0.305***	-0.0300	-0.316***
	(0.00859)	(0.0601)	(0.0118)	(0.0572)	(0.00630)	(0.0599)	(0.00973)	(0.0628)	(0.0141)	(0.0840)	(0.0190)	(0.0636)
construction	0.000793	-0.190***	0.00116	0.162***	0.0256	-0.418***	0.0375	0.222***	0.173***	-0.934***	0.253***	0.472***
	(0.0189)	(0.0664)	(0.0276)	(0.0583)	(0.0182)	(0.0678)	(0.0263)	(0.0624)	(0.0438)	(0.104)	(0.0564)	(0.0684)
Managerial control type	-0.0483	0.0485	-0.0611	-0.0761	-0.171***	-0.281**	-0.217***	0.485***	-0.0574	-0.527***	-0.0725	0.667***
	(0.0368)	(0.122)	(0.0465)	(0.112)	(0.0375)	(0.119)	(0.0462)	(0.120)	(0.0571)	(0.168)	(0.0721)	(0.125)
constant		3.610***		-1.904***		1.935***		0.143		3.509***		-5.360***
		(0.567)		(0.549)		(0.556)		(0.586)		(0.777)		(0.599)
Raw Gap	low-middle income	upper-middle income	total Gap		low-middle income	upper-middle income	total Gap		low-middle income	upper-middle income	total Gap	
	12.37***	12.77***	0.395***		13.58***	13.97***	0.390***		14.93***	15.22***	0.295*	
	(0.0775)	(0.0716)	(0.106)		(0.0874)	(0.0788)	(0.118)		(0.116)	(0.121)	(0.168)	
Observations	1,953				1,953				1,953			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. +: Low-middle income countries are used as the reference group

Appendix 4B: Quantile Detailed Decomposition of Firm's Turnover by Computer Accessibility

Table A-4B.1: Botswana detailed decomposition of firm turnover by computer accessibility (firms with computer as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	Without reweighting access to computer as reference group		F(x) for computer reweighted to lack of computer access		Without reweighting access to computer as reference group		F(x) for computer reweighted to lack of computer access		Without reweighting access to computer as reference group		F(x) for computer reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.836**	-0.105	-0.218	-2.261**	-0.485	2.416**	-0.186	-2.416**	0.201	-1.607***	0.435*	-3.204***
	(0.341)	(0.344)	(0.245)	(1.087)	(0.348)	(1.091)	(0.352)	(1.091)	(0.307)	(0.328)	(0.233)	(1.211)
log of employee	-0.0295	-1.316**	-0.00655	0.360	-0.116	-1.379**	-0.0258	0.101	0.735***	-1.604***	0.163*	1.327
	(0.180)	(0.530)	(0.0400)	(1.753)	(0.183)	(0.566)	(0.0425)	(1.763)	(0.179)	(0.560)	(0.0880)	(1.959)
log of ICT capital	-0.634**	1.234	-0.372**	-9.239**	-0.240	-1.002	-0.141	-10.12***	-0.0782	-2.370**	-0.0460	-10.96**
	(0.285)	(1.165)	(0.171)	(3.867)	(0.286)	(1.228)	(0.168)	(3.883)	(0.250)	(1.181)	(0.147)	(4.315)
log of non-ICT capital	-0.421***	1.461	-0.0188	-5.363***	-0.268*	-0.105	-0.0120	-6.012***	-0.220*	-1.477	-0.00983	-7.339***
	(0.151)	(0.921)	(0.0768)	(1.444)	(0.141)	(0.967)	(0.0491)	(1.467)	(0.123)	(0.921)	(0.0404)	(1.629)
log of raw materials	-0.0549	-0.743	0.0485	-0.631	-0.227**	0.704	0.201**	-1.290	-0.170**	0.874	0.150*	1.400
	(0.0792)	(1.037)	(0.0703)	(0.882)	(0.103)	(1.074)	(0.0955)	(0.910)	(0.0846)	(0.992)	(0.0780)	(1.009)
sole proprietorship	-0.00912	0.158	0.00603	0.203	-0.123	-0.0629	0.0815	0.193	-0.0122	0.108	0.00809	0.103
	(0.0496)	(0.106)	(0.0332)	(0.180)	(0.0772)	(0.109)	(0.0840)	(0.182)	(0.0443)	(0.104)	(0.0301)	(0.201)
sec. education	-0.0111	-0.132	-0.0132	-0.0437	0.0225	-0.00498	0.0267	0.0526	0.0664	-0.0497	0.0789	-0.0522
	(0.0648)	(0.0958)	(0.0770)	(0.177)	(0.0664)	(0.0997)	(0.0789)	(0.181)	(0.0650)	(0.102)	(0.0765)	(0.201)
voc. education	0.0306	-0.250	-0.00368	-0.125	-0.0428	-0.165	0.00515	0.161	0.0222	-0.0401	-0.00267	-0.436
	(0.0657)	(0.247)	(0.0261)	(0.476)	(0.0692)	(0.266)	(0.0358)	(0.485)	(0.0575)	(0.268)	(0.0193)	(0.541)
tertiary education	0.193	-0.695	0.140	0.681	0.473**	-0.872*	0.343*	0.957	0.0614	-0.851*	0.0444	0.173
	(0.210)	(0.461)	(0.158)	(0.960)	(0.228)	(0.496)	(0.192)	(0.976)	(0.185)	(0.495)	(0.134)	(1.081)
manufacturing	-0.00572	0.0467	0.00884	0.373	0.00561	0.156	-0.00867	0.367	0.0173	0.203	-0.0267	0.259
	(0.0178)	(0.146)	(0.0256)	(0.244)	(0.0178)	(0.152)	(0.0257)	(0.246)	(0.0381)	(0.142)	(0.0504)	(0.271)
construction	0.280**	-0.265*	-0.0692	-0.137	0.218*	-0.116	-0.0540	-0.0679	-0.0311	0.147	0.00769	-0.216
	(0.129)	(0.146)	(0.0623)	(0.315)	(0.121)	(0.145)	(0.0513)	(0.315)	(0.0916)	(0.131)	(0.0234)	(0.352)
management type	-0.174*	0.263*	0.0628	-0.344	-0.188*	0.326**	0.0677	-0.301	-0.190**	0.520***	0.0683	-0.233
	(0.102)	(0.142)	(0.0512)	(0.225)	(0.105)	(0.148)	(0.0540)	(0.225)	(0.0961)	(0.147)	(0.0520)	(0.248)
constant		0.134		12.00***		2.336		13.54***		2.933**		12.77***
		(1.372)		(4.180)		(1.459)		(4.205)		(1.430)		(4.672)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	12.53***	11.59***		-0.941***	13.07***	12.40***		-0.671***	14.30***	12.89***		-1.407***
	(0.0897)	(0.169)		(0.191)	(0.115)	(0.172)		(0.207)	(0.133)	(0.163)		(0.210)
Observations	255				255				255			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.2: Cameroon detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.649***	-1.319***	-1.450***	-0.658***	-1.061***	-1.598***	-1.248***	-0.755***	-1.762***	-0.0827	-1.594***	-1.007***
	(0.359)	(0.386)	(0.312)	(0.203)	(0.320)	(0.345)	(0.289)	(0.142)	(0.406)	(0.406)	(0.320)	(0.175)
log of employee	-0.121	-0.173	-0.130	0.763	-0.369**	0.409	-0.396**	0.813*	-0.974***	2.014***	-1.045***	1.121**
	(0.177)	(0.727)	(0.190)	(0.632)	(0.165)	(0.535)	(0.174)	(0.426)	(0.199)	(0.607)	(0.193)	(0.490)
log of ICT capital	-0.540**	1.356	-0.453**	0.454	-0.0496	-2.176**	-0.0416	-1.829**	-0.202	-3.049***	-0.169	-3.091***
	(0.242)	(1.309)	(0.202)	(1.196)	(0.219)	(0.944)	(0.183)	(0.820)	(0.235)	(1.068)	(0.197)	(0.935)
log of non-ICT capital	-0.414***	2.340**	-0.612***	-1.055	-0.690***	4.101***	-1.021***	-0.899	-0.268**	1.225	-0.397**	-1.324*
	(0.141)	(1.123)	(0.186)	(0.887)	(0.160)	(0.869)	(0.178)	(0.601)	(0.128)	(0.960)	(0.179)	(0.689)
log of raw materials	-0.170**	1.269	-0.264***	1.321	-0.0360	-0.425	-0.0560	0.542	-0.267***	2.139**	-0.415***	1.525*
	(0.0709)	(1.173)	(0.0948)	(1.108)	(0.0540)	(0.812)	(0.0831)	(0.734)	(0.0850)	(0.929)	(0.0981)	(0.850)
sole proprietorship	-0.632***	-0.223	0.0165	0.352	-0.199	0.256	0.00520	0.488***	-0.238	-0.192	0.00624	0.0711
	(0.224)	(0.273)	(0.0307)	(0.221)	(0.192)	(0.210)	(0.0107)	(0.161)	(0.206)	(0.232)	(0.0126)	(0.165)
sec. education	0.152**	0.385**	0.317***	0.0699	0.0231	0.186	0.0480	0.0563	0.0288	0.629***	0.0599	0.491***
	(0.0757)	(0.166)	(0.112)	(0.125)	(0.0475)	(0.113)	(0.0974)	(0.0837)	(0.0513)	(0.181)	(0.105)	(0.143)
voc. education	0.250***	0.185	0.278***	0.153	0.175**	0.113	0.195**	0.0946	0.146*	0.144	0.163*	0.131
	(0.0909)	(0.119)	(0.0954)	(0.0992)	(0.0788)	(0.0732)	(0.0844)	(0.0617)	(0.0820)	(0.0922)	(0.0891)	(0.0837)
tertiary education	-0.0905	0.454	-0.206	-0.0605	0.128	0.827***	0.291	0.612***	0.256*	0.855***	0.584**	0.816***
	(0.131)	(0.322)	(0.297)	(0.263)	(0.121)	(0.262)	(0.270)	(0.194)	(0.137)	(0.289)	(0.291)	(0.231)
manufacturing	-0.0502	-0.0369	-0.270***	0.260	-0.0390	0.175	-0.210**	0.420***	0.0722	0.647***	0.389***	0.377***
	(0.0533)	(0.170)	(0.0964)	(0.162)	(0.0422)	(0.127)	(0.0868)	(0.132)	(0.0745)	(0.185)	(0.0981)	(0.140)
construction	-0.0131	-0.164	-0.0776	-0.0860	-0.0145	0.156*	-0.0859*	0.242***	-0.00323	0.117	-0.0192	0.142*
	(0.0259)	(0.106)	(0.0560)	(0.0843)	(0.0280)	(0.0832)	(0.0516)	(0.0893)	(0.0108)	(0.0852)	(0.0535)	(0.0747)
management type	-0.0201	-0.0700	-0.0482	0.470**	0.00991	-0.210	0.0238	0.383**	-0.312***	-0.0434	-0.750***	-0.0131
	(0.0919)	(0.272)	(0.220)	(0.229)	(0.0835)	(0.207)	(0.200)	(0.155)	(0.117)	(0.229)	(0.218)	(0.170)
constant		-6.643***		-3.301**		-5.010***		-1.678		-4.568***		-1.253
		(1.773)		(1.677)		(1.232)		(1.119)		(1.406)		(1.290)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	12.96***	9.992***		-2.968***	13.39***	10.73***		-2.660***	13.96***	12.12***		-1.845***
	(0.151)	(0.119)		(0.192)	(0.155)	(0.116)		(0.194)	(0.175)	(0.144)		(0.227)
Observations	280				280				280			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.3: Ethiopia detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-2.987***	-0.390	0.490	-4.829***	-1.568***	-2.291***	0.709***	1.947***	-2.860***	-0.619	2.358***	-1.890*
	(0.386)	(0.406)	(0.304)	(0.223)	(0.317)	(0.336)	(0.255)	(0.594)	(0.451)	(0.438)	(0.381)	(1.068)
log of employee	-0.153	-1.452	0.0760	-1.866	-0.298*	3.641***	0.148*	6.553***	-1.206***	5.932***	0.601***	1.865**
	(0.192)	(1.270)	(0.0966)	(1.159)	(0.161)	(0.773)	(0.0845)	(0.728)	(0.219)	(0.887)	(0.154)	(0.926)
log of ICT capital	-0.306	-1.472	-0.204	-2.354	-0.502***	3.981***	-0.334***	12.29***	-0.0440	4.319***	-0.0293	4.033
	(0.213)	(2.594)	(0.142)	(2.521)	(0.178)	(1.479)	(0.120)	(2.016)	(0.225)	(1.634)	(0.150)	(3.079)
log of non-ICT capital	-0.335	-3.555**	0.114	-4.766***	0.566***	-8.684***	-0.192**	-7.201***	0.435	-4.143***	-0.148	1.734*
	(0.251)	(1.624)	(0.0894)	(1.350)	(0.212)	(1.066)	(0.0847)	(0.789)	(0.267)	(1.252)	(0.0970)	(0.916)
log of raw materials	-1.801***	2.517*	1.078***	-6.130***	-1.470***	3.421***	0.880***	4.330***	-2.293***	6.546***	1.373***	-1.302
	(0.231)	(1.529)	(0.174)	(1.297)	(0.191)	(0.985)	(0.143)	(0.950)	(0.269)	(1.160)	(0.210)	(1.384)
sole proprietorship	-0.0118	-0.513*	-0.00429	-0.501**	0.224*	0.429**	0.0818	-0.239*	0.166	0.401*	0.0604	-0.723***
	(0.158)	(0.273)	(0.0575)	(0.211)	(0.135)	(0.188)	(0.0527)	(0.131)	(0.169)	(0.224)	(0.0631)	(0.184)
sec. education	-0.125	0.491**	-0.138	0.587***	-0.0248	-0.160	-0.0274	--0.124	-0.526***	-0.784***	-0.581***	-0.144
	(0.0915)	(0.206)	(0.0997)	(0.204)	(0.0737)	(0.114)	(0.0813)	(0.153)	(0.137)	(0.192)	(0.135)	(0.240)
voc. education	-0.0108	0.00384	-0.0107	0.00723	0.00112	0.000119	0.00111	0.000588	-0.00924	-0.00390	-0.00916	-0.000301
	(0.0160)	(0.0107)	(0.0153)	(0.0178)	(0.00580)	(0.00342)	(0.00573)	(0.00352)	(0.0143)	(0.00999)	(0.0137)	(0.00413)
tertiary education	-0.194*	1.464***	-0.280*	1.097***	-0.00433	-0.519*	-0.00624	0.620*	0.828***	-2.253***	1.194***	-0.814
	(0.116)	(0.461)	(0.162)	(0.403)	(0.0924)	(0.282)	(0.133)	(0.372)	(0.187)	(0.365)	(0.206)	(0.600)
manufacturing	0.0480	0.781***	0.181**	0.566***	0.0669	0.289**	0.252***	0.732***	-0.0664	-0.723***	-0.250***	-0.0508
	(0.0378)	(0.231)	(0.0866)	(0.199)	(0.0465)	(0.137)	(0.0768)	(0.143)	(0.0484)	(0.174)	(0.0942)	(0.147)
construction	-0.0485	0.206*	0.000903	0.148**	-0.113	0.126	0.00211	0.0907*	-0.167	0.196*	0.00310	0.0343
	(0.0584)	(0.113)	(0.0108)	(0.0730)	(0.0738)	(0.0772)	(0.0251)	(0.0530)	(0.104)	(0.108)	(0.0369)	(0.0619)
management type	-0.0503	0.579***	-0.323**	0.430***	-0.0149	0.157**	-0.0958	0.00767	0.0224	0.0925	0.144	0.411***
	(0.0414)	(0.154)	(0.130)	(0.119)	(0.0195)	(0.0721)	(0.105)	(0.0587)	(0.0263)	(0.0790)	(0.134)	(0.122)
constant		0.561		7.952***		-4.973***		-15.36***		-10.20***		-6.933*
		(3.076)		(2.941)		(1.784)		(2.448)		(1.992)		(3.806)
	computer access	no computer access	total Gap		computer access	no computer access	total Gap		computer access	no computer access	total Gap	
Raw Gap	15.60***	12.22***	-3.377***		16.87***	13.01***	-3.859***		17.54***	14.06***	-3.479***	
	(0.223)	(0.143)	(0.265)		(0.158)	(0.118)	(0.197)		(0.159)	(0.199)	(0.255)	
Observations	282				282				282			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.4: Ghana detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.525	-0.613	0.0332	0.00470	-1.201***	0.303	-1.059***	0.736***	-0.203	-0.587	1.292**	0.863*
	(0.425)	(0.443)	(0.458)	(1.293)	(0.341)	(0.337)	(0.328)	(0.183)	(0.543)	(0.579)	(0.536)	(0.455)
log of employee	-0.600***	1.744	-0.484***	-8.115***	-0.495***	1.694**	-0.399***	-1.823***	-0.538***	4.418***	-0.434***	-0.652
	(0.188)	(1.135)	(0.144)	(2.374)	(0.135)	(0.769)	(0.102)	(0.527)	(0.177)	(1.324)	(0.136)	(1.023)
log of ICT capital	0.852***	-3.943***	0.858***	29.99***	0.229	-1.782*	0.230	1.230	1.677***	0.484	1.688***	-7.163***
	(0.263)	(1.336)	(0.263)	(5.734)	(0.170)	(0.917)	(0.171)	(0.943)	(0.279)	(1.781)	(0.277)	(1.741)
log of non-ICT capital	-0.00291	0.660	-0.0274	9.633***	-0.00218	0.494	-0.0205	0.445	-0.00318	0.0590	-0.0299	0.497
	(0.0578)	(0.861)	(0.0500)	(2.314)	(0.0434)	(0.586)	(0.0374)	(0.479)	(0.0632)	(1.064)	(0.0544)	(0.924)
log of raw materials	-0.387**	1.722	-0.641**	1.712	-0.331**	-0.995	-0.548***	-2.378***	-0.537**	-5.877***	-0.890***	9.189***
	(0.184)	(1.549)	(0.249)	(2.944)	(0.140)	(1.046)	(0.177)	(0.680)	(0.217)	(1.779)	(0.266)	(1.343)
sole proprietorship	-0.298**	-0.186	0.170*	0.0230	-0.142	-0.354**	0.0810	-0.162	-0.631***	-1.168***	0.359***	0.349
	(0.152)	(0.232)	(0.0917)	(0.368)	(0.0968)	(0.163)	(0.0570)	(0.108)	(0.186)	(0.310)	(0.125)	(0.216)
sec. education	0.0117	-1.376*	-0.0670	-5.070***	0.0667	-1.498**	-0.384***	-1.129**	0.0569	-2.142*	-0.327**	1.875*
	(0.0291)	(0.811)	(0.115)	(1.486)	(0.122)	(0.584)	(0.116)	(0.558)	(0.105)	(1.144)	(0.133)	(1.120)
voc. education	-0.0928	-0.0668	-0.0946	-0.301	-0.232***	-0.0505	-0.237***	-0.0323	-0.167*	-0.00680	-0.170*	0.000102
	(0.0842)	(0.0717)	(0.0854)	(0.219)	(0.0786)	(0.0515)	(0.0770)	(0.0438)	(0.0881)	(0.0789)	(0.0883)	(0.0778)
tertiary education	0.344*	-2.746*	0.624**	-6.386***	0.227*	-1.444	0.411**	-1.321	0.397**	-1.678	0.719**	1.130
	(0.185)	(1.508)	(0.308)	(2.399)	(0.123)	(1.038)	(0.205)	(1.012)	(0.186)	(2.090)	(0.299)	(2.056)
manufacturing	-0.190	0.0294	-0.295*	-0.543	-0.181**	0.0638	-0.280**	0.233**	-0.408***	-0.287	-0.632***	-0.169
	(0.116)	(0.168)	(0.162)	(0.358)	(0.0864)	(0.115)	(0.113)	(0.0914)	(0.157)	(0.206)	(0.180)	(0.162)
construction	-0.149	0.207	0.108	1.931***	-0.324*	0.213	0.236**	-0.308***	-0.146	0.411	0.107	-0.270
	(0.140)	(0.289)	(0.0979)	(0.731)	(0.169)	(0.196)	(0.107)	(0.113)	(0.135)	(0.312)	(0.0946)	(0.184)
management type	-0.0129	-0.168	-0.118	-1.479**	-0.0163	-0.401**	-0.150	-0.353**	0.0979	0.708**	0.901***	0.478*
	(0.0306)	(0.279)	(0.184)	(0.609)	(0.0323)	(0.196)	(0.124)	(0.139)	(0.178)	(0.339)	(0.216)	(0.264)
constant		3.509		-21.39***		4.365**		6.333***		4.493		-4.400
		(3.136)		(7.991)		(2.151)		(1.975)		(4.142)		(3.897)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	13.10***	11.96***		-1.139***	14.43***	13.53***		-0.898***	16.43***	15.64***		-0.790
	(0.193)	(0.197)		(0.276)	(0.199)	(0.165)		(0.258)	(0.459)	(0.343)		(0.573)
Observations	280				280				280			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.6: Mozambique detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.098**	-0.156	-0.131	-0.934***	-0.612**	-0.798***	-0.291	-1.749***	-0.158	-0.931***	0.381*	1.688***
	(0.431)	(0.443)	(0.394)	(0.293)	(0.296)	(0.307)	(0.266)	(0.217)	(0.222)	(0.217)	(0.206)	(0.175)
log of employee	-0.177**	-0.563	0.136*	-0.723	-0.165***	1.383***	0.127**	-0.0949	-0.241***	1.402***	0.185***	1.113**
	(0.0874)	(0.693)	(0.0711)	(0.669)	(0.0617)	(0.503)	(0.0523)	(0.480)	(0.0669)	(0.443)	(0.0607)	(0.444)
log of ICT capital	0.391*	-1.731	0.226*	-2.492**	0.126	-0.315	0.0728	-1.239	0.250**	-0.725	0.145**	0.812
	(0.209)	(1.085)	(0.124)	(1.150)	(0.130)	(0.792)	(0.0757)	(0.810)	(0.0987)	(0.703)	(0.0597)	(0.746)
log of non-ICT capital	-0.326**	-0.445	-0.184**	-1.745**	-0.0553	-2.004***	-0.0312	-2.182***	0.0569	-0.740*	0.0322	0.0480
	(0.126)	(0.709)	(0.0818)	(0.738)	(0.0707)	(0.507)	(0.0405)	(0.509)	(0.0532)	(0.437)	(0.0309)	(0.464)
log of raw materials	-0.547***	4.777***	0.247	3.376***	-0.303***	1.663**	0.137	0.969*	-0.269***	1.547**	0.122*	0.122
	(0.185)	(1.154)	(0.151)	(0.814)	(0.106)	(0.773)	(0.0843)	(0.568)	(0.0899)	(0.634)	(0.0738)	(0.522)
sole proprietorship	-0.243**	-0.793***	-0.410**	-0.0615	-0.223***	-0.660***	-0.375***	-0.0187	0.0375	-0.152	0.0632	0.0954
	(0.109)	(0.301)	(0.162)	(0.241)	(0.0789)	(0.209)	(0.108)	(0.168)	(0.0433)	(0.170)	(0.0718)	(0.155)
sec. education	0.355*	1.116**	0.373*	0.792	-0.163	0.314	-0.171	0.743*	-0.00280	-0.445	-0.00295	-0.143
	(0.186)	(0.501)	(0.193)	(0.544)	(0.113)	(0.365)	(0.119)	(0.392)	(0.0823)	(0.332)	(0.0866)	(0.354)
voc. education	-0.0797	0.203	-0.0204	0.0628	0.0540	0.0188	0.0138	0.0194	0.0290	-0.0606	0.00741	-0.0210
	(0.0754)	(0.128)	(0.0301)	(0.0896)	(0.0484)	(0.0700)	(0.0199)	(0.0605)	(0.0331)	(0.0633)	(0.0119)	(0.0557)
tertiary education	-0.761**	1.463**	-0.859***	0.0571	-0.394**	0.590	-0.444**	-0.0984	-0.263*	-0.485	-0.296*	0.701
	(0.300)	(0.640)	(0.332)	(0.645)	(0.184)	(0.461)	(0.205)	(0.459)	(0.136)	(0.409)	(0.152)	(0.428)
manufacturing	0.392	0.200**	0.364	0.243**	0.440**	0.0993**	0.408**	0.145**	0.164	0.0642*	0.152	-0.107**
	(0.279)	(0.0832)	(0.259)	(0.0954)	(0.175)	(0.0481)	(0.163)	(0.0600)	(0.130)	(0.0371)	(0.121)	(0.0476)
construction	-0.0973	0.0934	-0.00921	-0.657***	0.0358	-0.523***	0.00339	-1.091***	0.0444	0.0959	0.00421	0.0221
	(0.114)	(0.191)	(0.0197)	(0.188)	(0.0700)	(0.158)	(0.00898)	(0.213)	(0.0530)	(0.110)	(0.00903)	(0.0977)
management type	-0.00469	-0.159	0.00396	-0.793***	0.0365	0.330**	-0.0308	-0.704***	0.0353	0.227*	-0.0298	-0.0420
	(0.0164)	(0.227)	(0.0141)	(0.203)	(0.0535)	(0.162)	(0.0493)	(0.152)	(0.0514)	(0.138)	(0.0475)	(0.125)
constant		-4.318**		1.008		-1.693		1.801		-1.659		-0.913
		(1.806)		(1.957)		(1.312)		(1.360)		(1.158)		(1.250)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	13.04***	11.79***		-1.254***	14.28***	12.87***		-1.410***	14.53***	13.44***		-1.090***
	(0.168)	(0.158)		(0.230)	(0.138)	(0.118)		(0.182)	(0.109)	(0.111)		(0.155)
Observations	277				277				277			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.7: Namibia detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.483	-1.010**	0.509*	-0.873***	0.568*	-1.362***	1.267***	-1.052***	1.147***	-1.599***	0.828***	-1.091***
	(0.431)	(0.452)	(0.305)	(0.232)	(0.293)	(0.326)	(0.201)	(0.212)	(0.308)	(0.350)	(0.225)	(0.192)
log of employee	-0.643***	2.137***	-0.188**	-1.585***	-0.512***	2.521***	-0.150**	-0.363	-0.0493	0.589	-0.0144	-0.131
	(0.179)	(0.718)	(0.0868)	(0.518)	(0.131)	(0.516)	(0.0671)	(0.409)	(0.0826)	(0.487)	(0.0248)	(0.356)
log of ICT capital	-0.414**	0.511	-0.545**	-0.0254	0.185	-1.286**	0.243	-1.444**	0.318**	-0.876	0.418**	-0.667
	(0.184)	(0.829)	(0.232)	(0.736)	(0.116)	(0.622)	(0.149)	(0.589)	(0.129)	(0.559)	(0.162)	(0.505)
log of non-ICT capital	0.240*	2.159***	-0.0358	0.907**	0.171*	1.926***	-0.0255	1.903***	0.397*	3.445***	-0.0592	1.841***
	(0.144)	(0.570)	(0.0519)	(0.463)	(0.101)	(0.406)	(0.0368)	(0.388)	(0.218)	(0.451)	(0.0845)	(0.361)
log of raw materials	0.169	-2.159**	0.0729	-1.078	-0.0451	-1.767**	-0.0194	-1.899***	0.0947	-1.865***	0.0408	-1.342**
	(0.143)	(0.978)	(0.0629)	(0.856)	(0.0904)	(0.717)	(0.0391)	(0.682)	(0.0987)	(0.664)	(0.0432)	(0.600)
sole proprietorship	0.275**	0.301	0.298**	-0.170	0.322***	0.527***	0.350***	-0.0216	-0.128	-0.238	-0.139	-0.207*
	(0.136)	(0.227)	(0.141)	(0.163)	(0.100)	(0.175)	(0.0969)	(0.128)	(0.0909)	(0.155)	(0.0966)	(0.112)
sec. education	-0.252**	-0.515**	-0.484***	-0.387**	-0.238***	-0.332**	-0.458***	-0.263*	-0.411***	-0.412***	-0.789***	-0.126
	(0.104)	(0.203)	(0.140)	(0.175)	(0.0867)	(0.149)	(0.0969)	(0.136)	(0.137)	(0.144)	(0.122)	(0.108)
voc. education	-0.224***	-0.0437	0.531***	0.0118	-0.161***	-0.0414	0.381***	-0.0174	-0.241***	-0.0804	0.570***	-0.0330
	(0.0841)	(0.0432)	(0.144)	(0.0297)	(0.0586)	(0.0372)	(0.0977)	(0.0257)	(0.0820)	(0.0591)	(0.127)	(0.0297)
tertiary education	0.439**	-1.380***	0.353**	-0.882**	0.771***	-0.942***	0.621***	-0.0296	0.929***	-1.411***	0.748***	-0.267
	(0.191)	(0.486)	(0.152)	(0.412)	(0.158)	(0.364)	(0.121)	(0.323)	(0.180)	(0.339)	(0.137)	(0.273)
manufacturing	0.0789	-0.321*	0.263**	-0.0604	0.0424	-0.0818	0.141**	0.140	0.00849	0.111	0.0283	0.212**
	(0.0667)	(0.166)	(0.109)	(0.118)	(0.0373)	(0.113)	(0.0686)	(0.0972)	(0.0218)	(0.107)	(0.0696)	(0.0887)
construction	0.0473	0.144	0.250**	0.0416	0.0347	0.0574	0.183***	0.0795	0.00335	-0.123	0.0177	0.0479
	(0.0657)	(0.124)	(0.0978)	(0.0936)	(0.0477)	(0.0877)	(0.0643)	(0.0764)	(0.0128)	(0.0858)	(0.0634)	(0.0643)
management type	-0.198*	0.0747	-0.00651	-0.287**	-0.00311	-0.230*	-0.000102	-0.144	0.224**	-0.497***	0.00737	-0.0679
	(0.106)	(0.181)	(0.0280)	(0.132)	(0.0593)	(0.133)	(0.00199)	(0.101)	(0.0873)	(0.147)	(0.0316)	(0.0842)
constant		-1.918		2.641**		-1.712*		1.006		-0.243		-0.350
		(1.218)		(1.114)		(0.919)		(0.886)		(0.819)		(0.761)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	13.18***	11.68***		-1.493***	13.75***	12.95***		-0.794***	14.13***	13.68***		-0.452***
	(0.163)	(0.161)		(0.229)	(0.139)	(0.109)		(0.177)	(0.117)	(0.119)		(0.167)
Observations	307				307				307			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.8: Nigeria detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.039	-3.675***	-0.614**	-0.396	0.477	-6.497***	-1.020***	-2.559***	-3.338***	-1.130*	-2.101***	2.588***
	(0.879)	(1.040)	(0.257)	(0.932)	(0.956)	(0.982)	(0.290)	(0.227)	(0.684)	(0.664)	(0.325)	(0.227)
log of employee	-0.293**	7.351***	-0.0445	5.609***	-0.170	0.735	-0.0258	-0.655***	0.202**	-0.962***	0.0307	0.655***
	(0.123)	(0.858)	(0.0385)	(0.870)	(0.120)	(0.526)	(0.0267)	(0.144)	(0.0878)	(0.359)	(0.0268)	(0.144)
log of ICT capital	-1.064	6.054**	-0.325	16.04***	1.516**	-2.992**	0.463**	-1.233***	0.569	-1.288	0.174	1.233***
	(0.655)	(2.510)	(0.200)	(2.696)	(0.702)	(1.264)	(0.214)	(0.396)	(0.472)	(0.861)	(0.144)	(0.396)
log of non-ICT capital	-0.249	-7.816***	-0.0711	-10.95***	0.852	-2.401	0.244	4.300***	-0.150	0.102	-0.0430	-4.300***
	(0.581)	(2.507)	(0.166)	(2.693)	(0.622)	(1.555)	(0.179)	(0.464)	(0.419)	(1.056)	(0.120)	(0.464)
log of raw materials	-0.689***	2.323	-0.285***	14.48***	-0.773***	5.474***	-0.320***	1.132***	-0.437***	3.111***	-0.181***	-1.132***
	(0.153)	(1.537)	(0.0964)	(1.648)	(0.167)	(0.881)	(0.107)	(0.264)	(0.105)	(0.599)	(0.0633)	(0.264)
sole proprietorship	0.0507	-0.0601	0.0418	-0.110	-0.318	-0.0325	-0.262	-0.0153*	0.0413	-0.00234	0.0340	0.0153*
	(0.229)	(0.0568)	(0.189)	(0.0728)	(0.246)	(0.0269)	(0.202)	(0.00896)	(0.166)	(0.0143)	(0.136)	(0.00896)
sec. education	-0.189*	-0.000741	-0.185*	-0.00130	-0.305***	-0.00120	-0.299***	0.000931	-0.155**	-0.000607	-0.151**	-0.000931
	(0.106)	(0.00293)	(0.104)	(0.295)	(0.116)	(0.00472)	(0.114)	(0.0735)	(0.0769)	(0.00240)	(0.0754)	(0.0735)
voc. education	-0.0500	-0.000594	-0.0486	-0.000625	-0.0791**	-0.000510	-0.0768*	0.000349	-0.00836	-6.80e-05	-0.00813	-0.000349
	(0.0328)	(0.00502)	(0.0322)	(0.0754)	(0.0400)	(0.00397)	(0.0395)	(0.0189)	(0.0206)	(0.000560)	(0.0201)	(0.0189)
tertiary education	0.180	-2.448	0.177	-2.613	-0.327*	0.719*	-0.322*	0.941	-0.209	0.495	-0.206	-0.941
	(0.183)	(3.216)	(0.181)	(263.0)	(0.197)	(0.432)	(0.194)	(65.48)	(0.133)	(0.335)	(0.131)	(65.48)
manufacturing	-0.0530	-0.0118	-0.0524	-0.0101	-0.0601	-0.00534	-0.0595	0.00168	-0.0116	-0.000952	-0.0115	-0.00168
	(0.0437)	(0.0198)	(0.0430)	(0.0187)	(0.0469)	(0.00818)	(0.0461)	(0.00280)	(0.0302)	(0.00310)	(0.0299)	(0.00280)
construction	0.972**	-7.878***	-0.0224	-9.153***	0.733	-2.002***	-0.0169	-0.924***	-0.189	-1.046***	0.00435	0.924***
	(0.492)	(1.100)	(0.0223)	(1.107)	(0.520)	(0.565)	(0.0188)	(0.122)	(0.349)	(0.376)	(0.00887)	(0.122)
management type	0.344*	-0.498	0.201*	-1.711**	-0.592***	0.859**	-0.345**	0.925***	-2.990***	4.636***	-1.743***	-0.925***
	(0.205)	(0.803)	(0.122)	(0.757)	(0.222)	(0.347)	(0.135)	(0.0723)	(0.265)	(0.275)	(0.250)	(0.0723)
constant		-0.690		-11.99		-6.850***		-7.031		-6.174***		7.061
		(3.804)		(263.4)		(1.097)		(65.58)		(0.766)		(65.58)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	15.29***	10.57***		-4.714***	17.78***	11.76***		-6.021***	18.28***	13.81***		-4.468***
	(0.541)	(0.151)		(0.561)	(0.123)	(0.181)		(0.218)	(0.123)	(0.227)		(0.258)
Observations	265				265				265			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.9: Rwanda detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.352***	-0.315	-1.475***	0.588	-2.758***	-0.173	-3.004***	0.873***	-0.0175	-0.935***	-0.565***	-0.488***
	(0.306)	(0.352)	(0.336)	(0.455)	(0.600)	(0.528)	(0.591)	(0.121)	(0.181)	(0.184)	(0.173)	(0.0956)
log of employee	-0.209*	1.157	-0.0769	-0.906	-1.080***	4.740***	-0.398***	-0.158	0.00590	-0.0552	0.00217	-0.265
	(0.122)	(0.817)	(0.0472)	(0.868)	(0.253)	(0.823)	(0.120)	(0.289)	(0.0450)	(0.353)	(0.0166)	(0.312)
log of ICT capital	0.0847	-6.028*	0.199	-3.488	0.339	-3.660**	0.795	1.728	0.387***	-3.431**	0.908***	-1.327
	(0.162)	(3.452)	(0.380)	(3.513)	(0.260)	(1.701)	(0.609)	(1.431)	(0.0673)	(1.564)	(0.152)	(1.553)
log of non-ICT capital	-0.263	-1.516	-0.327	3.421	0.752	-1.566	0.936	-1.136	-0.215*	2.462***	-0.268*	1.962**
	(0.296)	(2.079)	(0.368)	(2.171)	(0.476)	(1.743)	(0.590)	(0.786)	(0.114)	(0.916)	(0.141)	(0.851)
log of raw materials	-0.729***	-1.657	-0.674***	-12.96***	-1.499***	5.806***	-1.384***	3.010***	-0.390***	1.342**	-0.361***	0.192
	(0.175)	(1.542)	(0.132)	(2.052)	(0.328)	(1.380)	(0.235)	(0.599)	(0.0833)	(0.675)	(0.0587)	(0.640)
sole proprietorship	-0.0495	-1.505***	-0.0122	-3.588***	0.188	1.543***	0.0466	-0.574***	0.0411	0.155	0.0102	0.0563
	(0.0554)	(0.565)	(0.0185)	(0.579)	(0.118)	(0.528)	(0.0556)	(0.203)	(0.0269)	(0.242)	(0.0123)	(0.215)
sec. education	0.117	-1.551	-0.117	-0.802	-0.0899	-0.114	0.0898	0.341	-0.0620*	0.115	0.0619*	-0.0272
	(0.0871)	(1.333)	(0.0830)	(1.573)	(0.130)	(0.668)	(0.128)	(0.561)	(0.0358)	(0.601)	(0.0330)	(0.606)
voc. education	-0.0741*	-0.0327	-0.0662*	-0.0455	0.0370	-0.00929	0.0331	0.0191	0.0226	0.00113	0.0202	-0.00514
	(0.0420)	(0.0467)	(0.0376)	(0.0605)	(0.0453)	(0.0190)	(0.0405)	(0.0245)	(0.0142)	(0.0135)	(0.0127)	(0.0145)
tertiary education	-0.0143	-0.877	0.0764	-0.468	0.216	0.973**	-1.152***	-0.117	0.171	0.927***	-0.912***	0.277
	(0.0393)	(0.641)	(0.197)	(0.746)	(0.212)	(0.406)	(0.346)	(0.259)	(0.162)	(0.324)	(0.135)	(0.283)
manufacturing	-0.00578	-0.0306	-0.00906	0.102	-0.553***	-0.443***	-0.868***	-0.212***	-0.00135	0.124*	-0.00212	0.169**
	(0.0601)	(0.141)	(0.0942)	(0.148)	(0.214)	(0.163)	(0.199)	(0.0758)	(0.0230)	(0.0696)	(0.0361)	(0.0719)
construction	0.0833	0.141	0.0912	0.252*	-1.147***	-0.116	-1.255***	-0.00904	0.0865	0.0138	0.0946	-0.00988
	(0.164)	(0.0910)	(0.180)	(0.152)	(0.294)	(0.0741)	(0.308)	(0.0186)	(0.0637)	(0.0214)	(0.0693)	(0.0201)
management type	-0.292**	0.201	-0.560**	-1.009***	0.0795	-0.117	0.152	-0.119	-0.0621	-0.360***	-0.119	-0.348***
	(0.129)	(0.260)	(0.221)	(0.310)	(0.182)	(0.298)	(0.349)	(0.0852)	(0.0454)	(0.118)	(0.0838)	(0.0994)
constant		11.38***		-5.843		-7.210***		-1.900		-2.229		-1.162
		(3.794)		(4.084)		(2.210)		(1.554)		(1.709)		(1.684)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	13.42***	11.75***		-1.667***	16.41***	13.48***		-2.931***	16.43***	15.48***		-0.953***
	(0.279)	(0.129)		(0.307)	(0.137)	(0.300)		(0.330)	(0.0993)	(0.109)		(0.147)
Observations	279				279				279			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.10: South Africa detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-2.730***	-0.892	-0.712***	-1.627***	-1.891***	-1.613***	-0.524**	-3.456***	-0.387	-2.904***	-0.203	4.217***
	(0.575)	(0.594)	(0.241)	(0.339)	(0.429)	(0.438)	(0.235)	(0.584)	(0.322)	(0.376)	(0.224)	(0.245)
log of employee	-1.014***	2.118*	-0.286**	0.803	-1.477***	3.793***	-0.417***	4.268***	-0.667***	1.213	-0.188***	0.194
	(0.366)	(1.193)	(0.127)	(0.868)	(0.281)	(0.919)	(0.134)	(1.168)	(0.188)	(0.791)	(0.0721)	(0.645)
log of ICT capital	-1.065**	3.011*	-0.347**	4.830***	-0.204	-2.306**	-0.0665	-3.958**	-0.173	-0.582	-0.0563	1.766***
	(0.514)	(1.600)	(0.176)	(0.925)	(0.356)	(1.151)	(0.116)	(1.584)	(0.254)	(0.866)	(0.0833)	(0.471)
log of non-ICT capital	-0.571**	2.017	-0.233*	-2.358**	-0.345*	-0.796	-0.141*	1.268	-0.179	1.888**	-0.0728	-2.216***
	(0.261)	(1.379)	(0.123)	(1.075)	(0.182)	(1.040)	(0.0832)	(1.659)	(0.128)	(0.870)	(0.0556)	(0.688)
log of raw materials	0.0303	-3.344***	-0.00671	-3.677***	0.298	-3.081***	-0.0661	-10.13***	0.723***	-4.662***	-0.160	4.958***
	(0.260)	(0.939)	(0.0579)	(0.717)	(0.187)	(0.723)	(0.0589)	(1.013)	(0.155)	(0.632)	(0.107)	(0.527)
sole proprietorship	0.0448	0.0940	0.0194	0.193**	0.157	-0.0993	0.0680	-0.136	0.247***	-0.213**	0.107*	0.281***
	(0.168)	(0.103)	(0.0732)	(0.0936)	(0.121)	(0.0836)	(0.0605)	(0.109)	(0.0944)	(0.0857)	(0.0625)	(0.0871)
sec. education	0.156	-0.825**	0.0569	-1.213***	0.0609	-0.458	0.0222	0.289	0.0284	0.0347	0.0104	-0.282
	(0.121)	(0.397)	(0.114)	(0.411)	(0.0631)	(0.326)	(0.0469)	(0.400)	(0.0401)	(0.314)	(0.0240)	(0.309)
voc. education	0.0634	-0.00135	0.0441	-0.0141	0.00482	-0.000328	0.00335	0.0350	0.0410	0.00677	0.0285	-0.0127
	(0.0733)	(0.0169)	(0.0562)	(0.0210)	(0.0484)	(0.0143)	(0.0337)	(0.0372)	(0.0385)	(0.0155)	(0.0308)	(0.0183)
tertiary education	-0.298	-2.543*	-0.174	-3.201**	-0.317**	0.589	-0.186	3.970***	-0.353***	0.500	-0.207*	-0.598
	(0.191)	(1.424)	(0.138)	(1.368)	(0.150)	(1.200)	(0.123)	(1.465)	(0.131)	(1.183)	(0.123)	(1.150)
manufacturing	-0.000304	-0.453**	0.0225	-0.796***	-0.000414	-0.0299	0.0306	0.960***	-0.00256	1.286***	0.189	-0.572***
	(0.0143)	(0.216)	(0.0427)	(0.178)	(0.0194)	(0.167)	(0.0350)	(0.206)	(0.120)	(0.199)	(0.130)	(0.142)
construction	-0.0358	0.179*	0.0331	-0.0421	-0.0125	0.102	0.0116	0.187	-0.0194	0.147**	0.0179	-0.121**
	(0.0472)	(0.103)	(0.0413)	(0.0671)	(0.0255)	(0.0729)	(0.0230)	(0.116)	(0.0248)	(0.0682)	(0.0216)	(0.0528)
management type	-0.0404	-0.312	0.159	-0.161	-0.0549	0.543**	0.215**	1.946***	-0.0325	-0.535**	0.128*	0.934***
	(0.0677)	(0.301)	(0.0992)	(0.218)	(0.0895)	(0.237)	(0.107)	(0.303)	(0.0533)	(0.211)	(0.0664)	(0.188)
constant		-0.834		4.010**		0.130		-2.159		-1.988		-0.115
		(2.233)		(1.972)		(1.828)		(2.238)		(1.737)		(1.624)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	15.20***	11.58***		-3.622***	16.07***	12.57***		-3.504***	17.71***	14.42***		-3.291***
	(0.183)	(0.219)		(0.286)	(0.179)	(0.199)		(0.268)	(0.198)	(0.167)		(0.259)
Observations	290				290				290			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.11: Tanzania detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.290***	-0.244	-0.629	-1.492***	-1.795***	0.872**	-0.434	-1.510***	-0.495	-1.163***	0.920*	-16.03***
	(0.320)	(0.345)	(0.567)	(0.149)	(0.421)	(0.417)	(0.646)	(0.185)	(0.387)	(0.428)	(0.503)	(2.015)
log of employee	-0.0604	-2.393**	0.115	-2.128***	-0.302*	0.0498	0.577**	-0.925	-0.353***	2.432**	0.673***	-40.94***
	(0.130)	(0.947)	(0.248)	(0.690)	(0.158)	(1.063)	(0.281)	(0.779)	(0.136)	(1.029)	(0.223)	(3.558)
log of ICT capital	-0.926***	-1.077	-1.144***	-2.508*	-0.397	-3.594*	-0.490	-3.469**	0.0638	-6.373***	0.0788	-23.47***
	(0.296)	(1.636)	(0.362)	(1.424)	(0.324)	(1.854)	(0.400)	(1.617)	(0.250)	(1.922)	(0.309)	(6.548)
log of non-ICT capital	-0.109	0.890	0.0565	-0.274	-0.298	2.569**	0.155*	-0.568	-0.333*	3.435***	0.174*	10.59***
	(0.0928)	(0.884)	(0.0450)	(0.535)	(0.188)	(0.998)	(0.0849)	(0.606)	(0.201)	(0.917)	(0.0895)	(2.994)
log of raw materials	-0.0808	1.659**	0.0728*	0.195	-0.0516	0.498	0.0465	-0.540	-0.00825	-1.931**	0.00744	8.460***
	(0.0538)	(0.767)	(0.0399)	(0.612)	(0.0451)	(0.865)	(0.0366)	(0.696)	(0.0279)	(0.870)	(0.0250)	(2.198)
sole proprietorship	-0.0359	-0.200	0.258***	0.223	-0.0175	0.306	0.126	0.457*	0.0179	-0.356	-0.129*	3.793***
	(0.0676)	(0.269)	(0.0945)	(0.204)	(0.0351)	(0.304)	(0.0982)	(0.236)	(0.0348)	(0.298)	(0.0770)	(1.021)
sec. education	-0.0807	-0.155	-0.202	-0.0592	-0.259**	-0.175	-0.647***	0.269	-0.211**	0.143	-0.526***	-2.736***
	(0.0656)	(0.178)	(0.139)	(0.142)	(0.129)	(0.201)	(0.166)	(0.169)	(0.104)	(0.201)	(0.130)	(0.799)
voc. education	-0.0741	-0.0223	-0.0761	-0.0242	-0.409***	-0.0128	-0.420***	0.00513	-0.248***	0.0205	-0.255***	0.0423
	(0.0643)	(0.0317)	(0.0657)	(0.0336)	(0.102)	(0.0221)	(0.0988)	(0.0156)	(0.0701)	(0.0310)	(0.0691)	(0.0639)
tertiary education	0.199	-0.0759	0.375	0.0428	0.478**	-0.325	0.900**	0.176	0.707***	-0.211	1.332***	1.685
	(0.187)	(0.346)	(0.347)	(0.242)	(0.221)	(0.391)	(0.387)	(0.275)	(0.200)	(0.372)	(0.304)	(1.165)
manufacturing	-0.199*	0.0708	-0.267*	0.123	-0.571***	0.0950	-0.768***	0.294**	-0.181*	-0.0726	-0.244*	1.756***
	(0.113)	(0.0812)	(0.146)	(0.0782)	(0.157)	(0.0935)	(0.174)	(0.126)	(0.0978)	(0.0934)	(0.126)	(0.658)
construction	0.0279	-0.105	-0.0395	-0.0310	0.0101	0.0867	-0.0143	0.0960	0.0710	-0.169	-0.101**	2.143***
	(0.0381)	(0.121)	(0.0394)	(0.0759)	(0.0303)	(0.135)	(0.0408)	(0.0887)	(0.0750)	(0.130)	(0.0498)	(0.694)
management type	0.0484	0.306	0.222**	-0.0304	0.0221	-0.199	0.101	-0.361**	-0.0200	0.100	-0.0918	0.460
	(0.0537)	(0.191)	(0.0987)	(0.131)	(0.0320)	(0.211)	(0.105)	(0.156)	(0.0270)	(0.200)	(0.0815)	(0.634)
constant		0.857		2.980*		1.573		3.057*		1.820		22.19***
		(1.797)		(1.567)		(2.035)		(1.781)		(2.113)		(6.543)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	12.20***	10.67***		-1.533***	12.62***	11.70***		-0.923***	14.65***	13.00***		-1.659***
	(0.149)	(0.138)		(0.204)	(0.187)	(0.200)		(0.274)	(0.248)	(0.157)		(0.293)
Observations	263				263				263			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.12: Uganda detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.423***	0.332	-0.0584	0.656**	-0.884***	-1.250***	0.305**	-0.126	-0.802***	-1.254***	0.293*	-0.428
	(0.261)	(0.285)	(0.192)	(0.306)	(0.207)	(0.219)	(0.150)	(0.304)	(0.220)	(0.212)	(0.157)	(0.262)
log of employee	-0.283**	1.456	0.236**	0.930	-0.234**	-0.281	0.195**	-0.626	0.0422	1.246**	-0.0352	0.204
	(0.123)	(0.966)	(0.101)	(0.867)	(0.0953)	(0.732)	(0.0784)	(0.679)	(0.0957)	(0.546)	(0.0799)	(0.433)
log of ICT capital	-0.133	-3.080**	-0.0587	0.396	-0.290*	3.786***	-0.129*	9.518***	-0.0401	-0.540	-0.0178	5.773***
	(0.201)	(1.370)	(0.0893)	(1.602)	(0.155)	(1.041)	(0.0693)	(1.448)	(0.165)	(0.772)	(0.0732)	(1.139)
log of non-ICT capital	-0.268*	-3.242*	0.0464	-6.449***	-0.136	-0.746	0.0235	-2.103	-0.471***	-0.317	0.0816**	-0.183
	(0.150)	(1.958)	(0.0325)	(1.795)	(0.114)	(1.485)	(0.0221)	(1.398)	(0.130)	(1.075)	(0.0412)	(0.884)
log of raw materials	-0.866***	-3.545**	0.00245	-3.864**	-0.575***	-3.537***	0.00163	-3.247**	-0.539***	2.288**	0.00152	1.984**
	(0.150)	(1.759)	(0.0854)	(1.617)	(0.107)	(1.334)	(0.0568)	(1.274)	(0.108)	(0.978)	(0.0531)	(0.826)
sole proprietorship	0.367***	0.0920	0.184***	0.0290	0.301***	0.0771	0.151***	-0.00387	0.0259	0.0128	0.0130	-0.000699
	(0.128)	(0.0626)	(0.0699)	(0.0549)	(0.0988)	(0.0481)	(0.0544)	(0.0421)	(0.103)	(0.0307)	(0.0516)	(0.0261)
sec. education	-0.00370	-0.0844	-0.00710	-0.240	-0.0258	-0.250	-0.0495	-0.291	0.0204	-0.180	0.0391	0.179
	(0.0566)	(0.540)	(0.109)	(0.536)	(0.0448)	(0.410)	(0.0839)	(0.413)	(0.0473)	(0.255)	(0.0895)	(0.252)
voc. education	0.0334	-0.00214	0.0155	-0.0270	-0.0313	-0.0199	-0.0145	0.00757	-0.0429	-0.00737	-0.0199	0.0911
	(0.0403)	(0.0851)	(0.0222)	(0.0848)	(0.0317)	(0.0650)	(0.0185)	(0.0646)	(0.0354)	(0.0406)	(0.0224)	(0.0555)
tertiary education	-0.167	-1.047	-0.212	-1.867	0.0137	-0.599	0.0174	-0.766	-0.0139	0.523	-0.0177	1.459**
	(0.114)	(1.458)	(0.140)	(1.443)	(0.0820)	(1.102)	(0.105)	(1.104)	(0.0877)	(0.687)	(0.112)	(0.676)
manufacturing	-0.0651*	0.122	-0.227**	0.428**	0.00264	0.0609	0.00921	0.0617	0.00766	-0.0506	0.0267	-0.0887
	(0.0391)	(0.185)	(0.0906)	(0.183)	(0.0194)	(0.140)	(0.0675)	(0.141)	(0.0210)	(0.0992)	(0.0722)	(0.0942)
construction	-0.0593	-0.0212	-0.0593	-0.0446	-0.0264	0.0201	-0.0263	-0.00680	0.0319	-0.000807	0.0319	-0.0174
	(0.0369)	(0.0274)	(0.0366)	(0.0335)	(0.0268)	(0.0216)	(0.0267)	(0.0200)	(0.0289)	(0.0127)	(0.0288)	(0.0155)
management type	0.0204	0.0482	0.0219	0.578***	0.118**	-0.150	0.126**	0.352**	0.177***	-0.188	0.190***	-0.570***
	(0.0685)	(0.229)	(0.0735)	(0.211)	(0.0561)	(0.174)	(0.0589)	(0.164)	(0.0635)	(0.131)	(0.0656)	(0.114)
constant		9.635***		10.79***		0.390		-3.022		-4.041***		-9.258***
		(2.641)		(2.720)		(2.000)		(2.204)		(1.321)		(1.506)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	13.16***	12.07***		-1.091***	15.08***	12.95***		-2.133***	15.57***	13.51***		-2.056***
	(0.212)	(0.116)		(0.242)	(0.163)	(0.0879)		(0.186)	(0.109)	(0.0960)		(0.146)
Observations	351				351				351			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.13: Zambia detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-2.205***	0.0136	-0.00455	-2.123***	-2.103***	-0.398	0.0353	-0.921***	-1.274***	-1.954***	0.501**	-2.210***
	(0.287)	(0.285)	(0.232)	(0.403)	(0.266)	(0.280)	(0.209)	(0.355)	(0.312)	(0.319)	(0.212)	(0.462)
log of employee	-0.114	-0.867	-0.0100	-0.233	-0.419***	1.471**	-0.0367	1.263*	-0.543***	3.874***	-0.0475	3.541***
	(0.135)	(0.710)	(0.0162)	(0.694)	(0.134)	(0.707)	(0.0422)	(0.669)	(0.163)	(0.654)	(0.0544)	(0.584)
log of ICT capital	-0.331**	-1.043	-0.223**	-6.427***	-0.226	-5.353***	-0.152	-8.498***	0.603***	-1.186	0.406***	-1.866
	(0.149)	(1.333)	(0.101)	(1.667)	(0.139)	(1.355)	(0.0944)	(1.576)	(0.172)	(1.074)	(0.119)	(1.419)
log of non-ICT capital	-0.410***	2.289**	0.0600	-1.811	-0.0501	2.566***	0.00732	-1.711	0.0881	-0.430	-0.0129	-5.932***
	(0.130)	(0.891)	(0.0499)	(1.269)	(0.0973)	(0.867)	(0.0153)	(1.092)	(0.118)	(0.909)	(0.0199)	(1.184)
log of raw materials	-1.241***	-0.710	0.232	-5.878***	-1.274***	-2.629**	0.238	-1.609	-1.386***	-0.0428	0.259	1.849
	(0.183)	(1.339)	(0.144)	(1.353)	(0.179)	(1.335)	(0.148)	(1.298)	(0.207)	(1.210)	(0.161)	(1.130)
sole proprietorship	0.0118	-0.0299	0.00227	0.0976	0.0496	0.255**	0.00950	0.286***	-0.228**	0.0538	-0.0437	0.342***
	(0.0761)	(0.0953)	(0.0147)	(0.102)	(0.0721)	(0.104)	(0.0155)	(0.106)	(0.0929)	(0.0847)	(0.0370)	(0.101)
sec. education	0.104	0.0205	0.0984	0.0236	0.00869	-0.00384	0.00823	0.00519	-0.0743	-0.0149	-0.0703	-0.00799
	(0.139)	(0.0268)	(0.132)	(0.0308)	(0.130)	(0.0142)	(0.123)	(0.0157)	(0.157)	(0.0203)	(0.149)	(0.0157)
voc. education	0.0991	0.267	0.0159	-0.239	-0.0322	-0.0928	-0.00517	-0.0176	-0.0521	-0.143	-0.00836	0.0586
	(0.0807)	(0.165)	(0.0555)	(0.191)	(0.0599)	(0.150)	(0.0200)	(0.165)	(0.0748)	(0.138)	(0.0308)	(0.157)
tertiary education	-0.220	1.956	-0.162	3.638**	-0.00323	-0.558	-0.00238	0.433	0.0525	-0.692	0.0387	0.743
	(0.199)	(1.258)	(0.150)	(1.540)	(0.184)	(1.255)	(0.135)	(1.415)	(0.222)	(1.125)	(0.164)	(1.342)
manufacturing	0.0199	0.0306	-0.0278	-0.368*	0.0160	-0.621***	-0.0225	-0.741***	0.0252	-0.711***	-0.0352	-1.159***
	(0.0271)	(0.164)	(0.0361)	(0.188)	(0.0251)	(0.176)	(0.0338)	(0.190)	(0.0314)	(0.167)	(0.0414)	(0.202)
construction	0.0793	-0.205**	0.0205	-0.273**	0.00426	-0.192**	0.00110	0.145*	0.0116	0.125	0.00299	0.439***
	(0.0499)	(0.0890)	(0.0292)	(0.110)	(0.0308)	(0.0856)	(0.00808)	(0.0834)	(0.0376)	(0.0764)	(0.0104)	(0.140)
management type	-0.202*	0.0870	-0.0111	-0.357	-0.178*	-0.104	-0.00973	0.338	0.229*	-0.258	0.0125	-0.534**
	(0.106)	(0.281)	(0.0220)	(0.275)	(0.0995)	(0.280)	(0.0194)	(0.266)	(0.121)	(0.256)	(0.0249)	(0.230)
constant		-1.781		9.226***		4.864**		9.184***		-2.527		0.315
		(2.009)		(2.464)		(2.021)		(2.297)		(1.731)		(2.130)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	12.50***	10.31***		-2.191***	13.70***	11.20***		-2.502***	15.29***	12.06***		-3.228***
	(0.165)	(0.143)		(0.218)	(0.231)	(0.131)		(0.266)	(0.171)	(0.154)		(0.230)
Observations	276				276				276			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4B.14: Zimbabwe detailed decomposition of firm turnover by computer accessibility (firms with computer access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access		No reweighting computer access as reference group		F(x) for computer access reweighted to lack of computer access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.764***	-1.492***	-0.618***	-0.339	-1.798***	-2.352***	-0.558***	-1.909***	-1.557***	-2.227***	-0.741***	-2.443***
	(0.474)	(0.503)	(0.196)	(0.389)	(0.407)	(0.413)	(0.168)	(0.224)	(0.431)	(0.448)	(0.161)	(0.232)
log of employee	-0.648**	-4.363***	-0.233*	-3.118*	-1.001***	-0.914	-0.360***	-2.112*	-0.366	-2.317**	-0.131	-1.988*
	(0.317)	(1.462)	(0.120)	(1.712)	(0.279)	(1.136)	(0.116)	(1.104)	(0.294)	(1.095)	(0.108)	(1.015)
log of ICT capital	-0.157	-7.552***	-0.107	-6.994***	-0.290**	3.338***	-0.198**	3.767***	-0.438***	4.699***	-0.298***	3.429***
	(0.158)	(1.684)	(0.108)	(1.834)	(0.138)	(1.263)	(0.0981)	(1.258)	(0.153)	(1.155)	(0.112)	(1.125)
log of non-ICT capital	-0.799***	-4.439**	-0.223**	-2.495	-0.368**	-0.895	-0.103*	-1.424	-0.146	-1.337	-0.0408	-1.044
	(0.201)	(2.133)	(0.0963)	(2.338)	(0.162)	(1.623)	(0.0579)	(1.576)	(0.171)	(1.515)	(0.0499)	(1.420)
log of raw materials	-0.0393	-2.136	-0.00859	-0.693	-0.156	-0.255	-0.0342	-0.332	-0.112	-0.0887	-0.0244	0.189
	(0.135)	(1.321)	(0.0299)	(1.244)	(0.117)	(1.023)	(0.0336)	(0.862)	(0.126)	(0.982)	(0.0316)	(0.768)
sole proprietorship	-0.867***	-0.0255	-0.747***	-0.00534	-0.111	0.00553	-0.0960	0.00358	-0.134	-0.00190	-0.116	0.00267
	(0.194)	(0.0381)	(0.181)	(0.0415)	(0.146)	(0.0281)	(0.126)	(0.0279)	(0.158)	(0.0261)	(0.136)	(0.0252)
sec. education	-0.0859	-0.0945	-0.103	-0.172	0.00493	-0.0515	0.00592	0.0773	0.210	0.0580	0.252*	0.0269
	(0.129)	(1.243)	(0.154)	(1.301)	(0.110)	(0.909)	(0.132)	(0.932)	(0.128)	(0.792)	(0.150)	(0.818)
voc. education	0.0168	0.00125	0.0107	0.00232	0.00399	-0.00177	0.00255	0.00528	0.0223	0.00101	0.0142	0.00443
	(0.0247)	(0.0342)	(0.0206)	(0.0358)	(0.0180)	(0.0251)	(0.0119)	(0.0264)	(0.0264)	(0.0219)	(0.0243)	(0.0231)
tertiary education	0.739***	-0.754	0.830***	-0.271	0.232	-0.161	0.260	0.902	-0.163	0.541	-0.183	0.711
	(0.232)	(8.085)	(0.254)	(8.462)	(0.174)	(5.913)	(0.194)	(6.062)	(0.185)	(5.153)	(0.208)	(5.320)
manufacturing	-0.0349	0.0911	-0.0311	0.114	-0.0126	-0.191	-0.0112	0.0701	-0.191**	0.0776	-0.170**	-0.361***
	(0.0796)	(0.189)	(0.0711)	(0.180)	(0.0683)	(0.151)	(0.0609)	(0.120)	(0.0858)	(0.148)	(0.0831)	(0.115)
construction	0.128	0.235	0.00187	0.458*	-0.0459	-0.172	-0.000669	0.00697	-0.148	0.446	-0.00216	0.458***
	(0.350)	(0.376)	(0.00853)	(0.257)	(0.301)	(0.319)	(0.00503)	(0.147)	(0.327)	(0.347)	(0.00924)	(0.157)
management type	-0.0162	0.696***	-0.00731	0.608**	-0.0526	0.508**	-0.0237	0.817***	-0.0925	0.569***	-0.0418	0.956***
	(0.0646)	(0.263)	(0.0295)	(0.255)	(0.0571)	(0.205)	(0.0294)	(0.178)	(0.0646)	(0.201)	(0.0382)	(0.165)
constant		16.85*		12.22		-3.561		-3.690		-4.873		-4.827
		(9.502)		(9.943)		(6.961)		(7.111)		(6.086)		(6.244)
	computer access	no computer access		total Gap	computer access	no computer access		total Gap	computer access	no computer access		total Gap
Raw Gap	17.95***	14.69***		-3.255***	19.49***	15.34***		-4.149***	19.85***	16.06***		-3.784***
	(0.241)	(0.168)		(0.294)	(0.130)	(0.142)		(0.193)	(0.111)	(0.131)		(0.172)
Observations	281				281				281			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix 4C: Quantile Detailed Decomposition of Firm's Turnover by Internet Accessibility

Table A-4C.1: Botswana detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.553***	-0.514*	-0.402***	-0.553*	-0.416***	-1.258***	-0.315***	-1.193***	-0.364***	-1.297***	-0.257***	-1.396***
	(0.136)	(0.308)	(0.0983)	(0.303)	(0.140)	(0.184)	(0.0997)	(0.150)	(0.132)	(0.190)	(0.0935)	(0.196)
log of employee	-0.0521	-4.271***	-0.0249	-3.642***	-0.0618	-0.00699	-0.0295	-0.493	0.0312	-0.439	0.0149	-0.131
	(0.0626)	(1.268)	(0.0300)	(1.274)	(0.0649)	(0.522)	(0.0312)	(0.522)	(0.0605)	(0.529)	(0.0289)	(0.561)
log of ICT capital	-0.177	-4.440**	-0.126	-6.677***	0.117	-1.835*	0.0832	-3.466***	0.132	-4.332***	0.0939	-6.832***
	(0.109)	(2.044)	(0.0779)	(2.021)	(0.112)	(0.944)	(0.0796)	(0.845)	(0.106)	(0.944)	(0.0751)	(0.919)
log of non-ICT capital	-0.203**	0.329	-0.154**	0.818	-0.264***	-0.752	-0.200***	1.966***	-0.315***	0.624	-0.239***	0.705
	(0.0847)	(1.577)	(0.0615)	(1.596)	(0.0922)	(0.745)	(0.0657)	(0.738)	(0.0934)	(0.740)	(0.0647)	(0.807)
log of raw materials	-0.122**	-2.974**	-0.0430	-3.422**	-0.140**	0.780	-0.0494	-0.220	-0.0979**	0.339	-0.0345	0.555
	(0.0524)	(1.405)	(0.0307)	(1.366)	(0.0578)	(0.634)	(0.0347)	(0.520)	(0.0460)	(0.634)	(0.0254)	(0.550)
sole proprietorship	-0.0468	0.0399	-0.0438	0.0427	-0.126***	0.0148	-0.118***	0.0198	-0.0905**	0.0461	-0.0848**	0.0309
	(0.0373)	(0.125)	(0.0346)	(0.125)	(0.0453)	(0.0478)	(0.0403)	(0.0475)	(0.0396)	(0.0511)	(0.0359)	(0.0508)
sec. education	0.0841*	0.0949	0.0410	0.134	0.0826	-0.00689	0.0402	0.0360	0.0327	-0.0549	0.0159	0.0299
	(0.0502)	(0.143)	(0.0326)	(0.152)	(0.0511)	(0.0528)	(0.0327)	(0.0561)	(0.0412)	(0.0605)	(0.0218)	(0.0585)
voc. education	0.167*	0.103	0.162*	0.189	0.136	0.0471	0.132	0.149	0.0948	-0.0878	0.0921	0.0125
	(0.0971)	(0.342)	(0.0918)	(0.347)	(0.0978)	(0.133)	(0.0934)	(0.140)	(0.0901)	(0.138)	(0.0867)	(0.142)
tertiary education	-0.247*	0.847	-0.207*	1.075	-0.135	-0.556	-0.113	-0.124	-0.0671	-0.536	-0.0563	-0.115
	(0.145)	(1.410)	(0.120)	(1.418)	(0.146)	(0.558)	(0.122)	(0.558)	(0.136)	(0.570)	(0.114)	(0.594)
manufacturing	0.0351	0.665**	-0.00169	0.626**	0.0291	-0.0227	-0.00140	-0.00775	-0.0356	0.426***	0.00171	0.224*
	(0.0271)	(0.293)	(0.0117)	(0.290)	(0.0257)	(0.114)	(0.00969)	(0.107)	(0.0269)	(0.133)	(0.0118)	(0.119)
construction	-0.00219	0.125	-0.00305	0.0431	-0.0428	-0.169**	-0.0596*	-0.204**	-0.0442*	0.0285	-0.0615**	-0.00182
	(0.0201)	(0.121)	(0.0280)	(0.113)	(0.0261)	(0.0801)	(0.0310)	(0.0935)	(0.0254)	(0.0446)	(0.0295)	(0.0463)
management type	0.0106	0.0178	-0.00174	-0.0597	-0.0103	0.212**	0.00169	0.233**	-0.00467	0.134*	0.000765	0.184**
	(0.0142)	(0.177)	(0.00886)	(0.177)	(0.0141)	(0.0902)	(0.00860)	(0.0919)	(0.00939)	(0.0796)	(0.00406)	(0.0857)
constant		8.949***		10.32***		1.037		0.919		2.556**		3.943***
		(2.865)		(2.858)		(1.159)		(1.112)		(1.179)		(1.183)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	13.30***	12.23***		-1.067***	14.28***	12.61***		-1.674***	14.58***	12.92***		-1.661***
	(0.311)	(0.0663)		(0.318)	(0.149)	(0.0678)		(0.164)	(0.146)	(0.0648)		(0.160)
Observations	255				255				255			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.2: Cameroon detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.351***	-0.418	-2.714***	0.0766	-0.513	-0.0524	-2.036***	0.229	0.147	-0.867*	-0.992***	-0.583
	(0.472)	(0.503)	(0.359)	(0.248)	(0.444)	(0.471)	(0.248)	(0.273)	(0.189)	(0.452)	(0.157)	(0.434)
log of employee	-0.0704	1.910**	-0.746***	0.573	-0.0413	0.759	-0.437***	-0.0796	-0.0555	0.150	-0.588***	-1.042
	(0.142)	(0.891)	(0.254)	(0.672)	(0.0834)	(0.646)	(0.165)	(0.526)	(0.111)	(1.515)	(0.101)	(1.505)
log of ICT capital	-1.330***	9.917***	-1.684***	6.421***	-0.838***	6.006***	-1.061***	4.754***	-0.408***	-7.776**	-0.516***	-7.183*
	(0.298)	(1.984)	(0.317)	(1.706)	(0.192)	(1.489)	(0.207)	(1.338)	(0.101)	(3.836)	(0.111)	(3.821)
log of non-ICT capital	-0.606**	3.390**	-0.938***	-2.450**	-0.322**	-1.355	-0.499***	-4.375***	0.155*	-3.708	0.240***	-2.928
	(0.286)	(1.729)	(0.264)	(1.151)	(0.164)	(1.230)	(0.170)	(0.922)	(0.0836)	(2.599)	(0.0923)	(2.560)
log of raw materials	-0.0793	-4.745***	-0.0966	-4.060***	0.320***	-5.255***	0.391***	-2.567**	0.0178	1.036	0.0217	1.890
	(0.146)	(1.747)	(0.178)	(1.518)	(0.115)	(1.323)	(0.122)	(1.191)	(0.0520)	(3.418)	(0.0633)	(3.407)
sole proprietorship	0.0875	-0.352	0.178	-0.606*	-0.350**	-1.145***	-0.712***	-0.611**	-0.0739	-0.126	-0.150*	-0.0643
	(0.126)	(0.362)	(0.244)	(0.325)	(0.177)	(0.391)	(0.170)	(0.273)	(0.0542)	(0.651)	(0.0876)	(0.646)
sec. education	0.0174	-0.0824	0.0167	-0.107	-0.161*	-0.131	-0.154*	-0.211	-0.614***	0.122	-0.587***	0.197
	(0.136)	(0.164)	(0.130)	(0.163)	(0.0968)	(0.145)	(0.0876)	(0.174)	(0.152)	(0.347)	(0.0902)	(0.359)
voc. education	0.0133	-0.193	-0.0810	-0.161	0.0428	-0.240	-0.261***	-0.00424	0.0276	-0.223	-0.168***	-0.118
	(0.0681)	(0.209)	(0.0557)	(0.187)	(0.218)	(0.193)	(0.0760)	(0.128)	(0.140)	(0.390)	(0.0476)	(0.374)
tertiary education	0.842**	-3.859***	0.706**	-3.378***	0.901***	-2.761***	0.756***	-2.427***	1.065***	1.418	0.893***	1.974
	(0.357)	(1.195)	(0.284)	(1.091)	(0.258)	(0.908)	(0.192)	(0.849)	(0.203)	(2.332)	(0.123)	(2.332)
manufacturing	-0.174	-0.413	-0.133*	-0.212	-0.0852	0.0690	-0.0650	0.178	-0.0112	0.468	-0.00852	0.494
	(0.116)	(0.276)	(0.0729)	(0.219)	(0.0666)	(0.171)	(0.0445)	(0.174)	(0.0291)	(0.495)	(0.0220)	(0.498)
construction	-0.000485	-0.217	-0.0203	-0.281*	0.000911	0.397*	0.0382	0.355**	-0.00129	0.459	-0.0541*	0.523
	(0.0115)	(0.166)	(0.0817)	(0.161)	(0.0212)	(0.207)	(0.0539)	(0.180)	(0.0300)	(0.302)	(0.0307)	(0.322)
management type	-0.0506	0.0716	0.0835	-0.273	0.0191	-0.344	-0.0316	-0.375*	0.0453	-1.201*	-0.0748**	-1.061
	(0.0794)	(0.336)	(0.0582)	(0.278)	(0.0342)	(0.259)	(0.0347)	(0.228)	(0.0665)	(0.667)	(0.0317)	(0.653)
constant		-5.844***		4.611**		3.948**		5.594***		8.514*		6.735
		(2.252)		(1.939)		(1.696)		(1.523)		(4.394)		(4.376)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	12.79***	11.02***		-1.768***	13.19***	12.63***		-0.566*	14.39***	13.67***		-0.720
	(0.208)	(0.208)		(0.294)	(0.259)	(0.153)		(0.301)	(0.453)	(0.108)		(0.466)
Observations	280				280				280			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.3: Ethiopia detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.341***	-1.643***	2.711***	-5.215***	-0.768**	-2.789***	1.585***	-6.165***	-1.825***	0.0952	2.537***	-6.620***
	(0.322)	(0.372)	(0.443)	(0.258)	(0.359)	(0.390)	(0.508)	(0.194)	(0.352)	(0.333)	(0.416)	(0.194)
log of employee	-0.291***	1.567	0.467***	0.314	-0.510***	3.394***	0.820***	1.209	-0.179*	1.986**	0.287*	1.209
	(0.108)	(1.471)	(0.168)	(1.404)	(0.132)	(1.032)	(0.197)	(0.900)	(0.0952)	(0.983)	(0.150)	(0.900)
log of ICT capital	-0.0859	-6.255**	-0.126	-6.464**	-0.182	6.210***	-0.267	5.637***	-0.291**	6.624***	-0.427**	5.637***
	(0.141)	(2.964)	(0.207)	(2.917)	(0.162)	(1.967)	(0.238)	(1.870)	(0.128)	(1.930)	(0.188)	(1.870)
log of non-ICT capital	-0.0304	-5.939***	-0.000192	-5.959***	0.873***	-3.708**	0.00551	-0.339	0.427*	-2.035	0.00269	-0.339
	(0.268)	(1.912)	(0.00191)	(1.627)	(0.314)	(1.554)	(0.0255)	(1.042)	(0.245)	(1.382)	(0.0125)	(1.042)
log of raw materials	-0.997***	-2.094	1.502***	-7.397***	-1.133***	-0.812	1.707***	-6.850***	-1.757***	2.569**	2.647***	-6.850***
	(0.161)	(1.655)	(0.194)	(1.523)	(0.184)	(1.233)	(0.222)	(0.980)	(0.216)	(1.142)	(0.200)	(0.980)
sole proprietorship	0.174	-0.0987	-0.0226	-0.271	0.298**	0.162	-0.0387	-0.131	0.0220	-0.106	-0.00287	-0.131
	(0.129)	(0.268)	(0.0202)	(0.241)	(0.152)	(0.209)	(0.0275)	(0.154)	(0.115)	(0.189)	(0.0150)	(0.154)
sec. education	0.0153	0.704**	0.0791	0.641**	-0.0665	-0.488**	-0.343***	-0.207	0.0535	0.0151	0.276***	-0.207
	(0.0247)	(0.276)	(0.100)	(0.257)	(0.0702)	(0.196)	(0.120)	(0.148)	(0.0563)	(0.160)	(0.0947)	(0.148)
voc. education	-0.00422	0.00484	-0.00553	0.00656	-0.00438	-0.00129	-0.00574	0.000496	0.00528	0.00254	0.00693	0.000496
	(0.00863)	(0.0154)	(0.00827)	(0.0201)	(0.00925)	(0.00561)	(0.00911)	(0.00381)	(0.00999)	(0.00842)	(0.00885)	(0.00381)
tertiary education	-0.0265	1.613***	0.395***	1.124***	0.00925	-0.778**	-0.138	-0.614**	-0.0172	-0.296	0.256*	-0.614**
	(0.0569)	(0.461)	(0.149)	(0.408)	(0.0226)	(0.334)	(0.168)	(0.259)	(0.0374)	(0.300)	(0.134)	(0.259)
manufacturing	-0.0826	0.865***	0.301***	0.485*	0.0235	-0.0914	-0.0856	0.0287	0.0939	-0.423**	-0.342***	0.0287
	(0.0598)	(0.316)	(0.0800)	(0.287)	(0.0285)	(0.212)	(0.0864)	(0.180)	(0.0665)	(0.207)	(0.0748)	(0.180)
construction	-0.0164	0.136	0.00165	0.124	-0.0744	0.120	0.00749	0.0436	-0.179	0.236*	0.0180	0.0436
	(0.0639)	(0.107)	(0.00658)	(0.0756)	(0.0828)	(0.103)	(0.0103)	(0.0369)	(0.111)	(0.132)	(0.0185)	(0.0369)
management type	0.00340	0.508***	0.120***	0.380***	-0.00216	0.0823	-0.0762	0.161**	-0.00521	-0.0311	-0.184***	0.161**
	(0.0380)	(0.162)	(0.0446)	(0.130)	(0.0241)	(0.0754)	(0.0475)	(0.0684)	(0.0582)	(0.0665)	(0.0473)	(0.0684)
constant		7.345**		-11.80***		-6.879***		-5.104**		-8.446***		-5.559**
		(3.485)		(3.381)		(2.376)		(2.169)		(2.299)		(2.169)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	15.66***	12.68***		-2.984***	16.94***	13.38***		-3.556***	17.72***	15.99***		-1.730***
	(0.257)	(0.115)		(0.282)	(0.193)	(0.141)		(0.239)	(0.193)	(0.153)		(0.246)
Observations	282				282				282			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.4: Ghana detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.838**	0.525	-0.165	-0.499**	-0.550	-0.157	0.315	1.540***	-0.442	1.726***	0.445	-0.180
	(0.355)	(0.381)	(0.198)	(0.246)	(0.360)	(0.289)	(0.205)	(0.273)	(0.512)	(0.447)	(0.335)	(0.461)
log of employee	-0.344**	1.714	-0.211**	-0.167	-0.316***	3.107***	-0.194***	1.634**	-0.320**	3.283***	-0.197**	1.800**
	(0.143)	(1.071)	(0.0854)	(0.872)	(0.121)	(0.848)	(0.0722)	(0.753)	(0.146)	(0.996)	(0.0875)	(0.730)
log of ICT capital	0.242*	-3.192***	0.100*	-0.975	0.305***	-1.710**	0.127**	-1.388*	0.836***	-3.468***	0.347***	-1.780*
	(0.133)	(0.994)	(0.0591)	(0.956)	(0.0991)	(0.800)	(0.0492)	(0.833)	(0.203)	(0.853)	(0.112)	(0.930)
log of non-ICT capital	0.136*	-0.0950	0.143**	-1.379*	0.137*	0.884	0.144***	0.592	0.146	2.577***	0.154**	5.732***
	(0.0806)	(0.769)	(0.0648)	(0.720)	(0.0722)	(0.613)	(0.0524)	(0.627)	(0.0900)	(0.700)	(0.0744)	(0.766)
log of raw materials	-0.275**	-4.133***	-0.0694	-5.478***	-0.282***	-1.383	-0.0712	-3.995***	-0.831***	6.259***	-0.210	4.343***
	(0.118)	(1.350)	(0.0733)	(1.237)	(0.107)	(1.077)	(0.0739)	(1.072)	(0.294)	(1.200)	(0.216)	(1.157)
sole proprietorship	-0.336*	-0.0303	-0.271*	0.105	-0.0610	0.168	-0.0492	0.191*	0.0576	0.114	0.0465	0.193*
	(0.185)	(0.109)	(0.149)	(0.103)	(0.122)	(0.102)	(0.0987)	(0.103)	(0.215)	(0.101)	(0.173)	(0.103)
sec. education	-0.0115	-0.574	-0.0576	-0.690	-0.00795	0.0329	-0.0400	-0.607	0.0377	0.774**	0.189	-2.485
	(0.0684)	(0.389)	(0.0523)	(124.3)	(0.0474)	(0.306)	(0.0360)	(116.1)	(0.224)	(0.338)	(0.144)	(199.7)
voc. education	-0.0839	-0.0369	-0.0423	-0.0501	-0.105*	-0.0463	-0.0531	-0.0798	0.0880	0.0387	0.0444	-0.252
	(0.0547)	(0.0336)	(0.0382)	(11.39)	(0.0549)	(0.0380)	(0.0432)	(10.65)	(0.0613)	(0.0364)	(0.0415)	(18.31)
tertiary education	0.116	-1.502**	0.126	-1.032	0.203**	0.197	0.219***	-0.00600	-0.117	0.709	-0.127	-4.377
	(0.103)	(0.749)	(0.104)	(260.3)	(0.102)	(0.602)	(0.0848)	(243.3)	(0.118)	(0.604)	(0.122)	(418.4)
manufacturing	-0.0445	-0.117	0.0496	-0.110	-0.165	-0.350**	0.184*	-0.337**	-0.141	-0.235	0.157	-0.214*
	(0.0497)	(0.156)	(0.0411)	(0.128)	(0.157)	(0.144)	(0.108)	(0.132)	(0.137)	(0.152)	(0.0977)	(0.117)
construction	-0.232	0.809***	0.0773	0.137	-0.241	0.372*	0.0802	-0.562***	-0.186	0.519**	0.0620	0.508**
	(0.163)	(0.293)	(0.0809)	(0.180)	(0.162)	(0.193)	(0.0823)	(0.202)	(0.142)	(0.251)	(0.0673)	(0.209)
management type	-0.00554	0.317	-0.0101	0.392	-0.0167	0.442*	-0.0305	-0.173	-0.0116	-0.201	-0.0212	-0.262
	(0.0524)	(0.307)	(0.0957)	(0.247)	(0.0370)	(0.243)	(0.0651)	(0.209)	(0.0626)	(0.291)	(0.114)	(0.217)
constant		7.366***		8.748		-1.870		3.191		-8.643***		-3.385
		(2.059)		(396.0)		(1.665)		(370.1)		(1.754)		(636.4)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	13.07***	12.75***		-0.313	14.51***	13.80***		-0.707***	14.79***	16.07***		1.283***
	(0.246)	(0.156)		(0.292)	(0.221)	(0.156)		(0.271)	(0.207)	(0.270)		(0.340)
Observations	280				280				280			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.5: Kenya detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.661***	-0.314	-0.226	-0.105	-0.852***	-0.0422	-0.403***	0.0270	-0.682***	-0.488*	-0.357***	-1.056***
	(0.230)	(0.204)	(0.148)	(0.159)	(0.193)	(0.175)	(0.123)	(0.166)	(0.177)	(0.262)	(0.132)	(0.233)
log of employee	-0.0779	-0.0297	-0.0502	0.720	-0.181***	0.386	-0.117***	-0.321	-0.109	2.912***	-0.0702	1.474
	(0.0640)	(0.774)	(0.0414)	(0.754)	(0.0684)	(0.800)	(0.0449)	(0.785)	(0.0692)	(0.957)	(0.0448)	(0.923)
log of ICT capital	0.0407	-0.391	0.0407	-0.514	-0.0555	-1.043	-0.0555	-3.707***	-0.0775	6.148***	-0.0775	3.157**
	(0.0975)	(1.257)	(0.0974)	(1.327)	(0.0885)	(1.312)	(0.0884)	(1.370)	(0.103)	(1.567)	(0.103)	(1.598)
log of non-ICT capital	-0.0362	0.465	0.0235	1.915	-0.0514	2.128*	0.0334	2.575*	-0.0691	-3.667**	0.0449	-2.793*
	(0.0365)	(1.215)	(0.0271)	(1.332)	(0.0505)	(1.276)	(0.0378)	(1.369)	(0.0676)	(1.523)	(0.0506)	(1.594)
log of raw materials	-0.755***	4.507***	-0.313***	1.568	-0.481***	1.276	-0.199***	1.798	-0.182**	-2.765**	-0.0757**	-2.784**
	(0.204)	(1.129)	(0.0968)	(1.151)	(0.137)	(1.113)	(0.0642)	(1.136)	(0.0847)	(1.315)	(0.0369)	(1.277)
sole proprietorship	0.140**	0.162	0.0878**	0.295**	0.109*	0.121	0.0683*	-0.142	-0.181**	-0.0641	-0.114**	0.129
	(0.0632)	(0.119)	(0.0409)	(0.126)	(0.0557)	(0.121)	(0.0358)	(0.119)	(0.0701)	(0.142)	(0.0458)	(0.139)
sec. education	-9.30e-05	0.0762	-0.00576	-0.145	0.000222	-0.182	0.0137	-0.212	8.95e-05	-0.0733	0.00554	-0.134
	(0.0158)	(0.258)	(0.0222)	(71.98)	(0.0378)	(0.236)	(0.0309)	(65.43)	(0.0152)	(0.271)	(0.0229)	(67.19)
voc. education	0.0174	0.00708	0.00666	-0.00349	-0.0734	0.00256	-0.0280	0.00964	-0.0704	0.00965	-0.0269	0.0186
	(0.0953)	(0.0154)	(0.0366)	(1.218)	(0.0878)	(0.0106)	(0.0376)	(1.107)	(0.101)	(0.0202)	(0.0420)	(1.137)
tertiary education	-0.0982	0.226	-0.0227	-0.600	0.0475	-0.203	0.0110	-0.176	0.0563	0.164	0.0130	0.319
	(0.114)	(0.554)	(0.0438)	(143.8)	(0.0951)	(0.513)	(0.0278)	(130.7)	(0.111)	(0.598)	(0.0325)	(134.2)
manufacturing	0.0572	-0.167*	0.0450	-0.300***	-0.129**	0.0414	-0.101***	0.0512	-0.0244	0.499***	-0.0192	0.711***
	(0.0415)	(0.0989)	(0.0322)	(0.113)	(0.0504)	(0.0954)	(0.0376)	(0.0959)	(0.0408)	(0.157)	(0.0321)	(0.191)
construction	0.0221	-0.138*	-0.0477*	-0.0690	0.00617	-0.0955	-0.0133	-0.0862	0.0115	0.0529	-0.0248	-0.0701
	(0.0382)	(0.0768)	(0.0247)	(0.0694)	(0.0125)	(0.0687)	(0.0156)	(0.0720)	(0.0211)	(0.0728)	(0.0196)	(0.0779)
management type	0.0301	0.190*	0.0101	0.142	-0.0436	0.0228	-0.0147	0.221**	-0.0369	0.0170	-0.0124	0.170
	(0.0281)	(0.110)	(0.0157)	(0.100)	(0.0347)	(0.106)	(0.0216)	(0.108)	(0.0324)	(0.125)	(0.0189)	(0.121)
constant		-5.221***		-3.113		-2.495		0.0169		-3.721*		-1.255
		(1.639)		(217.0)		(1.672)		(197.3)		(1.985)		(202.5)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	12.70***	11.72***		-0.975***	13.25***	12.36***		-0.894***	14.23***	13.06***		-1.170***
	(0.152)	(0.112)		(0.189)	(0.167)	(0.0948)		(0.192)	(0.238)	(0.0996)		(0.258)
Observations	277				277				277			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.6: Mozambique detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	**25th quantile**				**50th quantile**				**75th quantile**			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.0589	-1.183***	-0.367	-0.920***	0.138	-1.396***	-0.0960	-1.605***	-0.736***	-0.163	-0.602***	-0.162
	(0.346)	(0.385)	(0.246)	(0.271)	(0.212)	(0.249)	(0.156)	(0.256)	(0.172)	(0.199)	(0.132)	(0.222)
log of employee	-0.212**	0.297	-0.00982	-0.806	-0.272***	2.007***	-0.0126	0.767	-0.178***	1.265**	-0.00822	0.673
	(0.100)	(0.975)	(0.0388)	(0.894)	(0.0880)	(0.612)	(0.0494)	(0.641)	(0.0643)	(0.610)	(0.0324)	(0.636)
log of ICT capital	0.224	-1.990	0.182	-1.456	0.246**	-0.924	0.199**	-3.499***	-0.468***	1.576	-0.379***	-3.412***
	(0.184)	(1.541)	(0.150)	(1.483)	(0.101)	(0.966)	(0.0823)	(1.097)	(0.103)	(0.973)	(0.0847)	(1.083)
log of non-ICT capital	-0.185*	-1.191	-0.245**	-1.095	-0.0388	-2.048***	-0.0514	-2.349***	0.187***	-1.601***	0.248***	1.214*
	(0.0982)	(0.868)	(0.114)	(0.818)	(0.0450)	(0.533)	(0.0581)	(0.693)	(0.0691)	(0.528)	(0.0654)	(0.664)
log of raw materials	-0.418**	2.650**	-0.305***	0.277	-0.198**	1.297*	-0.144**	1.301*	-0.145**	0.638	-0.106**	2.051***
	(0.169)	(1.175)	(0.116)	(0.950)	(0.0819)	(0.700)	(0.0561)	(0.753)	(0.0638)	(0.690)	(0.0440)	(0.734)
sole proprietorship	-0.0439	-1.255***	-0.228**	-0.967***	-0.0385	-0.773***	-0.200***	-0.385	-0.000734	-0.173	-0.00381	0.0783
	(0.0747)	(0.407)	(0.0900)	(0.343)	(0.0648)	(0.248)	(0.0609)	(0.241)	(0.00706)	(0.239)	(0.0361)	(0.237)
sec. education	0.116	1.247	0.292	1.620**	-0.0709	-1.128**	-0.179*	-0.743	0.000232	-0.576	0.000583	-1.401**
	(0.0974)	(0.786)	(0.185)	(0.767)	(0.0558)	(0.505)	(0.0997)	(0.533)	(0.0355)	(0.496)	(0.0894)	(0.550)
voc. education	0.00863	0.115	-0.0172	0.136	-0.00202	-0.0524	0.00401	-0.0180	-0.000564	-0.0236	0.00112	-0.0927
	(0.0376)	(0.100)	(0.0323)	(0.108)	(0.00919)	(0.0534)	(0.00929)	(0.0436)	(0.00373)	(0.0438)	(0.00596)	(0.0741)
tertiary education	-0.196	0.555	-0.364	0.761	-0.000648	-0.901*	-0.00120	-0.848*	-0.0467	-0.494	-0.0865	-0.620
	(0.139)	(0.714)	(0.228)	(0.687)	(0.0645)	(0.465)	(0.120)	(0.491)	(0.0625)	(0.457)	(0.112)	(0.484)
manufacturing	0.290	0.0959	0.268	0.0990	0.222**	0.0382	0.206**	-0.0338	-0.363***	0.00256	-0.336***	-0.00697
	(0.196)	(0.0695)	(0.182)	(0.0701)	(0.106)	(0.0352)	(0.0981)	(0.0355)	(0.101)	(0.0283)	(0.0939)	(0.0303)
construction	0.336	-0.686**	0.0496	-0.787***	0.170	-0.720***	0.0250	-1.100***	0.199*	0.0229	0.0293	0.189
	(0.206)	(0.333)	(0.0421)	(0.269)	(0.110)	(0.223)	(0.0218)	(0.262)	(0.106)	(0.179)	(0.0232)	(0.175)
management type	0.0220	-0.134	0.0105	-0.229	0.120**	0.160	0.0579*	0.278**	0.0791	0.104	0.0380	0.602***
	(0.0915)	(0.203)	(0.0441)	(0.177)	(0.0578)	(0.126)	(0.0329)	(0.133)	(0.0500)	(0.124)	(0.0266)	(0.160)
constant		-0.887		1.527		1.649		5.023***		-0.904		0.564
		(2.421)		(2.329)		(1.520)		(1.706)		(1.531)		(1.686)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	13.30***	12.06***		-1.242***	14.35***	13.09***		-1.258***	14.39***	13.49***		-0.899***
	(0.240)	(0.167)		(0.293)	(0.155)	(0.105)		(0.187)	(0.126)	(0.0953)		(0.158)
Observations	280				280				280			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.7: Namibia detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-1.053***	0.0335	-0.272	0.233	0.0300	-0.939***	0.357**	0.598***	0.316	-1.025***	0.421***	0.505**
	(0.386)	(0.460)	(0.265)	(0.280)	(0.248)	(0.308)	(0.149)	(0.225)	(0.216)	(0.279)	(0.139)	(0.235)
log of employee	-0.335*	2.942***	-0.0655	-0.0516	-0.279**	3.179***	-0.0545	-2.130***	-0.107*	1.634***	-0.0210	-0.601
	(0.176)	(0.928)	(0.0892)	(0.821)	(0.142)	(0.529)	(0.0740)	(0.498)	(0.0607)	(0.380)	(0.0289)	(0.454)
log of ICT capital	-0.192	0.389	-0.163	-0.106	0.124	0.293	0.105	-0.746	0.123	-0.362	0.104*	0.479
	(0.151)	(1.338)	(0.125)	(1.282)	(0.0833)	(0.735)	(0.0690)	(0.722)	(0.0752)	(0.501)	(0.0620)	(0.544)
log of non-ICT capital	0.0902	1.048*	0.135	-0.159	0.105	1.010***	0.158***	-0.510*	0.212	1.965***	0.317***	-1.912***
	(0.0841)	(0.605)	(0.0929)	(0.490)	(0.0773)	(0.342)	(0.0592)	(0.289)	(0.144)	(0.315)	(0.0811)	(0.312)
log of raw materials	-0.126	-1.908	-0.0534	1.248	-0.0506	-2.262***	-0.0215	0.278	-0.0235	-1.021*	-0.00996	-0.714
	(0.105)	(1.387)	(0.0453)	(1.309)	(0.0559)	(0.766)	(0.0240)	(0.752)	(0.0488)	(0.534)	(0.0208)	(0.629)
sole proprietorship	0.00692	0.417	0.00707	-0.617**	0.0889	0.221	0.0909	-0.0936	-0.0871	0.0628	-0.0891	0.253**
	(0.106)	(0.309)	(0.109)	(0.293)	(0.0622)	(0.170)	(0.0609)	(0.152)	(0.0564)	(0.116)	(0.0547)	(0.116)
sec. education	-0.473***	-0.318	-0.193**	0.0209	-0.354***	-0.128	-0.144**	-0.0227	-0.361***	-0.173*	-0.147**	0.0609
	(0.156)	(0.241)	(0.0927)	(0.212)	(0.104)	(0.127)	(0.0660)	(0.120)	(0.102)	(0.0983)	(0.0662)	(0.0925)
voc. education	-0.366***	0.1981	-0.366***	0.876	-0.133***	0.612	-0.133***	0.398	-0.228***	0.654	-0.228***	0.876
	(0.0882)	(0.781)	(0.0882)	(0.712)	(0.040)	(0.541)	(0.0403)	(0.765)	(0.050)	(0.541)	(0.050)	(0.751)
tertiary education	0.394*	-0.192	0.298*	-0.154	0.689***	-0.347	0.521***	0.114	0.627***	-0.638*	0.474***	0.391
	(0.224)	(0.888)	(0.168)	(0.847)	(0.152)	(0.489)	(0.108)	(0.476)	(0.137)	(0.337)	(0.0973)	(0.359)
manufacturing	-0.0242	-0.186	-0.0922*	0.0711	-0.0281	-0.00627	-0.107**	0.000141	-0.0132	0.0193	-0.0503*	0.0878
	(0.0532)	(0.189)	(0.0544)	(0.167)	(0.0606)	(0.100)	(0.0416)	(0.0940)	(0.0289)	(0.0712)	(0.0275)	(0.0774)
construction	0.0602	-0.0223	0.221**	0.294	-0.0149	-0.0475	-0.0548	0.200*	0.0184	0.0340	0.0677	-0.132
	(0.0783)	(0.171)	(0.0899)	(0.185)	(0.0222)	(0.0950)	(0.0459)	(0.112)	(0.0254)	(0.0670)	(0.0418)	(0.0894)
management type	-0.0878	0.137	-0.00174	0.362	-0.118	-0.427**	-0.00233	0.692***	0.157**	-0.179	0.00310	0.287**
	(0.126)	(0.303)	(0.00995)	(0.264)	(0.0746)	(0.183)	(0.0130)	(0.191)	(0.0735)	(0.127)	(0.0173)	(0.127)
constant		-2.274		-0.677		-2.425**		2.814***		-2.367***		2.306***
		(1.916)		(1.874)		(1.053)		(1.061)		(0.710)		(0.828)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	13.03***	12.01***		-1.019***	13.92***	13.01***		-0.909***	14.31***	13.60***		-0.709***
	(0.251)	(0.161)		(0.298)	(0.170)	(0.0892)		(0.192)	(0.119)	(0.0823)		(0.145)
Observations	307				307				307			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.8: Nigeria detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	7.572***	-7.294***	9.313***	1.193	1.283***	1.093***	2.568***	-1.271*	1.283***	1.407***	1.267***	0.175
	(1.623)	(1.700)	(0.944)	(0.989)	(0.0751)	(0.165)	(0.798)	(0.668)	(0.0751)	(0.191)	(0.0650)	(0.626)
log of employee	-0.887	-1.858	-0.371	-0.625	0.0304	-0.332**	0.0127	0.808*	0.0304	0.545***	0.0127	-1.690***
	(1.008)	(1.677)	(0.410)	(1.065)	(0.0274)	(0.142)	(0.0110)	(0.465)	(0.0274)	(0.130)	(0.0110)	(0.538)
log of ICT capital	9.238***	22.08***	8.710***	1.392	0.297***	2.048***	0.280***	-0.221	0.297***	2.049***	0.280***	-8.961***
	(1.619)	(3.875)	(1.405)	(2.795)	(0.0462)	(0.390)	(0.0391)	(0.890)	(0.0462)	(0.238)	(0.0391)	(0.897)
log of non-ICT capital	0.256	2.230	0.718	-1.232	0.0300	-1.518**	0.0842***	-7.375***	0.0300	-1.271***	0.0842***	2.895***
	(0.347)	(6.615)	(0.877)	(5.028)	(0.0199)	(0.745)	(0.0247)	(1.214)	(0.0199)	(0.437)	(0.0247)	(1.028)
log of raw materials	-0.747	-7.615*	0.0110	8.024***	-0.000170	-1.302***	2.50e-06	-5.584***	-0.000170	0.0669	2.50e-06	-4.512***
	(0.502)	(4.553)	(0.0729)	(2.978)	(0.0117)	(0.409)	(0.000172)	(0.994)	(0.0117)	(0.245)	(0.000172)	(0.938)
sole proprietorship	0.0159	-0.570	0.603**	0.421	-0.000710	0.148**	-0.0269***	-0.0625	-0.000710	0.0236	-0.0269***	0.136
	(0.228)	(0.389)	(0.307)	(0.289)	(0.0101)	(0.0752)	(0.00964)	(0.0691)	(0.0101)	(0.0208)	(0.00964)	(0.0859)
sec. education	-0.0977	-0.061	-0.0977	-0.891	-0.00129	0.0045	-0.00129	0.00.6	-0.00129	-0.0712	-0.00129	0.003
	(0.106)	(0.055)	(0.106)	(0.712)	(0.00274)	(0.513)	(0.00274)	(0)	(0.00274)	(0.0.081)	(0.00274)	(0.056)
voc. education	-0.00382	-0.0143	-9.12e-05	0.00462	-4.39e-05	-0.00396	-1.05e-06	-0.00693	-4.39e-05	0.000813	-1.05e-06	-0.00729
	(0.0247)	(0.0580)	(0.0143)	(2.153)	(0.000363)	(0.0131)	(0.000165)	(1.295)	(0.000363)	(0.00394)	(0.000165)	(1.306)
tertiary education	0.323*	-3.916**	0.314*	-2.770	0.0136**	-0.165***	0.0132**	-0.277	0.0136**	-0.165***	0.0132**	2.490
	(0.184)	(1.933)	(0.174)	(465.4)	(0.00573)	(0.0515)	(0.00529)	(280.0)	(0.00573)	(0.0515)	(0.00529)	(282.4)
manufacturing	0.0223	0.00515	0.0219	-0.00478	0.00210	0.00151	0.00207	0.000559	0.00210	0.00127	0.00207	-0.000641
	(0.0484)	(0.0346)	(0.0468)	(0.0341)	(0.00181)	(0.00701)	(0.00158)	(0.00647)	(0.00181)	(0.00523)	(0.00158)	(0.00553)
construction	-0.545	0.781	-0.545	0.315	0.912***	0.852	0.912***	0.689	0.912***	0.816	0.912***	0.817
	(1.518)	(0.581)	(1.518)	(0.812)	(0.0576)	(0.719)	(0.0576)	(0.751)	(0.0576)	(0)	(0.0576)	(0.615)
management type	-0.00308	-8.049***	-0.0508	8.234***	-0.000564	-0.277*	-0.00932	-1.113***	-0.000564	0.0461	-0.00932	-0.669**
	(0.0267)	(1.780)	(0.328)	(1.328)	(0.00331)	(0.161)	(0.00897)	(0.351)	(0.00331)	(0.0948)	(0.00897)	(0.320)
constant		-9.587*		-12.25		2.494***		12.56		0.111		10.49
		(5.693)		(467.5)		(0.618)		(281.3)		(0.362)		(283.7)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	14.26***	14.54***		0.278	15.38***	17.76***		2.376***	15.58***	18.27***		2.690***
	(1.110)	(0.704)		(1.315)	(0.152)	(0.0626)		(0.165)	(0.174)	(0.0626)		(0.185)
Observations	265				265				265			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.9: Rwanda detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.257	-2.908***	-0.218	2.175***	0.394	-2.665***	0.132	2.554***	1.201***	-0.686*	0.499***	1.341***
	(0.517)	(0.539)	(0.226)	(0.489)	(0.472)	(0.505)	(0.244)	(0.434)	(0.365)	(0.393)	(0.184)	(0.460)
log of employee	0.0401	1.679***	0.00783	-2.412***	0.0477	1.849***	0.00931	-1.201***	0.0284	2.205***	0.00554	-0.603
	(0.0431)	(0.491)	(0.0330)	(0.459)	(0.0498)	(0.464)	(0.0392)	(0.390)	(0.0300)	(0.749)	(0.0233)	(0.750)
log of ICT capital	0.000141	-0.288	0.00864	0.862	0.00146	-0.703	0.0895	0.467	-0.00555	1.260	-0.340***	-1.930
	(0.00222)	(1.495)	(0.0906)	(1.464)	(0.0171)	(1.477)	(0.0803)	(1.434)	(0.0649)	(2.864)	(0.0818)	(2.864)
log of non-ICT capital	0.297	-0.367	-0.0479	-0.495	0.0509	-1.278	-0.00822	-0.176	-0.179	-3.605**	0.0289	1.220
	(0.243)	(1.088)	(0.0445)	(0.955)	(0.198)	(1.010)	(0.0321)	(0.782)	(0.149)	(1.505)	(0.0273)	(1.490)
log of raw materials	-0.447***	2.074*	-0.00216	-3.486***	-0.574***	3.142***	-0.00278	-2.009**	-0.521***	1.002	-0.00252	-0.498
	(0.143)	(1.061)	(0.0727)	(1.087)	(0.159)	(0.980)	(0.0934)	(0.817)	(0.136)	(1.422)	(0.0848)	(1.503)
sole proprietorship	-0.0137	0.123	-0.0513	-0.739*	0.0641	1.174***	0.240***	-0.114	-0.0139	0.429	-0.0522	-0.958
	(0.0283)	(0.440)	(0.0842)	(0.381)	(0.0837)	(0.427)	(0.0851)	(0.338)	(0.0224)	(0.670)	(0.0525)	(0.667)
sec. education	-0.462*	-0.00712	-0.296*	0.0654	0.333	0.166	0.214	-0.0511	0.368**	0.268	0.236**	-0.429
	(0.243)	(0.349)	(0.156)	(0.513)	(0.210)	(0.355)	(0.135)	(0.405)	(0.152)	(0.702)	(0.0981)	(0.782)
voc. education	-0.0966	-0.0557	0.0706	0.0291	0.0240	0.00292	-0.0175	-0.00663	0.0232	-0.00626	-0.0169	-0.0229
	(0.0764)	(0.0855)	(0.0660)	(0.0758)	(0.0259)	(0.0455)	(0.0208)	(0.0527)	(0.0219)	(0.0898)	(0.0181)	(0.102)
tertiary education	0.160	-0.0707	0.100	0.202	-0.450	0.658	-0.281	-0.0634	1.312***	-1.325	0.820***	-0.257
	(0.386)	(2.367)	(0.242)	(3.440)	(0.338)	(2.356)	(0.211)	(2.716)	(0.265)	(4.665)	(0.165)	(5.104)
manufacturing	-0.0300	0.00159	-0.0206	-0.0614	-0.465***	-0.0442	-0.319***	0.0793	-0.497***	-0.0429	-0.341***	-0.0126
	(0.118)	(0.0239)	(0.0812)	(0.0581)	(0.119)	(0.0442)	(0.0877)	(0.0712)	(0.0969)	(0.0554)	(0.0750)	(0.0439)
construction	0.226	-1.930***	0.0441	1.707***	1.272***	-3.189***	0.248***	2.828***	0.728***	-1.592**	0.142**	1.662**
	(0.245)	(0.542)	(0.0495)	(0.502)	(0.297)	(0.622)	(0.0919)	(0.549)	(0.192)	(0.807)	(0.0554)	(0.814)
management type	0.0686	0.0140	-0.0306	-0.0267	0.0892	0.0568	-0.0399	0.104	-0.0421	-0.344*	0.0188	0.306
	(0.0554)	(0.102)	(0.0299)	(0.100)	(0.0658)	(0.0980)	(0.0367)	(0.0919)	(0.0341)	(0.194)	(0.0184)	(0.191)
constant		-4.082		6.530		-4.499		2.697		1.066		2.865
		(3.130)		(4.270)		(3.096)		(3.434)		(6.018)		(6.496)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	15.03***	11.86***		-3.165***	15.56***	13.29***		-2.271***	15.92***	16.43***		0.514*
	(0.153)	(0.145)		(0.211)	(0.153)	(0.161)		(0.222)	(0.263)	(0.130)		(0.293)
Observations	279				279				279			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.10: South Africa detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	0.340	-1.557**	2.741***	-0.630**	3.729***	-2.624***	5.530***	-2.510***	1.499***	-1.239***	1.501***	-1.867***
	(0.781)	(0.743)	(0.478)	(0.315)	(0.706)	(0.619)	(0.532)	(0.371)	(0.176)	(0.262)	(0.132)	(0.330)
log of employee	-3.033***	6.803***	-1.351***	0.816	-0.542	0.869	-0.241	2.661**	0.601***	-3.619***	0.268***	3.097***
	(0.643)	(1.770)	(0.326)	(1.026)	(0.483)	(1.459)	(0.217)	(1.059)	(0.131)	(0.863)	(0.0659)	(1.125)
log of ICT capital	-1.542***	5.153**	-0.351**	5.236***	-1.676***	3.202**	-0.382***	0.0349	-0.246**	-3.044***	-0.0560*	-1.039
	(0.588)	(2.017)	(0.153)	(1.266)	(0.490)	(1.621)	(0.137)	(1.369)	(0.118)	(0.606)	(0.0293)	(1.385)
log of non-ICT capital	0.813***	-3.596***	0.176	-1.420	-0.212	-1.733	-0.0458	-5.779***	0.229***	-3.847***	0.0495	-1.304
	(0.305)	(1.363)	(0.120)	(0.939)	(0.232)	(1.158)	(0.0566)	(0.955)	(0.0650)	(0.866)	(0.0315)	(1.024)
log of raw materials	0.0185	-2.899**	-0.0907	-3.679***	-0.110	0.806	0.537**	-3.786***	-0.0695	0.385	0.340***	-2.358***
	(0.0610)	(1.260)	(0.293)	(0.704)	(0.0865)	(1.047)	(0.247)	(0.710)	(0.0473)	(0.657)	(0.0789)	(0.763)
sole proprietorship	2.220***	0.305**	1.622***	0.172**	1.563***	0.248**	1.142***	0.164**	0.622***	0.114**	0.454***	0.231**
	(0.417)	(0.129)	(0.350)	(0.0771)	(0.325)	(0.106)	(0.267)	(0.0742)	(0.0928)	(0.0571)	(0.0834)	(0.0994)
sec. education	2.827***	-0.117	2.424***	-0.402**	2.357***	0.213	2.021***	0.187	0.131	-0.143	0.113	-0.0709
	(0.935)	(0.189)	(0.813)	(0.197)	(0.748)	(0.178)	(0.651)	(0.162)	(0.187)	(0.165)	(0.160)	(0.170)
voc. education	0.0228	0.000186	0.00553	-0.0159	0.000141	0.00692	3.40e-05	0.0256	-0.00653	-0.00431	-0.00158	-0.00162
	(0.0361)	(0.0182)	(0.0252)	(0.0236)	(0.0237)	(0.0181)	(0.00574)	(0.0329)	(0.00845)	(0.0163)	(0.00707)	(0.0164)
tertiary education	-2.091**	-1.182	-1.577**	-3.351**	0.849	-1.395	0.640	2.445	-0.0732	-0.491	-0.0552	-0.732
	(0.928)	(1.960)	(0.710)	(1.634)	(0.734)	(1.758)	(0.556)	(1.590)	(0.188)	(1.680)	(0.142)	(1.772)
manufacturing	-0.600**	0.413	-0.385**	0.0786	0.245	0.220	0.157	0.214	0.0382	-0.120	0.0245	-0.240
	(0.247)	(0.366)	(0.175)	(0.174)	(0.182)	(0.302)	(0.121)	(0.174)	(0.0456)	(0.178)	(0.0297)	(0.191)
construction	0.131	-0.0458	0.107	0.0372	0.0375	0.201	0.0307	0.0572	0.0171	0.120*	0.0140	0.125
	(0.128)	(0.151)	(0.106)	(0.0623)	(0.0957)	(0.135)	(0.0784)	(0.0652)	(0.0251)	(0.0664)	(0.0206)	(0.0762)
management type	1.573***	1.593***	2.162***	-0.0362	1.216***	2.044***	1.671***	1.447***	0.256***	0.494***	0.352***	0.919***
	(0.334)	(0.351)	(0.375)	(0.190)	(0.261)	(0.335)	(0.295)	(0.240)	(0.0601)	(0.190)	(0.0705)	(0.227)
constant		-7.985***		1.935		-7.307***		-0.182		8.917***		-0.495
		(2.669)		(2.063)		(2.342)		(2.030)		(2.056)		(2.244)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	15.16***	13.94***		-1.217***	16.06***	17.17***		1.105***	17.77***	18.03***		0.261
	(0.187)	(0.313)		(0.365)	(0.205)	(0.376)		(0.428)	(0.233)	(0.107)		(0.256)
Observations	290				290				290			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.11: Tanzania detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.692*	-0.183	-0.919	-0.480*	-0.254	-0.0934	-0.0795	-0.909***	1.479**	-1.864**	0.0838	-1.821***
	(0.408)	(0.463)	(0.609)	(0.275)	(0.317)	(0.370)	(0.439)	(0.266)	(0.667)	(0.743)	(0.797)	(0.651)
log of employee	-0.266*	-1.231	-0.343***	-3.116*	-0.195*	-1.145	-0.251***	-2.497**	-0.449**	13.45***	-0.579***	10.20**
	(0.138)	(1.849)	(0.112)	(1.762)	(0.100)	(1.284)	(0.0806)	(1.223)	(0.217)	(4.093)	(0.154)	(3.997)
log of ICT capital	-0.366**	-5.385**	-0.829**	-7.259***	-0.172	0.182	-0.389	-0.892	-0.230	-3.276	-0.522	-4.592
	(0.184)	(2.576)	(0.410)	(2.471)	(0.130)	(1.785)	(0.293)	(1.709)	(0.234)	(5.653)	(0.529)	(5.573)
log of non-ICT capital	-0.0883	-0.817	-0.131	0.718	-0.0840	0.0632	-0.125	1.623	-0.00913	-23.24***	-0.0136	-21.24***
	(0.0956)	(2.818)	(0.140)	(2.773)	(0.0692)	(1.951)	(0.100)	(1.926)	(0.121)	(6.318)	(0.180)	(6.277)
log of raw materials	0.0193	2.023*	0.210**	1.108	0.0167	0.787	0.181**	0.0150	0.0339	-0.0944	0.368***	-1.795
	(0.0525)	(1.116)	(0.103)	(1.007)	(0.0451)	(0.775)	(0.0741)	(0.707)	(0.0914)	(2.334)	(0.135)	(2.250)
sole proprietorship	-0.193*	-0.0287	0.261**	0.181	-0.192**	-0.249	0.259***	-0.0412	0.494**	0.186	-0.666***	-0.705
	(0.113)	(0.269)	(0.113)	(0.240)	(0.0971)	(0.196)	(0.0824)	(0.164)	(0.226)	(0.558)	(0.156)	(0.557)
sec. education	-0.130	0.0733	-0.155	0.159	-0.511***	-0.0826	-0.609***	0.0813	0.0538	-0.259	0.0642	-0.212
	(0.148)	(0.308)	(0.175)	(0.321)	(0.133)	(0.217)	(0.132)	(0.217)	(0.189)	(0.706)	(0.226)	(0.698)
voc. education	-0.112*	-0.0511	-0.133**	-0.0257	-0.175**	-0.0191	-0.208***	0.0186	0.0501	0.229	0.0598	0.223
	(0.0625)	(0.106)	(0.0645)	(0.0880)	(0.0680)	(0.0619)	(0.0560)	(0.0615)	(0.0672)	(0.355)	(0.0784)	(0.348)
tertiary education	0.456	0.340	0.520	1.496	0.939***	-1.832	1.071***	-0.0671	1.583***	-0.853	1.807***	1.724
	(0.352)	(3.217)	(0.399)	(3.194)	(0.264)	(2.230)	(0.287)	(2.212)	(0.474)	(7.227)	(0.518)	(7.208)
manufacturing	-0.0534	0.0382	-0.441***	0.249	-0.0555	0.590**	-0.458***	0.817***	-0.0776	-1.479**	-0.641***	-1.091*
	(0.131)	(0.251)	(0.131)	(0.242)	(0.136)	(0.255)	(0.0992)	(0.304)	(0.190)	(0.705)	(0.172)	(0.616)
construction	-0.0445	-0.192	-0.0823	-0.153	-0.0574	0.126	-0.106*	0.177	-0.249	-0.227	-0.461***	-0.0124
	(0.0506)	(0.152)	(0.0809)	(0.130)	(0.0457)	(0.103)	(0.0590)	(0.125)	(0.157)	(0.249)	(0.121)	(0.200)
management type	0.0856	0.400	0.205	0.208	0.232**	0.200	0.555***	-0.200	0.279*	1.709**	0.668***	1.241**
	(0.0793)	(0.254)	(0.170)	(0.215)	(0.110)	(0.168)	(0.125)	(0.155)	(0.149)	(0.676)	(0.222)	(0.578)
constant		4.647		5.953		1.286		0.0575		11.99		14.44
		(4.095)		(3.987)		(2.838)		(2.774)		(9.059)		(8.972)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	11.81***	10.93***		-0.875**	12.54***	12.19***		-0.347	13.75***	13.36***		-0.385
	(0.306)	(0.164)		(0.347)	(0.320)	(0.132)		(0.347)	(0.694)	(0.249)		(0.737)
Observations	263				263				263			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.12: Uganda detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	0.197	-0.975***	1.239***	-0.958**	0.0242	-0.995***	0.678**	-1.607***	-0.543***	0.801***	-0.894***	-1.944***
	(0.203)	(0.375)	(0.311)	(0.405)	(0.242)	(0.235)	(0.329)	(0.149)	(0.195)	(0.237)	(0.314)	(0.155)
log of employee	-0.0358	-1.068	0.200**	-1.585	0.00106	0.422	-0.00593	0.717	0.0143	-0.315	-0.0803	0.271*
	(0.0498)	(1.933)	(0.101)	(1.898)	(0.0184)	(0.833)	(0.103)	(0.742)	(0.0258)	(0.393)	(0.100)	(0.141)
log of ICT capital	0.0833	-4.108*	0.161	-2.597	0.179*	-4.133***	0.346*	-2.074**	-0.670***	3.848***	-1.297***	1.032***
	(0.0904)	(2.321)	(0.174)	(2.270)	(0.0951)	(1.022)	(0.179)	(0.893)	(0.125)	(0.520)	(0.180)	(0.199)
log of non-ICT capital	0.00633	-1.927	-0.00704	-1.947	-0.147	4.469***	0.164***	-0.862	-0.0683	2.363***	0.0760**	-0.239
	(0.0233)	(3.617)	(0.0254)	(3.539)	(0.123)	(1.583)	(0.0598)	(1.381)	(0.0605)	(0.786)	(0.0355)	(0.251)
log of raw materials	0.286*	-9.016***	0.826***	-14.78***	0.258*	7.175***	0.746***	2.066	0.135*	3.228***	0.391***	1.045***
	(0.146)	(3.469)	(0.123)	(3.402)	(0.133)	(1.505)	(0.119)	(1.308)	(0.0742)	(0.720)	(0.0963)	(0.0976)
sole proprietorship	0.0659	-0.0815	0.107	-0.122	0.00658	0.133	0.0107	0.133	-0.00423	-0.00296	-0.00685	0.00544
	(0.0439)	(0.182)	(0.0655)	(0.182)	(0.0411)	(0.0868)	(0.0666)	(0.0827)	(0.0399)	(0.0279)	(0.0647)	(0.0106)
sec. education	-0.285	0.657	-0.285	0.764	0.0979	0.321	0.0979	0.189	-0.175	0.079	-0.175	0.059
	(0.181)	(0.459)	(0.181)	(0.631)	(0.184)	(0.412)	(0.184)	(0.327)	(0.179)	(0.219)	(0.179)	(0.219)
voc. education	-0.0277	0.00504	-0.0295	0.00689	-0.0314	0.00218	-0.0334	0.00428	-0.0414	-0.00276	-0.0440	-0.002
	(0.0405)	(0.0230)	(0.0428)	(0.0247)	(0.0417)	(0.00942)	(0.0441)	(0.0117)	(0.0411)	(0.00614)	(0.0432)	(0.213)
tertiary education	0.0687	-0.152	0.0694	-0.161	-0.255	0.564	-0.258	-0.161	0.294	-0.650	0.297	-0.161
	(0.221)	(0.488)	(0.223)	(0.457)	(0.227)	(0.501)	(0.229)	(0.457)	(0.221)	(0.487)	(0.223)	(0.457)
manufacturing	0.0144	0.408	0.0433	0.411	-0.0718	-0.693***	-0.215***	-0.512***	-0.00641	-0.799***	-0.0192	-0.753***
	(0.0265)	(0.411)	(0.0767)	(0.409)	(0.0437)	(0.220)	(0.0800)	(0.190)	(0.0257)	(0.180)	(0.0764)	(0.164)
construction	0.0206	0.006	0.0206	0.125	-0.0122	0.064	-0.0122	0.058	-0.0218	0.028	-0.0218	0.035
	(0.0234)	(0.210)	(0.0234)	(0.481)	(0.0238)	(0151)	(0.0238)	(0.213)	(0.0233)	(0.2581)	(0.0233)	(0217)
management type	0.000815	0.150	0.133*	0.0142	-0.00100	-0.117	-0.163**	0.0780	-8.99e-05	-0.0164	-0.0146	0.0128
	(0.0270)	(0.336)	(0.0715)	(0.327)	(0.0332)	(0.151)	(0.0739)	(0.129)	(0.00301)	(0.0787)	(0.0704)	(0.0254)
constant		14.82***		19.80***		-8.816***		-0.996		-6.852***		-3.158***
		(4.693)		(4.661)		(1.939)		(1.853)		(0.742)		(0.506)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	13.44***	12.66***		-0.777*	14.40***	13.43***		-0.971***	15.05***	15.31***		0.257
	(0.428)	(0.0921)		(0.437)	(0.164)	(0.118)		(0.202)	(0.169)	(0.107)		(0.200)
Observations	351				351				351			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.13: Zambia detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.0733	-0.653**	0.893**	0.456	0.935**	-1.037**	1.978***	-0.00793	0.621***	0.967***	1.199***	1.599***
	(0.347)	(0.329)	(0.352)	(0.313)	(0.449)	(0.444)	(0.375)	(0.228)	(0.172)	(0.221)	(0.148)	(0.408)
log of employee	-0.516***	1.483	-0.256**	-1.406	0.262**	-1.410	0.130*	-0.100	0.178***	-1.132*	0.0882**	1.449*
	(0.145)	(0.992)	(0.113)	(1.019)	(0.105)	(0.906)	(0.0685)	(0.844)	(0.0515)	(0.612)	(0.0395)	(0.791)
log of ICT capital	0.143	-2.575**	0.0810	-1.810	0.238**	-3.835***	0.135**	-2.803**	-0.105***	-0.339	-0.0595**	1.401
	(0.101)	(1.271)	(0.0587)	(1.773)	(0.0993)	(1.157)	(0.0612)	(1.386)	(0.0396)	(0.810)	(0.0248)	(1.438)
log of non-ICT capital	0.169	1.676	0.116	-0.526	0.608**	6.866***	0.419**	-0.315	0.136*	2.759***	0.0938**	-6.740***
	(0.132)	(1.249)	(0.0845)	(1.170)	(0.295)	(1.195)	(0.165)	(0.862)	(0.0736)	(0.549)	(0.0431)	(1.020)
log of raw materials	0.134	2.674	1.051***	-1.693	0.180	0.126	1.413***	6.570***	0.0735	0.675	0.576***	1.928
	(0.125)	(1.869)	(0.229)	(1.810)	(0.167)	(1.704)	(0.253)	(1.539)	(0.0681)	(1.168)	(0.101)	(1.375)
sole proprietorship	0.000836	0.133	-0.0921	-0.465***	-0.00133	-0.172	0.146**	0.115	-0.000457	-0.165*	0.0504**	0.410***
	(0.0402)	(0.146)	(0.0566)	(0.154)	(0.0638)	(0.136)	(0.0688)	(0.112)	(0.0220)	(0.0887)	(0.0250)	(0.123)
sec. education	-0.0731	0.076	-0.0731	0.056	-0.151	0.072	-0.151	0.085	-0.023	0.061	-0.023	0.019
	(0.119)	(0.287)	(0.119)	(0.185)	(0.117)	(0.119)	(0.117)	(0.298)	(0.043)	(0.132)	(0.043)	(0.078)
voc. education	-0.0189	0.0628	-0.0159	-0.269*	-0.228	-0.139	-0.192	-0.0662	-0.0728	-0.00839	-0.0611	-0.0472
	(0.169)	(0.138)	(0.142)	(0.154)	(0.183)	(0.139)	(0.157)	(0.0870)	(0.0685)	(0.0669)	(0.0583)	(0.0831)
tertiary education	0.0401	0.953	0.0376	-3.028**	0.377	-3.599**	0.354	1.237	0.0951	-0.392	0.0892	-0.625
	(0.258)	(1.862)	(0.242)	(1.320)	(0.266)	(1.734)	(0.247)	(1.053)	(0.0985)	(0.878)	(0.0920)	(1.049)
manufacturing	-0.0983	-0.133	-0.115	0.0770	-0.186	-0.0889	-0.218	0.0559	0.458***	0.284***	0.537***	-0.0623
	(0.121)	(0.0922)	(0.141)	(0.0960)	(0.115)	(0.0819)	(0.133)	(0.0779)	(0.0746)	(0.0855)	(0.0696)	(0.0756)
construction	0.137	-0.345*	0.104	0.398***	-0.178	0.209	-0.136	-0.194*	-0.118**	-0.122	-0.0897**	0.199*
	(0.135)	(0.185)	(0.102)	(0.154)	(0.131)	(0.162)	(0.0984)	(0.106)	(0.0579)	(0.0829)	(0.0426)	(0.107)
management type	0.00925	0.268	0.0549	-0.399	0.0132	0.104	0.0781	-0.399*	-0.000358	-0.612***	-0.00213	0.933***
	(0.0413)	(0.298)	(0.0441)	(0.298)	(0.0585)	(0.275)	(0.0553)	(0.237)	(0.00235)	(0.168)	(0.0103)	(0.249)
constant		-4.850**		9.576***		0.902		-4.107**		0.0185		2.754
		(2.467)		(2.176)		(2.273)		(1.781)		(1.350)		(1.704)
	internet access	no internet access		total Gap	internet access	no internet access		total Gap	internet access	no internet access		total Gap
Raw Gap	12.52***	11.79***		-0.726***	13.11***	13.01***		-0.102	14.15***	15.73***		1.588***
	(0.168)	(0.175)		(0.242)	(0.187)	(0.206)		(0.278)	(0.152)	(0.0971)		(0.180)
Observations	276				276				276			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A-4C.13: Zimbabwe detailed decomposition of firm turnover by internet accessibility (firms with internet access as reference group)

Variables	25th quantile				50th quantile				75th quantile			
	No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access		No reweighting internet access as reference group		F(x) for computer access reweighted to lack of internet access	
	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained	Explained	Unexplained
Total (Expl/unexpl)	-0.637*	-1.557***	7.812***	-5.683***	-1.405**	-0.0123	6.103***	-6.946***	0.370**	-1.365***	1.034***	-0.882**
	(0.374)	(0.357)	(1.083)	(0.265)	(0.694)	(0.599)	(1.952)	(0.147)	(0.149)	(0.196)	(0.334)	(0.348)
log of employee	-0.0546	-3.176*	0.170	-0.00518	-2.343***	14.55***	7.277***	-3.566***	-0.0439	-0.987	0.136	3.464**
	(0.138)	(1.865)	(0.428)	(0.0313)	(0.517)	(2.296)	(0.931)	(1.184)	(0.0434)	(0.847)	(0.132)	(1.449)
log of ICT capital	-0.0409	-2.671	1.959***	-0.0436**	-0.0451	8.248***	2.163**	2.378*	-0.00438	4.407***	0.210	0.157
	(0.103)	(2.206)	(0.481)	(0.0173)	(0.115)	(2.724)	(0.860)	(1.393)	(0.0114)	(1.000)	(0.143)	(1.327)
log of non-ICT capital	-0.161	-5.669*	5.285***	0.0669**	0.136	-11.86***	-4.441*	-5.782***	0.00122	-7.076***	-0.0400	-5.703***
	(0.135)	(2.942)	(1.426)	(0.0303)	(0.134)	(3.974)	(2.591)	(1.701)	(0.0133)	(1.277)	(0.434)	(1.403)
log of raw materials	-0.0379	-1.805	0.291	0.0107	-0.0183	-0.0672	0.141	-0.759	-0.0117	1.121	0.0902	7.786***
	(0.0467)	(1.800)	(0.295)	(0.0148)	(0.0716)	(2.656)	(0.541)	(0.915)	(0.0144)	(0.734)	(0.0912)	(1.390)
sole proprietorship	0.0145	0.0193	0.0115	-0.00153	-0.0434	0.0119	-0.0345	0.0186	0.0354	0.00547	0.0282	-0.00588
	(0.0721)	(0.0340)	(0.0574)	(0.00151)	(0.133)	(0.0341)	(0.106)	(0.0249)	(0.0236)	(0.0159)	(0.0196)	(0.0233)
sec. education	0.0105	0.348	-0.0594	-0.000511	-0.0315	-0.793	0.178	-0.161	-0.00248	-0.229	0.0140	-0.729**
	(0.0640)	(0.477)	(0.0919)	(0.00353)	(0.190)	(0.571)	(0.223)	(0.314)	(0.0153)	(0.225)	(0.0255)	-(0.342)
voc. education	-0.00831	-0.00399	-0.00854	0.000472	-0.0143	-0.00227	-0.0147	-0.00235	0.000573	-0.00286	0.000589	0.00436
	(0.0294)	(0.0183)	(0.0301)	(0.00236)	(0.0538)	(0.0107)	(0.0552)	(0.0109)	(0.00890)	(0.0130)	(0.00915)	(0.0210)
tertiary education	-0.0200	1.576	0.0212	0.00377	0.0861	-2.934	-0.0913	0.113	0.00156	-0.781	-0.00166	-4.139**
	(0.0550)	(2.627)	(0.0564)	(0.00519)	(0.179)	(3.151)	(0.178)	(1.696)	(0.0127)	(1.204)	(0.0134)	(1.780)
manufacturing	-0.0752	0.384	-0.132	-0.00454	0.622	-0.665	1.094*	0.0622	-0.0200	-0.310**	-0.0351	-1.343***
	(0.203)	(0.332)	(0.356)	(0.00535)	(0.381)	(0.478)	(0.658)	(0.176)	(0.0626)	(0.141)	(0.110)	(0.248)
construction	0.0297	0.0959	0.0541	-0.00425	0.00623	-0.0330	0.0114	-0.0340	0.366***	0.466***	0.668***	-0.0479
	(0.0667)	(0.178)	(0.121)	(0.00544)	(0.121)	(0.173)	(0.221)	(0.128)	(0.119)	(0.135)	(0.0987)	(0.153)
management type	-0.294***	1.860***	0.220**	-0.0184*	0.240	-0.00622	-0.180	0.659***	0.0474*	-0.0125	-0.0356*	0.135
	(0.108)	(0.408)	(0.0867)	(0.0105)	(0.158)	(0.462)	(0.121)	(0.254)	(0.0273)	(0.177)	(0.0211)	(0.362)
constant		7.485*		19.78***		-6.461		0.128		2.034		-0.452
		(3.899)		(3.313)		(4.566)		(2.561)		(1.805)		(2.517)
	internet access	no internet access	total Gap		internet access	no internet access	total Gap		internet access	no internet access	total Gap	
Raw Gap	18.12***	15.92***	-2.195***		19.84***	18.43***	-1.417***		20.44***	19.45***	-0.995***	
	(0.266)	(0.222)	(0.346)		(0.148)	(0.476)	(0.498)		(0.140)	(0.109)	(0.177)	
Observations	281				281				281			

Note: bootstrap Standard errors (200 replications) are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix 4B: Stata do-files for quantile decomposition

```
**********BOTSWANA
use "C:\Users\lexfa\Desktop\Data Analysis\final SME dataset.dta", clear
#delimit;
log using "C:\Users\lexfa\Dropbox\Fortin\Oaxaca Quantile Decomp log files\New Oaxaca
log files\
Access to Computers.smcl";
#delimit cr
keep if country==1
tab com, gen(com)
gen acom = com2
gen ncom = com1
save temp01, replace
keep if acom ==0
replace acom=2
save temp2, replace
use temp01, clear
append using temp2
save temp012,replace
set more off
***** probit for compute access effect
#delimit;
probit acom lnturnover lnemply2 lnvalictequ lntofixcost lnavdircost sol seceduc
voca tertiary manufa constru mgtfull [iweight=eweight]if acom==0 | acom==1;
#delimit cr
predict pcom, p
summ pcom , detail
gen pbar=r(mean)
summ acom [weight=eweight] if acom==0 | acom==1
replace eweight=eweight*(pcom)/(1-pcom)*((1-pbar)/pbar) if acom==2
summ eweight, detail
forvalues it = 0(1)2 {
** get rif for 25, 50 and 75 quantiles
pctile valx=lnturnover if acom==`it' [aweight=eweight], nq(100)
kdensity lnturnover [aweight=eweight] if acom==`it', at(valx) gen(evalt`it' denst`it')
width(0.4) nograph
```

```
 forvalues qt = 25(25)75 {
 local qc = `qt'/100.0
 gen rif`it'_`qt'=evalt`it'[`qt']+`qc'/denst`it'[`qt'] if lnturnover>=evalt`it'[`qt'] & acom==`it'
 replace rif`it'_`qt'=evalt`it'[`qt']-(1-`qc')/denst`it'[`qt'] if lnturnover<evalt`it'[`qt']&
acom==`it'
            }
 drop valx
            }
drop eval* denst*
gen rifat=.
forvalues qt = 25(25)75 {
di "evaluating quantile= " `qt'
** get decomposition without reweighing [E(X_1|t=1)- E(X_0|t=0)]B_0
replace rifat=rif0_`qt' if acom==0
replace rifat=rif1_`qt' if acom==1
 #delimit;
oaxaca rifat lnemply2 lnvalictequ lntofixcost lnavdircost sol seceduc voca tertiary
manufa constru mgtfull [aweight=eweight] if acom==0 | acom==1, by(acom) relax weight(1)
detail;
#delimit cr

est sto WRa_Botswana_`qt'
matrix Ra`qt'=e(b)

replace rifat=.
*** get composition effects with reweighing [E(X_0|t=1)- E(X_0|t=0)]B_c  as explained in
replace rifat=rif2_`qt' if acom==2
replace rifat=rif0_`qt' if acom==0
 #delimit;
oaxaca rifat lnemply2 lnvalictequ lntofixcost lnavdircost sol seceduc voca tertiary
manufa constru mgtfull [aweight=eweight] if acom==0 | acom==2, by(acom) relax weight(1)
detail;
#delimit cr
est sto CRc_Botswana_`qt'
matrix Rc=e(b)
```

```
replace rifat=.
*** get wage structure effects E(X_1|t=1)*[B_1-B_c]  as unexplained in
replace rifat=rif1_`qt' if acom==1
replace rifat=rif2_`qt' if acom==2

#delimit;
oaxaca rifat lnemply2 lnvalictequ lntofixcost lnavdircost sol seceduc voca tertiary
manufa constru mgtfull [aweight=eweight] if acom==1 | acom==2, by(acom) relax weight(0)
detail;
#delimit cr
est sto ASRw_Botswana_`qt'
matrix Rw=e(b)
        }
```