Differences in ICT use by entrepreneurial micro-firms: Evidence from Zambia

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Version: 8th October 2019

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ABSTRACT

Micro-firms are important for creating jobs and income in developing economies, but these firms face significant constraints, some of which could be ameliorated through ICT. However, it remains unclear which specific ICT uses are intensively employed by different entrepreneurial micro-firms. Notwithstanding external constraints, we examined differences in ICT use by comparably sized micro-firms operating in the same environment that exhibit different entrepreneurial attributes (proactiveness, innovativeness, risk-taking, and growth orientation). Using data from Zambian micro-firms, our findings demonstrate that the four entrepreneurial attributes have a positive yet different influence on three individual categories of ICT use: information and network access; online transaction and interaction; and in-house operations. Indirectly, we pinpoint which ICT applications will likely benefit entrepreneurial firms. Our findings could help researchers and policy-makers to target specific categories of ICT use that drive firm growth and nurture the desirable business behavioural orientations for deploying technology in business.

Keywords: entrepreneurial micro-firms; information and communications technology; innovativeness; business growth; Zambia; African SMEs

1. Introduction

Micro-firms – broadly defined as firms with 10 or fewer employees – are the predominant business establishments worldwide, accounting for a large share of new firms and jobs, and employing over half of the formal labour force in developing countries. Consequently, micro-firms are drivers of entrepreneurship, innovation, and wealth creation in most economies (Ntwoku, Negash, & Meso, 2017). In this regard, measures and tools that enhance micro-firms' survival and growth prospects could potentially raise the living standards of a large proportion of workers and their dependents, and generally drive the socio-economic advancement of developing countries. Information and communications technology (ICT) is proclaimed as an indispensable tool for helping micro-firms improve their business performance and, hence, their development impact (Heeks, 2018; Ilavarasan, 2017).

ICT use in business broadens access to resources and new markets, and enables more flexible and cost-effective business models, ultimately improving firms' productivity and efficiency (Alderete, 2017; Duncombe, 2016; Perez-Estebanez, Uroqia-Grande, & Rautiainen, 2018; Wamuyu, 2015). In severely constrained business environments, such as those in African countries, ICT could help micro-firms overcome some key barriers to business development and growth. Mobile money initiatives provide a valuable illustration: enabling relatively low-cost, instant, safe, and traceable payments for services rendered across physical distances. These cases demonstrate how ICT applications can help micro-firms with limited resources to improve business efficiency and liquidity, and reduce transaction costs (Heeks, 2018; Islam, Muzi, & Rodriguez Meza, 2016).

Nonetheless, ICT use by micro-firms remains low and basic (Foster, Graham, Mann, Waema, & Friederici, 2018; Murphy, Carmody, & Surborg, 2014; Wamuyu, 2015). Why micro-firms do not actively pursue ICT to improve their sustainability and growth prospects remains a key question that warrants attention. A generic explanation is that micro-firms are

more sensitive to the increasing costs, uncertainties, and risks associated with investing in ICT than their larger counterparts due to resource constraints (Simmons, Armstrong, & Durkin, 2011). However, firms facing such constraints would arguably adopt ICT more intensively, given its potential to improve business competitiveness in an increasingly ICT-embedded economy (Murphy et al., 2014). More importantly, some ICT uses (e.g. social media) have become increasingly affordable, accessible, and user-friendly means to improve business operations, supporting internal and external information sharing and seeking, collaboration, planning, and marketing in different ways (Diga & May, 2016; Ilavarasan & Otieno, 2018). There are also free and opensource software specifically designed for micro and small firms (e.g. the World Bank SME Toolkit). In sum, micro-firms' decision on increasing ICT use cannot fully be attributed to limited resources and skills.

Micro-firms differ in their goals and orientations toward business development (Jaouen & Lasch, 2015). Therefore, they are unlikely to find all ICT uses relevant and compatible with their business needs and strategies (Levy & Powell, 2005). Yet it remains unclear which specific ICT uses are intensively employed by different entrepreneurial micro-firms. Addressing this question requires greater appreciation of the heterogeneous nature of micro-firms and the functionalities of ICT in a disaggregated manner (Ilavarasan, 2017). Current understanding of micro-firms' ICT use has several limitations. For instance, micro-firms are either regarded as too small to be considered in related studies of small and medium-sized enterprises (SMEs), or they are included but masked by a focus on micro, small and medium-sized enterprises (MSMEs) as one homogenous group (Jones, Simmons, Packham, Beynon-Davies, & Pickernell, 2014). Both approaches provide inadequate insights for researchers and policy-makers specifically targeting the development of micro-firms. This is further compounded by ICT being generally measured as a single category of technology, of devices (e.g. mobile phones) and/or of applications (e.g. mobile money) (Ilavarasan, 2017).

This research addresses the above-mentioned limitations by explicitly focusing on micro-firms and on different categories of ICT use in business. Our approach differs from existing studies in two ways. *First*, we focus only on micro-firms, which controls for the number of employees and levels of resources and skills available to the firm. In general, micro-firms differ greatly from SMEs in terms of resource base and business scale. We further control for environmental factors by focusing only on secondary- and tertiary-sector micro-firms in a few locations of one urban city (i.e. Lusaka, Zambia). *Second*, we depart from the conventional approach of employing one composite measure of ICT use (e.g. total count of ICT devices and software owned, or the average frequency of ICT use) (Hall, Lotti, & Mairesse, 2013). Ownership of basic ICT infrastructure (e.g. computers, mobile devices, and broadband) is becoming a less important determinant of ICT access, usage, and value generation. We recognise the increasing availability and use of third-party apps, servers, platforms and so forth by focusing on the extent of a firm's digitisation.

Research has shown that internal and external factors explain differences in firms' ICT use (AlBar & Hoque, 2017; Nguyen, Newby, & Macaulay, 2015). The Technology-Organisation-Environment (TOE) framework, for example, suggests that the adoption of technologies such as ICT is influenced by various technological, organisational, and external environment factors (Tornatzky & Fleischer, 1990). By controlling for external factors (i.e. environmental context) and technological uses (i.e. ICT use), we highlight how internal firm attributes explain and predict the choice of ICT use by micro-firms. Specifically, the research draws on the entrepreneurship perspective to identify the different categories of ICT use by micro-firms exhibiting different entrepreneurial attributes.

Entrepreneurial and non-entrepreneurial firms differ in their endeavours to recognise and pursue business opportunities, irrespective of the technological, organisational, and environmental contexts in which they operate (Shane, 2003). Entrepreneurial firms

demonstrate higher tolerance for risks and uncertainties than their peers (Covin & Slevin, 1989; Stevenson & Jarillo, 1990). Based on this understanding, we posit that different entrepreneurial attributes are likely to influence the choice and extent to which different categories of ICT use are deployed by micro-firms. Prior studies broadly suggested that entrepreneurial firms demonstrate greater ICT use but do not pinpoint which entrepreneurial attributes are associated with which ICT uses in business (Simmons et al., 2011). This study elucidates the firm attributes that: 1) predict which ICT uses are most and least favoured by different entrepreneurial micro-firms; 2) promote more advanced use of ICT by micro-firms (Murphy et al., 2014); and 3) indicate a greater likelihood of spearheading and creating the critical mass in diffusing new technologies, including ICT, throughout the economy (Rogers, 1983). In turn, the ICT usage profile we develop can be indirectly used to determine whether a given micro-firm is entrepreneurial.

Theoretically, integrating the entrepreneurship literature to explain choice and extent of ICT use by firms enriches the notion that subjectively perceived usefulness determines technology acceptance (Davis, 1989), and that attitudes and subjective norms particularly influence ICT use in smaller firms (Chew, Ilavarasan, & Levy, 2013; Wolcott, Kamal, & Qureshi, 2008; Zaremohzzabieh et al., 2016). We provide a full account of which entrepreneurial attributes differentiate categories of ICT use in business and offer explicit theoretical explanations of the influence of these attributes on micro-firms' ICT usage.

In practice, our findings will help policy-makers, development agencies and service providers to develop support programmes that: (1) inculcate in micro-firms the key behavioural orientations likely to drive deeper ICT use in business; and/or (2) promote and diffuse target ICT applications that minimise uncertainties and risks associated with ICT use in micro-firms. By articulating the role of firms' entrepreneurial attributes in enhancing ICT uses in business, this study complements emphasis on the rising entrepreneurial spirit, especially among the

young generation, and on new technologies (including ICT innovations) in effecting socio-economic development in Africa (Kanza, 2016). Accordingly, this study highlights the need to better coordinate and link entrepreneurship and ICT diffusion policies/ measures.

The paper is organised as follows. The second section reviews the existing literature on ICT uses in business and entrepreneurial attributes, focusing especially on the context of Africa. The third section then presents the research methodology and data sets. The empirical results are explained and discussed in the fourth section, which is followed by the concluding section, considering the implications for research and practice.

2. Background literature

2.1. Development impact of increased ICT use in micro-firms

The development impact of ICT is manifested in its functions 'as both an enabling artefact and enabled set of social behaviours' (Thompson & Walsham, 2010, p. 113). Literature on ICT as an enabling artefact, particularly as a tool to improve business performance and competitiveness, is well-established. For micro-firms, ICT use presents distinctive advantages of affordability, flexibility, and efficiency, in terms of speed, reach, and coverage, to: share and obtain information and expertise (Aker, 2008; Ilavarasan & Otieno, 2018); access new markets and networks (Kuhn, Galloway, & Collins-Williams, 2016); market products (Felix, Rauschnabel, & Hinsch, 2017); connect with customers and coordinate value chain activities (Jagun, Heeks, & Whalley, 2008; Molony, 2009); improve operational efficiency (Esselaar, Stork, Ndiwalana, & Deen-Swarray, 2007); and configure cost-effective business models (Gerguri-Rashiti, Ramadani, Abazi-Alili, Dana, & Ratten, 2017). Technological advancements in ICT have increased practical options that suit the budget, skills level, and business activities of micro-firms.

ICT functions as an enabled set of social behaviours have received relatively less research attention. Increased ICT use reinforces certain business behaviours and attributes, often lacking in micro-firms, that are needed to enhance firm competitiveness and growth. By strengthening connectivity and reducing information asymmetries, ICT could raise micro-firms' awareness of emerging market trends, facilitate relationship building (Duncombe, 2016) and be alert and responsive to changes to enhance sustainability (Barba-Sanchez, Martinez-Ruiz, & Jimenez-Zarco, 2007). Similarly, ICT use promotes information-based business decision-making (Christoph, Enrico, & Alison, 2013; Donner & Escobari, 2010); planned coordination capacity (Jagun et al., 2008); skills learning (Oyelaran-Oyeyinka & Lah, 2006); and the strategic intent and confidence of micro-firms in business management and expansion (Matthews, 2007). Thus, ICT could alter the behaviour of micro-firms that are typically reactive to changes, short-sighted, and lacking in strategic intent to develop and grow their businesses (Chibelushi & Costello, 2009; Donner & Escobari, 2010; Jones et al., 2014).

In sum, it is this double effect of ICT that can foster a more vibrant, dynamic and well-equipped micro-firm sector in anticipation of the digital economy, and empower these firms to become driver of domestic entrepreneurship, innovation, productivity growth, and business competitiveness (Paunov & Rollo, 2016).

2.2. Status of ICT use by African micro-firms

ICT use by African micro-firms remains low (Foster et al., 2018; Wamuyu, 2015), and is largely limited to basic day-to-day telephony and communication purposes, such as real-time information search, contacting customers or suppliers, and basic marketing activities (Donner & Escobari, 2010). In the study by Deen-Swarray, Moyo, & Stork (2013), many micro-firms even reported having no need for ICT. This led Murphy et al. (2014, p. 279) to warn that the current basic level of ICT use in most micro-firms does little to improve and upgrade their

business development capabilities.

There is empirical evidence of more integrated and advanced ICT use by some micro-firms, for example, to digitalise business transactions and operation systems, support administration, manage customer and partner relationships, and plan and coordinate core value chain activities (e.g. Boadi, Boateng, Hinson, & Opoku, 2007; Jagun et al., 2008; Molony, 2009). However, such cases remain scarce (Donner & Escobari, 2010; Murphy et al., 2014). Deepening and broadening ICT use is crucial to ensuring the economic inclusion of micro-firms in increasingly digitalised business contexts.

2.3. Challenges and opportunities for increasing ICT use in African businesses

2.3.1. External ICT innovations driving increased ICT use

External factors such as slow and unreliable networks, high costs, limited availability, and low service quality negatively affect the value for money of even basic ICT use in business, especially among micro-firms generally deficient in resources (Donner & Maunder, 2014; Kabanda & Brown, 2017). Africa remains the world's least connected region, with limited ICT infrastructure and among the most expensive ICT services (see Table 1). The generally low penetration of ICT into African businesses also implies low peer pressure to use this technology (Deen-Swarray et al., 2013; Obiri-Yeboah, Owusu-Ansah, & Odei-Lartey, 2013).

There is a positive outlook in Africa that home-grown ICT applications and services that meet local business conditions and needs, such as mobile money or trading and accounting applications, will accelerate the uptake of ICT in business (GSMA, 2017; World Bank, 2012). For example, there are 19 African countries, including Zambia, with more mobile money accounts than bank accounts (GSMA, 2017), attracting millions of dollars in investment and employing thousands of cash agents and retailers, majority of which are micro-firms (The

Economist, 2017). As more individuals and firms accept mobile money payment systems, a unique opportunity arises for micro-firms to move toward cashless payments.

These indigenous applications and services are developed with local constraints in mind, such as infrastructure, skills, and technologies. They tend to be cheaper, simpler, more compatible, and easier to adopt for even micro-firms (Ilavarasan & Otieno, 2018). For example, indigenous mobile money applications are driving the mobile money revolution and promoting financial inclusion (Bhan, 2014; Heeks, 2018; Marincola, 2015). Other tailored mobile applications are also helping firms to circumvent physical infrastructure barriers, allowing businesses in remote places to access timely market and logistics information, which helps to improve the planning, pricing, and coordination of product inputs and outputs (Aker, 2008; Boadi et al., 2007; Duncombe, 2016). It is expected that affordable and compatible native applications and services for resource-constrained micro-firms will continue to flourish, driving firm productivity and competitiveness across the continent (GSMA, 2017).

In sum, there is hope that the growth of ICT will create and improve access to new business opportunities. Numerous African countries have reported double-digit growth rates in the ICT sector in 2016, with Ghana at 18.8% and Zambia (our focal country) at 40%. This growth is driven by network infrastructure development (e.g. fibre optics, data centres), the rapid expansion of regional ICT markets, and falling costs of broadband, which are collectively increasing the availability and affordability of enhanced ICT services (Analyse Africa, 2016).

2.3.2. Internal firm factors influencing ICT use by micro-firms

Amid improvements and emerging opportunities in the external environment, there are internal hindrances to increasing ICT use by micro-firms. Resource-deficiency (in terms of capital, personnel, skills/knowledge, and information) is commonly regarded as a major inhibitor of micro-firms' technology readiness and awareness (Wamuyu, 2015). However, cheaper and

simpler ICT applications are now available, government promotion is intense, and some ICT forms, such as mobile phones, are close to ubiquitous even in developing countries (Murphy et al., 2014). In this regard, the influence of affordability, skills, and awareness may not necessarily be deterministic (Chibelushi & Costello, 2009).

As some micro-firms evidently engage in diverse and more intensive use of ICT than peers in the same environment, differences in firms' perceptions of and attitudes toward the usefulness of ICT seem to be influential (Davis, 1989). Such firm differences could dwarf the perceived effect of external constraints on using the technology. Among various firm factors, some studies point to the entrepreneurial nature of firms as decisive to different perceptions and attitudes regarding ICT use, but understanding is yet to be enriched (Bengtsson, Boter, & Vanyushyn, 2007; Bharadwaj & Soni, 2007; Chew et al., 2013). Accordingly, more focused and deeper integration of the entrepreneurship perspective into the explanation of variations in ICT use among micro-firms is required (Simmons et al., 2011).

2.4. Entrepreneurial nature of firms and different ICT uses

The entrepreneurship perspective distinguishes entrepreneurial from non-entrepreneurial firms by their alertness to opportunities[1] and their willingness and ability to pursue them (Shane, 2003). Some suggest that the entrepreneurial–non-entrepreneurial differences in attitudes and behaviours toward developing and running a business are particularly sharp in environments of acute risks and uncertainties, as in the case of African micro-firms (Covin & Slevin 1989).

In any given situation, entrepreneurial firms are largely driven and poised to identify business opportunities, and to exploit these through innovation in products and/or production processes, creating a new market, developing a new or significantly improved way of organising resources, and using new materials to attain business goals (Stevenson & Jarillo,

[1] We adopt Shane's (2003, p. 18) definition of an entrepreneurial opportunity as 'a situation in which a person can create a new means-ends framework for recombining resources that the entrepreneur believes will yield a profit'.

1990). These firms are less intimidated by present constraints and assess resource investment (e.g. in ICT use) by the projected value of the opportunity they perceive rather than by present value (Eckhardt & Shane, 2003).

Based on the above understanding, we posit that entrepreneurial micro-firms are more likely than their peers to intensify ICT use in the face of the same external challenges and opportunities in the context of Africa. Further, these firms are expected to be more alert to which ICT uses are most relevant and useful to support their specific business objectives.

Entrepreneurial firms are commonly described as being proactive, innovative, risk-taking, and growth-oriented in pursuing business opportunities (Covin & Slevin, 1989; Penrose, 1995). *Proactiveness* denotes a firm's aspiration to shape the environment and pre-empt its competition. Firms that are alert to new opportunities and forward-looking in seizing them will be keen adopters and users of new technologies, including ICT (Lumpkin & Dess, 1996). One can expect these firms to be more eager, alert, and committed to keeping abreast of ICT developments, and to deploy the value of ICT use in seeking to stay ahead of their competitors (Bruque & Moyano, 2007; Levy & Powell, 2005). Such micro-firms endeavour to remain the first movers in the market, and so have a stronger urge to explore and exploit new business opportunities through using technology (Raymond, Bergeron, & Blili, 2005).

Innovativeness indicates 'a firm's tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes' (Lumpkin & Dess, 1996, p. 142). Entrepreneurial firms are innovative in nature. Firm innovativeness may take several forms and is manifested to various extents and degrees in business, whether in exploiting a new business idea or pioneering a novel and creative practice that may result in new goods, services, or technological processes. Passionate commitment to master the latest technological advances is considered to indicate innovativeness, with new technology seen as an integral part of innovation (Lumpkin & Dess,

1996, p. 143). This corroborates Rogers' (1983) belief that it is the innovators – the 'venturesome' – who lead in finding new ways of doing things and pioneer new technology diffusion. Thus, there is a broad understanding that innovativeness promotes firms' willingness and confidence to accelerate the use of ICT and exploit its opportunities more rigorously (Barba-Sanchez et al., 2007; Spiezia, 2011).

Risk-taking is demonstrated in a firm's willingness to take bold actions to pursue opportunities amid substantial risks. Investing in ICT can be risky for micro-firms given their limited resources and the uncertain returns from using the technology (Peppard, Ward, & Daniels, 2007). The direct and indirect costs of ICT use, including initial and subsequent investment in equipment acquisition and installation, and the capacity and skills needed to operate, maintain, manage, and continuously upgrade the technologies, can be substantial (Matthews, 2007). The impact of ICT use is often difficult to measure and assess, and it takes time to accrue (Peppard et al., 2007). Further, effective use of ICT requires long-term commitment and investment in changing existing organisational routines (Diaz-Chao, Sainz-Gonzalez & Torrent-Sellens, 2015), creating further operational challenges and resource burdens for micro-firms, as noted by Nguyen et al. (2015) and Wolcott et al. (2008). Limited expertise in detecting and handling ICT-related threats also imposes higher security and privacy risks for micro-firms (Grant, Edgar, Sukumar, & Meyer, 2014). In this regard, intensified ICT use represents a bold and confident manoeuvre of those micro-firms willing to commit scarce resources in the face of risks.

Growth-orientation manifests in firms' stronger ambitions to expand existing business scale and scope, in terms of factor inputs, processes, outputs, and/or geographical extent (Naldi & Davidsson, 2014). One distinctive advantage of ICT use is real-time connectivity across physical boundaries. Growth-oriented micro-firms that conduct or wish to conduct business beyond their local nexus would fully appreciate this advantage of ICT use alongside

conventional face-to-face contact in communication and building relationships (Jagun et al., 2008; Molony, 2009). In general, firms that expand their businesses beyond local markets have greater information needs (Duncombe, 2007) to cost-effectively and efficiently manage transactions and relationships with geographically dispersed customers, suppliers, and other business partners. Such firms are more likely to intensify and widen ICT uses to facilitate interactions and transactions across markets.

In brief, the four entrepreneurial attributes mentioned above may vary, and each may have unique effects on firms' behaviours – in this study, the choice and extent of ICT use – in a given operational context (Kreiser, Marino, Kuratko, & Weaver, 2013). This study aims to unveil the differences in ICT use by micro-firms exhibiting different entrepreneurial attributes.

3. Research methodology

3.1. Empirical context of Zambia

This study assesses the association between four entrepreneurial attributes and different categories of ICT use by micro-firms in Zambia—a landlocked country in southern Africa. Data were collected in Lusaka, the country's capital and main commercial centre. Zambia has made progress in promoting the MSME sector and ICT development since the 1990s. In the same period, it has achieved significant economic growth and seen entrepreneurship flourishing, especially among its youthful population. The country provides an intriguing context to derive relevant and useful insights for other African countries and developing contexts in general.

In terms of employee number, close to 96% of all firms in Zambia are micro-firms (Shah, 2012). The Global Entrepreneurship Monitor survey on Zambia observes a significant surge in entrepreneurial attitudes among its people (GEM, 2013). The survey specifically notes that, among all the economies surveyed that year, Zambia has the highest total early-stage

entrepreneurship activity (TEA) rate and one of the lowest rates for fear of failure. Most Zambian respondents, particularly among the younger generation, were found to hold positive attitudes towards entrepreneurship as a career choice and believe strongly in their capabilities to be an entrepreneur.

Zambia's relatively stable and competitive business environment, compared to that of its sub-Saharan African (SSA) peers, favours the spread of entrepreneurial spirit. Zambia has been ranked among the top ten in the SSA region in the World Bank's Ease of Doing Business survey for the last few years; in 2018, it ranks 6th of 48 countries in the SSA region and 85th of 190 countries globally. In the latest rankings, Zambia tops Kenya and South Africa in the 'Starting a Business' category; ranks 2nd in the SSA region for 'Paying Taxes'; and is in the Global Top-5 for 'Getting Credit' (World Bank, 2018).

At policy level, the country has specific policies in place to promote the development of the MSME sector and ICT. The 2008 MSME Policy set out clear strategies and designated implementing agencies, including the Zambia Development Agency and Citizen Economic Empowerment Commitment, to support actors in the MSME sector. An established network of associations – the Zambia Chamber of Small and Medium Business Associations - plays an active role in lobbying for government support.

Regarding ICT readiness, Zambia adopted its national ICT policy in 2007 and has set a vision for Zambia being transformed into an information and knowledge-based society and economy supported by consistent development and pervasive access to ICTs by all citizens by 2030 (Republic of Zambia, 2006). Availability of and accessibility to ICT in both urban and rural areas have improved over the years due to market liberalisation. Competition among the three major providers – ZAMTEL, MTN, and Airtel Zambia – has improved coverage and quality and driven down prices (Deloitte, 2013). The mobile penetration rate surged from 40% to over 70% between 2010 and 2016, while the internet penetration rate has also grown from a

mere 6% to over 25% in the same period (ITU, 2017). Access to submarine fibre optic cables further helps reduce the price of broadband services and increase the penetration of broadband internet.

Nevertheless, micro-firms in Zambia still face immense barriers to accessing and increasing the use of ICT. Zambia ranks 116th of 139 economies in the latest Global Information Technology Report (World Economic Forum, 2016), and 146th of 176 economies in the ICT Development index (ITU, 2017). It is lagging behind the lower-middle-income group average and its top-performing SSA peers in individual usage, skills, affordability, and infrastructure (World Economic Forum, 2016). Prices of both fixed broadband and mobile broadband remain far higher than in top-performing African countries (ITU, 2017). In this constrained business context, ICT use between entrepreneurial micro-firms and those that are conservatively managed or subsistence-based is expected to vary significantly (Chigunta, Chisup, & Elder, 2013). Table 1 presents the key ICT development and entrepreneurship indicators for Zambia.

[Table 1 near here]

3.2. Sampling and data collection

Three sampling criteria were used in this study. First, only micro-firms with between 1 and 10 employees, excluding the owner(s), were included. This follows the formal Zambian definition of micro-firms in the Small Enterprise Development Act 1996 (National Assembly of Zambia, n.d.). The cut-off of 10 employees is also consistent with the definition of the EU and existing studies on African enterprises (e.g. Duncombe & Heeks, 2002; Kyobe, 2004). Headcount was used as the sole criterion of firm size because turnover, market size, and profitability are generally unavailable for micro-firms (Kyobe, 2004). Second, only independent indigenous firms were included. Finally, owners – the key informant and decision-maker of micro-firms – had to be able to personally participate in the survey (Jaouen & Lasch, 2015).

The lack of credible and comprehensive directories of micro-firms makes postal and/or online surveying difficult and/or unreliable. Given our resource constraints and the wide geographical spread of micro-firms in Lusaka, local business service providers and national statisticians were consulted to identify three localities known to have a high concentration of micro-firms meeting our criteria. This also helps to control for variations in external factors, since all firms in the sample operate in a similar external environment.

Personal cold-calling was conducted to target and survey respondents in the three localities (within the Kalingalinga-Mutendere area and the central business district), with the intention of covering the whole population of micro-firms in the localities. This method is deemed practical and achievable in the context of Africa due to the general lack of reliable and up-to-date records of firms and their physical addresses (Donner, 2007). More importantly, this method prevented the exclusion of firms not affiliated with business associations and/or not recorded in any physical and/or online directories. Using a face-to-face survey method helped to improve responses in a context in which personal contact is important. It also allowed the researchers to clarify questions immediately if needed, and to maintain the consistency of respondents' understanding. In total, 259 completed usable questionnaires were obtained from firms visited in the selected localities. Table 2 summarises the descriptive statistics of the sample firms.

[Table 2 hear here]

3.3. Regression models, constructs, and measures

To address our main research question, we used hierarchical multiple regressions to investigate the association between the four entrepreneurial attributes and different categories of ICT use by micro-firms in our sample. The following subsections explain the constructs and their measurements used in the regression models.

Dependent variables: Categories of ICT use in business

Each respondent was asked to indicate the level of their firm's ICT use in a range of 18 business activities using a 5-point Likert scale (1 = 'Not at all', 5 = 'All the time'). These activities were consolidated and revised based on various prior studies describing categories of ICT use by small firms, including Esselaar et al. (2007) and Obiri-Yeboah et al. (2013). Employing a list of ICT uses provides specific details on the breadth and depth of ICT use in business, which cannot be fully revealed using one aggregate measure of ICT usage (e.g. total device count or average frequency of mobile and/or internet use), as adopted in most studies (Hall et al., 2012; Raymond et al., 2005). After conducting a preliminary exploratory factor analysis (EFA) of these 18 items, 1 item was removed based upon low loading (> .30). We re-ran the EFA on the remaining 17 items; all were retained for the CFA analysis. Additional 3 items were then removed due to exceptional low CFA loading than others (>.50). Finally, 14 items were retained for further factor and regression analyses.

Independent variables: Four entrepreneurial attributes of firms

To measure the entrepreneurial firm attributes of 'proactiveness', 'risk-taking', and 'innovativeness', we primarily adapted Covin and Slevin's (1989) 9-item scale. We simplified the wording of some original statements to meet the level of literacy and understanding of our targeted respondents, based on feedback from a pilot test on 25 micro-firms. These modifications ensure consistent interpretation by our respondents.

To measure 'growth orientation beyond local markets', we adapted Burpitt and Rondinelli's (1998) 4-item scale. The original scale was designed to measure a firm's foreign market growth orientation. We modified 'foreign markets' to the more generic 'markets beyond the local markets' in our questionnaire to better suit the business realities of our sampled micro-

firms, which rarely have a foreign business. This also serves to ensure consistent understanding of the respondents.

We used a 5-point Likert scale to measure all four entrepreneurial firm attributes. Respondents were asked to indicate whether they agree or disagree with 13 statements in mixed-order (1 = 'Strongly disagree', 5 = 'Strongly agree'). EFA was conducted on the 27 observed variables measuring ICT use (14 variables) and entrepreneurial attributes (13 variables) using the principal axis factoring (PAF) extraction method and oblique rotation (direct oblimin). We chose EFA over principal component analysis because our aim is to reveal and interpret the unobserved latent constructs (factors) that cause the observed variables to covary, rather than to simply reduce the observed variables into a smaller number of factors (Conway & Huffcutt, 2003). PAF is preferred for a relatively simple factor pattern and to reveal weak factors (De Winter & Dodou, 2012). This extraction method is often used in ICT for development research (e.g. Ghobakhloo & Tang, 2015). The Kaiser-Meyer-Olkin measure of 0.858 verified sampling adequacy for the analysis, while Bartlett's Test of Sphericity was significant (X^2 (406) = 4991.546, p=0.000), which suggests that structure detection is appropriate.

EFA returned seven latent factors with eigenvalues over Kaiser's criterion of 1, explaining close to 64% of the total variance. The results showed a reasonable level of unidimensionality; that is, each observed variable loaded highly on only one factor. After examining the correlation coefficients, scree plot, and factor loadings, we interpreted and grouped the observed variables into seven factors. Three factors were interpreted to measure the intensity of three categories of ICT use in business: 'Online Transaction and Interaction'; 'Online Information and Network Access'; and 'ICT for In-House Operation Systems'. In alignment with our measures, four entrepreneurial attributes of micro-firms: 'Proactiveness';

‘Risk-Taking’; ‘Innovativeness’; and ‘Growth Orientation Beyond Local Markets’ were extracted. Table 3 presents EFA factor loadings of the items.

[Table 3 near here]

We conducted confirmatory factor analysis using AMOS for checking the convergent and discriminant validity of the seven latent factors resulting from EFA. Standardised loadings of the majority of retrained observed variables of the seven latent factors exceed the ideal threshold of 0.7, with some falling between 0.6 and 0.7, thus exceeding the recommended acceptable threshold of 0.5 (Hair, Black, Babin, Anderson, & Tatham, 2006). The composite reliability and the average variance extracted (AVE) exceed their respective acceptable thresholds of 0.7 and 0.5, showing that convergent validity is adequate (Fornell & Larcker, 1981). Internal consistency is confirmed by Cronbach’s alpha values exceeding the recommended level of 0.70 for all seven constructs (Nunnally, 1978). Discriminant validity was also confirmed, with both the maximum shared variance and the average shared variance lower than the AVE, and the square root of AVE greater than the inter-construct correlations. The measurement model achieved acceptable fit statistics: Chi-squared = 586.274, df = 297, CMIN/df = 1.974, CFI = .934, TLI =.922, AGFI = .824, SRMR = .071, RMSEA = .061 and PCLOSE = .06 (Hu & Bentler, 1999; Marsh, Hau, & Wen, 2004). Table 4 presents findings on internal consistency, CFA item loading, convergent validity, and discriminant validity data for the seven constructs; Table 5 then presents the correlation matrix of the seven constructs with the square roots of AVE included.

[Table 4 and Table 5 near here]

Control variables

The study includes six control variables in the multiple regression analysis. ‘***Firm size’*** is measured by the number of employees at the time of the survey. Firm size is the most widely cited factor influencing ICT adoption. Abundant studies confirm that firm size, as a proxy for

a firm's resource base, is positively related to ICT adoption (Bengtsson et al., 2007). Despite our focus on micro-firms, the range from 1 to 10 employees still presents difference in firm resources. Therefore, firm size is included as a control variable. '***Firm age'*** is measured by the time lapse between the firm's founding year and the year of data collection. Firm age is an important measure of the firm's flexibility to accept and adopt new technologies like ICT. Younger firms are considered more flexible and dynamic. Specifically, it is suggested that younger firms possess the advantages of newness in learning and adopting new business practices and technologies (Bruneel, Yli-Renko, & Clarysse, 2010). However, the association between firm age and ICT use remains inconclusive in prior research (Thompson, Kwong, & Jones-Evans, 2012). '***Industry***' is a dichotomous variable, with '0' referring to firms in secondary sectors (production, construction, utilities) and '1' to those in tertiary (service) sectors. Simmons et al. (2011) suggest that business conditions in specific industries influence the need for ICT use; however, investigations of sectoral influence have yielded mixed results.

'***Gender of the owner***' is operationalised as a dichotomous variable, with '0' referring to male and '1' to female; and '***Age of the owner-manager'*** was captured by six age bands: 1 = 20 or under; 2 = 21 to 30; 3 = 31 to 40; 4 = 41 to 50; 5 = 51 to 60; and 6 = over 60 years old. Owner characteristics are the main factors influencing micro-firms' acceptance and adoption of new technologies, including ICT (Jones et al., 2014). Specifically, younger generation business owners are generally found to be more receptive to ICT adoption (Eze et al., 2011; Meyer, 2008), and gender seems to influence ICT usage behaviours (Venkatesh & Morris, 2000). '***Skill problem'*** is a dichotomous variable based on whether respondents report that 'lack of skills' presents a challenge to using ICT in their business: '0' is assigned where this is not perceived as a challenge, and '1' otherwise. Skill shortage is pinpointed as a main hindrance to micro-firms increasing their use of ICT beyond elementary communication

purposes (Mutula & van Brakel, 2007). Table 6 presents the correlations and descriptive statistics of all variables used in the analysis.

[Table 6 near here]

Common method variance

Since data for both the dependent and independent variables were collected from one respondent in each firm at one point in time, potential common method bias was assessed. We first tested common method variance (CMV) using Harman's single factor analysis. One general factor did not account for the majority of variance (30%). This suggests that CMV should not substantially affect the study's results.

For all six models, the variance inflation factor values are close to 1 and the tolerance statistics well below 0.2, suggesting that multicollinearity is unlikely to be a problem within our data (Ghobakhloo & Tang, 2015). Table 7 summarises the regression results.

[Table 7 near here]

4. Findings and discussion

Among the three categories of ICT use in business, our sampled micro-firms generally use ICT more intensely for 'Online Information and Network Access' (x = 3.72, s=0.96) and less intensely for 'Online Transaction and Interaction' (x = 2.98, s=1.30) and 'ICT for In-house Operation Systems' (x = 2.75; s=1.63) (see Table 6). However, very high ICT use (i.e. maximum score on the Likert Scale) was reported by 25% of respondents for 'Online Transaction and Interaction' and by one-third for 'ICT for In-house Operation Systems'. The findings thus show that some micro-firms in our sample have engaged in broader ICT uses, beyond common information access and communication functions. The increasing number of ICT tools and platforms that are accessible, affordable and simple to use may explain the observed broad use of ICT by micro-firms.

The regression results demonstrate that the four entrepreneurial attributes differ in the significance and strength of their association with each ICT use category.

Firm 'proactiveness' is positively and significantly associated with 'ICT for In-house Operation Systems' ($\beta = 0.121$, $p = 0.071$). Integrating ICT applications into firms' operation systems can generate a more transformational effect on reducing costs and improving operational efficiency (Murphy et al., 2014). However, it also demands higher resource investment, skills, and commitment to change and adapt existing operational routines and systems to match ICT applications. The required organisational changes tend to deter most resource-constrained micro-firms from increasing ICT use for this purpose (Jones et al., 2014; Matthews, 2007; Oyelaran-Oyeyinka & Lal, 2006). Therefore, it is logical to find that more proactive firms – those that are forward-looking and assertive to stay ahead of the competition – are willing to commit to digitalising internal operational systems through ICT, in order to realise the proclaimed efficiency gains essential to business competitiveness.

'Innovativeness' is the most consistent predictor of the extent of all three categories of ICT use by the studied micro-firms: it is significantly associated with 'Online Transaction and Interaction' *($\beta = 0.138$, $p = 0.030$)*; 'Online Information and Network Access' *($\beta = 0.182$, $p = 0.006$)*; and 'ICT for In-house Operation Systems' *($\beta = 0.180$, $p = 0.050$)*. These findings broadly support existing understanding that 'innovativeness' leads to higher ICT use in smaller firms (AlBar and Hoque, 2017; Barba-Sanchez et al., 2007). More importantly, our results provide clearer insights into how innovative firms see and exploit the diverse functionalities of ICT use to enable innovations in business development.

The significant influence of innovativeness across all categories of ICT use highlights two important insights into the practice and realisation of innovation in entrepreneurial firms. *First*, innovative micro-firms involved in the process of developing new products or processes and/or entering a new market are more receptive to deploying ICT in a broader range of

business activities beyond common communication purposes (Lumpkin & Dess, 1996). These firms are more likely to appreciate the advantages of ICT as a multi-functioning, cost-effective means to enhance connectivity for the acquisition of new information, knowledge, and technology to facilitate and upgrade their innovation capabilities (Barnes et al., 2012; Gielnik, Kramer, & Kappel, 2014). *Second*, these firms hold a more holistic view toward embedding innovations throughout the organisation, rather than narrowly focusing on creating end product innovations (Gallego, Gutierrez, & Lee, 2015; Higon, 2012). They tend to integrate new technologies to create an ICT-enabled business model and both operational and organisational system innovations (Spiezia, 2011). Further, these firms adopt innovative approaches to optimising ICT solutions for their business needs (Simmons et al., 2011). In sum, the findings show that innovative firms see and deploy ICT both as a supporting tool (i.e. an input and process) to create business innovations and as an integral part of innovative outputs (e.g. digitalised products) (Glavas & Mathews, 2014). This elaborates Rogers' view (1983) on how innovators pioneer new technology diffusion.

'Risk-taking' is only significantly and positively associated with the ICT use category 'Online Information and Network Access' ($\beta = 0.127$, $p = 0.046$). Cheaper, simpler, and more flexible real-time access to a large pool of readily available information and knowledge, and to potential business contacts from diverse sources, presents a high risk of information overload and security concerns (Mutula & van Brakel, 2007). These include risks of cybercrimes such as scam and fraud activities, computer virus attacks, and privacy violations that most micro-firms are ill-equipped to recognise, assess, and manage (Serianu, 2016). Even micro-firms in developed countries are limited in this regard: for instance, in a recent survey of UK SMEs, only 4% had plans to counter cyber-attacks, with the majority unable to bear the cost of doing so (Federation of Small Businesses, 2016). Risk-taking firms tend to be more alert and ready to anticipate, assess, and counter risks associated with acquiring and accessing business

information and contacts through external sources (Perren, 1999). This explains why more risk-oriented firms are often more at ease and willing to increase ICT use to exploit external, impersonal sources of information and new business contacts, compared to risk-averse firms (Hsieh & Kelly, 2016).

'Growth orientation beyond local markets' is significantly and positively associated with two categories of ICT use: 'Online Information and Network Access' ($\beta = 0.180$, $p = 0.001$) and 'Online Transaction and Interaction' ($\beta = 0.115$, $p = 0.030$). Firm growth is often discussed as a beneficial outcome of increased ICT use in business (Matthews, 2007; Simmons et al., 2011). Conversely, stronger intention to grow and capture new markets can be a major internal driver for increasing ICT use (Levy & Powell, 2005; Ongari, 2009). Our findings support this notion and further show that growth-oriented firms find two categories of ICT use particularly important to support geographic business expansion. Growth-oriented firms are often heavy networkers that actively identify and exploit ways to link with prospective customers and business partners (Raymond et al., 2005; Stevenson & Jarillo, 1990). It is easier for firms that aspire to expand beyond their local markets to envision the advantages that ICT presents over other conventional means for accessing information and knowledge about new markets; marketing and promoting the business outside their locations; connecting, communicating, and transacting with spatially distant customers, suppliers, and business partners (Mathews, Healy, & Wickramasekera, 2012; Rosenbaum, 2017).

From an ICT perspective, the results can be interpreted to suggest that *'Online Information and Network Access'* is far more significantly linked to entrepreneurial micro-firms in Africa than other categories of ICT use, as this category of ICT use is associated positively with firms that are innovative, risk-taking, and geographically growth-oriented. It would, therefore, seem that further promotion and facilitation of ICT use in '*Online Information and Network Access'* could help stimulate and encourage innovativeness and

growth orientation among entrepreneurial micro-firms, especially if the risks of using ICT in these activities are reduced. ICT use in '*Online Transaction and Interaction'* is positively associated with innovativeness and geographical growth orientation of firms. This indicates that innovative and growth-oriented firms would appreciate and have a stronger need for platforms that enable them to service distant markets. *Finally,* ICT use in '*In-house Operation Systems*' maps to firms that are proactive and/or innovative. This may indicate that integrating ICT applications into micro-firms' internal enterprise operations is gaining recognition as a means to free up resources (e.g. time, finance, and manpower) that could be reallocated to driving innovation and staying ahead of competitors. Taken together, different ICT applications seem to offer varying advantages for different entrepreneurial firms.

Regarding the control variables, the significant negative association between 'age of the owner-manager' and all three ICT use categories suggests that younger owner-managers tend to deploy ICT more broadly and intensively in their businesses than older owner-managers. These findings support the belief that younger generation owner-managers are faster and more responsive in learning ICT-related skills and adopting the technology in business (Higon, 2012). Conversely, older generation business owners are generally more sceptical and risk-averse in using the technology and adapting to the changes it may bring to business operations (Eze et al., 2011). In the specific context of Africa, where mobile and internet technology has only recently taken off, ICT literacy and awareness among older business owners are generally limited (Afolayan, Plant, White, Jones, & Beynon-Davis, 2015). The younger generation, by contrast, sees ICT almost as an indispensable part of daily life (Kalan, 2013).

It is surprising to find that 'firm size' – measured by number of employees and an important proxy for the level of firm resources – was only significantly and negatively associated with one ICT use category, that is, 'ICT for In-house Operation Systems' (β = -

0.120, p = 0.044). Penrose (1995, p. 33) stressed that it is the 'spirit of enterprise - a general entrepreneurial bias in favour of growth' that has the greatest influence on a firm's decisions on how and where resources are invested in pursuing the firm's business goals. To a large extent, this finding complements our argument that entrepreneurial firm attributes enhance explanations of variations in ICT use by micro-firms.

4.1. Implications for research

A number of implications for the ICT-for-development community, entrepreneurship researchers, and policy-makers can be drawn from our work and findings. *For the ICT for development community*, there are at least three main implications given the rapid sectoral changes. *First*, treating ICT as a single technology fails to reveal its multi-functionality, thus, providing only generalised results and insufficient insights into the needs of micro-firms (Hall et al., 2012). Supporting Ilavarasan's (2017) call for more subgroup and disaggregated analyses in ICT for development studies, this research shows that finer disaggregation of ICT uses is important to pinpoint ICT preferences and needs of micro-firms in the same context. Accordingly, the reasons for and factor conditions that encourage or hinder firms' individual uses of the technology can be more clearly identified.

Second, the definition of basic and sophisticated ICT use may need to be redefined given the rapid technological changes in ICT applications. For example, e-commerce is conventionally seen as more sophisticated use of the technology than information access and communication. However, the existence of user-friendly and wide-reaching third-party e-commerce platforms has made conducting online transactions a less complex activity for micro-firms than managing their own website for one-way information provision. Similarly, information search and utilisation may require more specialised skills and sophisticated business intelligence systems than adopting third-party software for internal business operations (e.g. accounting and sales). In this respect, the distinction between basic and

sophisticated use of ICT is determined more by the level of use and strategic alignment to the firm's business orientations and needs than by the characteristics of ICT applications.

Third, this research defines three specific categories of ICT use based on existing lists of business applications in firms. Novel applications of the technology, such as big data, blockchain, and artificial intelligence, are emerging rapidly, and existing applications are also evolving. These novel applications are not fully included in existing classifications of ICT applications. Therefore, ICT experts should endeavour to generate new classifications and categories of ICT use to inform future research and their development impact (Duncombe, 2016).

For entrepreneurship researchers, our work reinforces the belief that different entrepreneurial attributes may exist independently and impact firm decisions and behaviours in different ways. Thus, taking entrepreneurial orientation as a unidimensional construct will conceal distinct influences of these attributes on firm behaviours (Kreiser et al., 2013). While our study captures four measurable entrepreneurial attributes, research to test other equally important attributes (e.g. the need for autonomy and aggressiveness proposed by Lumpkin and Dess, 1996) may enrich the picture. Given their predominance in economies, micro-firms deserve research attention as a distinct group of firms.

Our study examines the effect of entrepreneurial attributes on different ICT uses. However, research is needed on the extent to which different ICT uses affect or alter micro-firms' attitudes and behaviours towards business development and growth. This will enrich knowledge of the impact of ICT as an enabled set of attitudinal and behavioural orientations influential to social and economic development, as indicated by Chew, Ilavarasan, & Levy's (2015) finding that ICT use enhances female entrepreneurs' perception of empowerment. This could build on our findings that different ICT applications are more desirable for firms exhibiting different entrepreneurial attributes.

4.2. Implications for policy

Given the importance of entrepreneurial firms in creating jobs and wealth, policy-makers may wish to advance the infrastructure and services that promote and enhance the ICT categories that are used by all entrepreneurial firms or by those firms whose attributes are key to achieving national priorities. For instance, online transaction and interaction are more important to firms that are growth-oriented. It may be argued that promoting the use of this category of ICT applications – such as those enabling online purchases, payments, and direct sales to customers – may favour growth-oriented micro-firms. Early efforts in Zambia include the e-Voucher cashless payments system for secure payments between farmers and input suppliers (Paymal, 2018), and Zambia National Farmers Union's online platforms for transport and market prices for commodities, which have helped to reduce risks and costs, improve value-chain efficiency and market access, and increase business volumes (Halewood & Surya, 2012). Besides mobile money, such efforts remain limited to sectors such as agriculture and health. Given the importance of growth-oriented firms in creating jobs and wealth, governments may wish to encourage the emergence of similar online systems for micro-firms in the secondary and tertiary sectors.

Efforts could also be devoted to creating awareness and improving the security of ICT applications in order to encourage trust and build micro-firms' confidence in ICT use for broader business purposes. The first Zambia E-Commerce Expo held in June 2018 provides a good example. However, these efforts tend to address larger firms, rather than micro- (or even small) firms. Therefore, similar efforts that target micro-firms with tailored products, services, and themes are warranted. This is supported by our finding that size does not seem to have notable influence on ICT use among micro-firms.

This research supports the observation that younger owner-managers use all categories of ICT more intensively than their older peers. For a continent that is largely young (median

age is about 18), efforts to ensure greater, deeper, reliable, and secure ICT services could drive ICT use and entrepreneurial firms in general. Some current initiatives by African governments to discourage the use of social media, through taxes on voice over internet protocol platforms such as Skype, Viber, and WhatsApp, may be counter-productive.

While gender seems to have no effect on ICT use among micro-firms in general, the low female ownership of micro-firms in the secondary and tertiary sectors warrants attention. Only 23% of the micro-firms we randomly sampled are owned and/or managed by females, which is a very low proportion. Efforts to encourage women entrepreneurs to enter the secondary and tertiary sectors are urgently required.

4.3. Limitations

With respect to this study's limitations, we drew data from micro-firms in an urban city in only one African country due to our resource constraints. Although we believe that this study's major implications are not limited to this research context, replicating our approach using micro-firms in other African and developing country contexts, and in both urban and rural settings, will improve the generalisability of our findings. Another potential limitation is that data were collected from only one key informant in each firm given that micro-firms have 10 or fewer employees. While our test for common method bias did not find it a problem, data from more than one informant for each firm will enable triangulation and eliminate concern over subjective bias. Our research primarily used self-reporting perceptual measures. Introducing some objective measures in future studies will reduce potential self-report bias and enhance the representativeness of the findings. Finally, introducing longitudinal and other innovative research designs such as experimental methods as proposed by Ilavarasan (2017) could enrich findings of cross-sectional analyses adopted in this study.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding

The survey for this work was partially funded by British Academy Research Grant [SG121373] and Adam Smith Research Foundation (ASRF) Seedcorn Fund.

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Table 1 Basic country information and key ICT and entrepreneurship indicators of Zambia

- A landlocked country located in southern Africa.
- A population of 16.6million; a density of about 22 inhabitants per square km.
- Depend on mining, services and agriculture.
- Low middle income: GDP per capita of $1,269 in 2016 according to World Bank data.
- Former British colonies and thus use English as official language.
- Have an open telecommunication market, with four operators – Airtel and MTN (mobile only), Zamtel (mobile and fixed line), and Vodafone Zambia (data only).
- Have made excellent progress in introducing supportive initiatives and policies to promote entrepreneurship and the use of ICTs.

Selected ICT and Entrepreneurship Indicators	**Top Performer in Sub-Saharan Africa**	**Zambia**	**Africa**	**Developing World Average**	**World Average**
ICT-related (mobile and internet) indicators					
Networked Readiness Index with 7 as the highest score (among 139 economies)[1]	4.4 (45) Mauritius	3.2 (116)	3.2	-	-
ICT Development Index with 10 as the highest score (among 176 economies) [2]	5.88 (72) Mauritius	2.54 (146)	2.64	4.26	5.11
Internet penetration (per 100 inhabitant) [2]	54% South Africa	25.51%	19.9%	39%	45.9%
Mobile cellular penetration (per 100 inhabitants) [2]	14.13% South Africa	72.43%	74.6%	96.3%	101.5%
Unique mobile subscription[3]	--	40%	46%	59%	63%

Active mobile broadband penetration (per 100 inhabitants) [4]	67.9% Botswana	32.2%	22.9%	43.6%	52.2%
Fixed (wired) broadband penetration (per 100 inhabitants)[2]	16.84% Mauritius	0.19%	0.4%	8.7%	12.4%
Mobile broadband prices 500MB (% GNI pc)[2]	0.7 Mauritius	7.8	9.3	-	3.7
Mobile broadband prices 1GB (%GNI pc)[2]	1.0 Mauritius	10.2	17.7	-	6.8
Fixed broadband prices (% GNI pc)[2]	0.3 Mauritius	19.5	39.4		13.9

ICT-related indicators: [1] World Economic Forum 2016; [2] ITU, 2017; [2] GSMA, 2016; [4] ITU/UNESCO Broadband Commission 2017

Entrepreneurship indicators (GEM, 2013, with 8 SSA countries included in the survey)					
Entrepreneurial Intension[1]	66.7% Malawi	44.5%	46.8%	-	-
Total Early Stage Entrepreneurial Activity[2] (TEA)	39.9% Nigeria and Zambia	39.9%	21.58%	-	-
Perceived opportunity[3]	84.7% Nigeria	76.8%	68.9%	-	-
Perceived capabilities[4]	89.5% Malawi	79.6%	74%	-	-
Fear for failure rate[5]	15% Uganda	15.4%	24.5%	-	-
Nascent entrepreneurship rate[6]	22.6% Zambia	22.6%	11.55%	-	-

Entrepreneurship indicators: GEM, 2013

The 8 sub-Saharan countries included in this global survey are: Angola; Botswana; Ghana; Malawi; Nigeria; South Africa; Uganda; and Zambia.

1. Percentage of 18-64 population who are expecting to start a new business within the next three years.
2. Percentage of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business.
3. Percentage of 18-64 population (individuals involved in any stage of entrepreneurial activity excluded) who see good opportunities to start a firm in the area where they live
4. Percentage of 18-64 population (individuals involved in any stage of entrepreneurial activity excluded) who believe they have the required skills and knowledge to start a business
5. Percentage of 18-64 population (individuals involved in any stage of entrepreneurial activity excluded) who indicate that fear of failure would prevent them from setting up a business
6. Percentage of 18-64 population who are currently a nascent entrepreneur, i.e., actively involved in setting up a business they will own or co-own; this business has not paid salaries, wages, or any other payments to the owners for more than three months

Table 2 Descriptive Statistics of Sample Firms (n=259)

	Mean	S.D.	Min - Max	Median	Mode
Firm Size	5.59	3.008	1 - 10	5	10
Firm Age	9.54	7.399	1 - 42	8	4
	Frequency	**Percentage (%)**			
Owner's Age					
20 or under	0	0			
21-30	57	22			
31-40	94	36.3			
41-50	71	27.4			
51-60	26	10			
Over 60	11	4.2			
Owner's Gender					
Male	199	76.8			
Female	60	23.2			
Industry*					
Secondary	**53**	**20.5**			
Section C: Manufacturing	*45*				
Section F: Construction	*8*				
Tertiary	**206**	**79.5**			
Section G: Wholesale and Retail; Repair of Motor Vehicles	138				
Section H: Transportation and Storage Services	8				
Section I: Accommodation and Food Services	23				
Section M: Professional, Scientific & Technical Services	6				
Section N: Administrative and Support Services	9				
Section S: Other Services (e.g. hairdressing; personal services; consumable repair)	22				

*First classified based on The International Standard Industrial Classification (ISIC) Revision 4 (https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf) and further grouped into two categories: Production (0) and Tertiary (1) as a control variable in the analysis.

Table 3: EFA Loadings of Retained 27 Observed Variables Using Principle Axis Factoring Method

	Factor						
	1	2	3	4	5	6	7
Online Purchase from Suppliers	**.848**						
Online Billing and Payment	**.666**						
Handle Customer Enquiry and Feedback	**.650**						
Conduct Banking Services	**.628**						
Online Selling to Customers	**.614**						
Recruit Staff	**.374**						
My firm is very interested in expanding business beyond the local market.		**.888**					
My firm believes it will have higher possible gains by doing business outside the local market.		**.874**					
My firm sees its most attractive opportunities for growth lie beyond the local market.		**.831**					
My firm believes doing business beyond the local market is the way to achieve success.		**.824**					
My firm initiates actions first rather than respond to competitors' acts.			**.642**				
My firm introduces products, services and processes to market earlier than competitors.			**.565**				
My firm adopts a highly competitive, 'undo-the competitor' business posture.			**.529**				
Find customers				**-.766**			
Market and promote products				**-.717**			
Find partners/ investors				**-.678**			
Learn business skills and knowledge				**-.609**			
Source technology to improve products and processes				**-.552**			
My firm introduced many new lines of products and services in the past five years.					**-.830**		
My firm emphasises innovative ideas, products and services.					**-.715**		
My firm made many dramatic changes in products and services in the past five years.					**-.504**		
My firm takes bold and aggressive actions to exploit opportunities in uncertain situations.						**.707**	
My firm takes bold and wide-ranging acts to achieve the firm's objectives.						**.701**	

My firm favours high risk projects with chances of very high returns.						**.617**	
Develop in-house business applications and tools							**-.857**
Support in-house business systems (e.g. data storage; administration)							**-.791**
Download software for operational use							**-.723**

Extraction Method: Principal Axis Factoring.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 14 iterations.

Table 4. Internal consistency, convergent validity and discriminant validity data of the constructs

Latent Factor	Number of Items	Items	Cronbach's alpha	CFA Item Loading	Composite reliability	AVE	MSV	ASV
Online Transaction and Interaction	**6**	• Online Purchase from Suppliers • Online Billing and Payment • Handle Customer Enquiry and Feedback • Conduct Banking Services • Online Selling to Customers • Recruit Staff	0.896	0.86 0.84 0.69 0.70 0.81 0.69	0.90	0.59	0.58	0.21
Online Information and Network Access	**5**	• Find Customers • Market and Promote Products • Find Partners/ Investors • Learn Business Skills and Knowledge • Source Technology to Improve Products and Processes	0.842	0.70 0.80 0.70 0.68 0.74	0.85	0.52	0.35	0.18
ICT for In-house Operation Systems	**3**	• Develop in-house ICT business applications and tools • Support in-house business systems (e.g. data storage; administration) • Download software for operational use	0.935	0.95 0.89 0.90	0.94	0.83	0.58	0.19
Proactiveness	**3**	• My firm initiates actions first rather than respond to competitors' acts. • My firm introduces products, services and processes to market earlier than competitors • Adopts a highly competitive, 'undo-the competitor' business posture.	0.845	0.82 0.82 0.78	0.85	0.65	0.40	0.19
Innovativeness	**3**	• My firm introduced many new lines of products and services in the past five years. • My firm emphasises innovative ideas, products and services. • My firm made many dramatic changes in products and services in the past five years.	0.810	0.83 0.78 0.70	0.81	0.60	0.40	0.19

Risk-taking	**3**	• My firm takes bold and aggressive actions to exploit opportunities in uncertain situations. • My firm takes bold and wide-ranging acts to achieve the firm's objectives. • My firm favours high risk projects with chances of very high returns.	0.749	0.77 0.72 0.62	0.75	0.50	0.38	0.14
Growth Orientation Beyond Local Market	**4**	• My firm is very interested in expanding business beyond the local market. • My firm believes it will have higher possible gains by doing business outside the local market. • My firm sees its most attractive opportunities for growth lie beyond the local market. • My firm believes doing business beyond the local market is the way to achieve success.	0.909	0.91 0.87 0.81 0.77	0.91	0.71	0.12	0.04

Table 5: Correlation Matrix of Dependent and Independent Constructs

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
(a) Online Transaction and Interaction	***0.768***						
(b) Online Information and Network Access	0.525	***0.721***					
(c) ICT for In-house Operation Systems	0.715	0.432	***0.911***				
(d) Proactiveness	0.295	0.325	0.319	***0.806***			
(e) Innovativeness	0.338	0.380	0.358	0.533	***0.775***		
(f) Risk-Taking	0.223	0.311	0.173	0.485	0.406	***0.707***	
(g) Growth Orientation Beyond Local Market	0.191	0.242	0.141	0.124	0.185	0.107	***0.843***

Note: The **bold *italic items*** on the diagonal represent the square roots of the average variance extracted (AVE). Items on Non-diagonal represent inter-construct correlation.

Table 6: Correlations of all the variables included in the analysis and descriptive statistics

		Means	SD	a	b	c	d	e	f	g	h	i	j	k	l	m
a.	Firm Size	5.59	3.01	1												
b.	Firm Age	9.54	7.40	.289**	1											
c.	Industry Type	0.8	-	-.369**	-.102	1										
d.	Owner's Gender	1.23	-	-.007	.082	.052	1									
e.	Owner's Age	3.38	2.07	.034	.234**	-.016	-.034	1								
f.	Skill Problem	0.18	-	-.115	.014	.065	.145*	.151*	1							
g.	Online Transaction and Interaction	2.98	1.30	.158*	.175**	-.198**	-.068	-.395**	-.221**	1						
h.	Online Information and Network Access	3.72	0.96	.037	.017	-.058	-.124*	-245**	-.319**	.525**	1					
i.	ICT for In-house Operation Systems	2.75	1.63	.065	.180**	-.138*	-.004	-.397**	-.198**	.715**	.432**	1				
j.	Proactiveness	3.65	0.79	.167**	.017	-.138*	.041	-.211**	-.097	.295**	.325**	.319**	1			
k.	Innovativeness	3.50	0.82	.177**	.107	-.062	-.007	-.170**	-.185**	.338**	.380**	.358**	.533**	1		
l.	Risk-Taking	3.35	0.77	.192**	-.027	-.088	-.123*	-.067	-.166**	.223**	.311**	.173**	.485**	.406**	1	
m.	Growth Orientation Beyond Local Market	3.20	0.94	.140*	.024	-.013	.083	-.083	-.056	.191**	.242**	.141*	.124*	.185**	.107	1

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 7: Multiple Regression Statistics

Dependent Variables	Online Transaction and Interaction		Online Information and Network Access		ICT for In-house Operation Systems	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Control Variables						
Firm Size	.023	-.036	-.027	-.118^{+}	-.068	-.120*
Firm Age	.264***	.252***	.085	.072	.294***	.273***
Industry	-.157**	-.156**	-.040	-.037	-.131*	-.124
Owner's Age	-.433***	-.392***	-.227***	-.151**	-.446***	-.383***
Owners' Gender	-.078	-.083	-.097	-.104^{+}	-.018	-.028
ICT Skill Problem	-.134	-.097	-.273***	-.218***	-.131*	-.095
Predictor Variables						
Proactiveness		.064		.109		.121^{+}
Innovativeness		.138*		.182**		.180**
Risk-taking		.071		.127*		.009
Growth Orientation Beyond Local Market		.115*		.180**		.064
R^2	.291	.355	.157	.306	.270	.343
Adjusted R^2	.274	.329	.137	.238	.253	.317
F-ratio	17.210***	13.637***	7.849***	10.939***	15.527***	12.950***

N= 259; $^{+}p<0.1$; *$p<0.05$; **$p<0.01$; ***$p<0.001$

Note: R^2 of between 0.30 to 0.35 of our models is deemed moderate (Chin, 1998). The R square and beta coefficient values are comparable to studies in similar contexts (e.g. Chew, Ilasaravan, & Levy, 2015).