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RESEARCH ARTICLE

DRIVERS OF TECHNOLOGICAL INNOVATIONS: EVIDENCE FROM KENYA'S MICRO AND SMALL ENTERPRISES

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ABSTRACT

Growth of micro and small enterprises (MSEs) is fundamental to the Kenyan economy. These enterprises play a pivotal role in Kenya's overall economic growth. In spite of the role that MSEs play, their growth is usually constrained by a host of factors. One avenue through which enterprises enhance their growth and survival is through technological innovation. In Kenya, the knowledge on how technological innovation can be harnessed to facilitate MSEs growth is nascent and inconclusive at best. This paper uses a knowledge production function approach to analyze factors that can be used to drive the innovation capability of MSEs. It uses a bivariate probit model and data from World Bank Enterprise Survey data for 2013 to examine some of the key drivers of process and product innovations amongst MSEs. Results from the study identified enhanced capital intensity, increased foreign partnership, listing in the capital markets and a focus beyond local markets as some of the factors that influence technological innovations. Meanwhile policies aimed at enhancing technological innovation should target more of the newly established MSEs.

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INTRODUCTION

The productivity growth of micro and small enterprises (MSEs) is fundamental to the growth of the Kenyan economy. This is partially true given that MSEs play a pivotal role in Kenya's overall economic growth. For instance in 2015, an estimated 7.38 million MSEs contributed approximately 24.7 per cent to Kenya's gross domestic product. Though the jobs they create largely fall within the informal sector, MSEs are also responsible for employing 14 million Kenyans (Republic of Kenya, 2016). In spite of the role that MSEs play in the Kenyan economy, their growth is usually constrained by a host of factors. According to (CBS, ICEG, K-Rep, 1999) one of the most severe constraints to the growth of MSEs relates to inadequate market for MSEs products. It was cited by 34.1 per cent for MSEs as one of the reasons for early closure of MSEs in Kenya (CBS, ICEG, K-Rep, 1999). Similarly in the 2015 MSE survey, 32 per cent of MSEs cited market for products as a major constraint to their growth and survival (Republic of Kenya, 2016). The second often cited problem is that of lack of access to credit. McCormick and Kinyanjui, (1997) agree that inadequate access to credit negatively affects growth of MSEs (Daniels *et al.,* 1995). However, argues that the high poverty levels characterizing owners of MSEs implies that even with access to credit, owners of MSEs often divert the loans borrowed for business development to smoothen their consumption instead of investing it in their enterprises. A number studies (Kimuyu &Omiti, 2000; Atieno, 2001; Kiraka, Kobia & Katwalo, 2013 and Mwangi & Wanjau, 2013) investigated the influence of credit as a constraint to the growth of MSEs. The authors, however, conclude majority of MSEs by virtue of being owned by the poor require much more than credit to grow. Among other factor constraining growth of MSEs is the burdensome and costly regulatory environment. Poor regulatory environment contributes to disproportionately high transaction costs for MSEs when compared to the larger enterprises (GoK, 2005). Poor infrastructure including road networks, lack of worksites that are serviced with electricity, water and sewerage systems have also been cited as other constraints afflicting MSEs growth (CBS, ICEG, K-Rep, 1999); (GoK, 2005); (Republic of Kenya, 2016). According to (CBS, ICEG, K-Rep, 1999) and (Republic of Kenya, 2016) inadequate market for MSEs products, however, remains one of the severest constraint to the growth of MSEs.

The ability to innovate within a firm is considered an important driver for firm survival and growth (Minniti, 2008); McCormick and Maalu, 2011; Audretsch, Coad and Segara, 2013). Indeed, (Audretsch, 1995), (Minniti, 2008) and (Ainin, Kamarulzaman, and Farida, 2010), argue that innovation is also an important ingredient for MSEs competitiveness. It can aid an enterprise to move to higher return activities and

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eventually facilitate a graduation from micro enterprises to small or medium enterprise and eventually to large enterprise. (Audretsch, 1995) (Minniti, 2008) posit that such a graduation should lead to creation of more and higher quality employment opportunities. According to (Organisation for Economic Cooperation and Development [OECD], 2005) innovation can emerge as an original idea, a diffusion, absorption or imitation of new methods or processes developed elsewhere. The MSE survey carried out in Kenya in 2015 reported that only 19.4 per cent of formal MSEs engaged in innovation activities (Republic of Kenya, 2016). An estimated 9.98 per cent of the formal MSE engaged in product innovation, while 3.78 per cent engaged in process innovation. Among the small enterprises category, however, a few sub-sectors such as manufacturing, Information and Communication Technology, finance and health, reported relatively higher proportions of 31-44 per cent of enterprises that engaged in innovation (Republic of Kenya, 2016). MSEs is one of the sectors where there is minimal research and development activities or even patents. In spite of this, anecdotal evidence suggests that substantial level of technological innovation exists among these firms. In Kenya, the factors influencing the decision of a firm to engage in technological innovation activities, however, remain unclear.

Review of existing knowledge

The resource base theory views the growth of firm as a largely internal process. Through this process productive opportunities and capabilities of a firm are used to expand the size of the firm. According to Penrose (1959) each firm possesses repositories of firm specific resources and capabilities that enable it to have a competitive advantage. It is the competitive advantages that enable such a firm to introduce new products in order to enhance its performance ((Penrose, 1959), (Hervas-Oliver, Semepre-Ripoli, and Boronat-Moll, 2014). The firm specific resources include assets such as its knowledge capabilities some of which are tacit in nature; firm attributes; organizational structure and external source of knowledge. The theory views a firm as a bundle of unique tangible and intangible resources and capability that are acquired, developed and expanded over time (Estene-Perez and Marez-Castillejo, 2008). It therefore emphasizes the aspect of firm learning as an important ingredient for firm growth. (Estene-Perez and Marez-Castillejo, 2008) adds that generation of firm specific capability need not be directly related to the firm's investments in research and development activities. The knowledge outputs from research and development inputs may, however, enable the firm to develop unique innovation capabilities that are not easily imititable by competitors. Such knowledge exhibit spill-over effects over the firm's other activities. (Hervas-Oliver, Semepre-Ripoli, and Boronat-Moll, 2014) argue that the decision to engage in innovation in a firm will to some extent be influenced by the firm's unique organizational capabilities, its capability and dynamism in reconfiguring and sustaining its resource base. According to (Kraaijenbrink, Spende, and Groen, 2009) one key shortcoming of the theory is its treatment of value as being exogenously determined from the firm.

Klette and Kortum, (2004) on the other hand view technological innovations decisions of a firm as a purposive profit maximisation firm behaviour. In a model (Klette and Kortum, 2004) assume a firm that start at size; $k \geq 1$, where k represents the number or products. At this size the firm earns profit according to the function: $\overline{\pi}k$; where $\overline{\pi}$ is optimal profit. Such a firm faces a prospect of Poisson hazard, μk , of being forced out by other innovative firms that introduce new competitive products. If the firm does not innovate, it will become $k-1$ size firm. However if the firm innovates it faces a Poisson hazard I of becoming $k+1$ firm. The firm's decision therefore becomes a profit optimization problem subject to the cost of innovation expenditures. Thus a firm is expected to scale up its technological innovation expenditure and activities in proportion to its knowledge capital. From this model, therefore, a firm will make the decision to innovate or not and the intensity of that innovation with a view to profit maximisation as well as to ensure its survival from competing firms.

There exists a plethora of empirical studies on the drivers of innovation across firms. Such studies include (Ayyagari, Demirgiic-Kunt, and Maksimovic, 2007), (Goedhuys, 2007), (Hall, Lotti, and Mairesse, 2008), (Mel, Mckenzie, and Ruff, 2008). Most of these studies are, however, in reference to developed countries except (Goedhuys, 2007) stud which was carried out in Tanzania. In Kenya techonogical innovations amongs MSEs are thin and the few that exists such as those by (Walobwa, Ngugi, and Chepkulei, 2013) (Kiraka, Kobia, and Katwalo, 2013) and (Mwangi and Namusonge, 2014)are in reference to specific sectors. (Ayyagari, Demirgiic-Kunt, and Maksimovic, 2007) argue that access to external financing; managerial skills, foreign competition and firm organizational structures are important determinants of firm's innovation. (Hall, Lotti, and Mairesse, 2008) found firm size to be positively associated to product and process innovation. Owner-manager characteristics such as their socio-economic background, personal traits, and performance abilities have been found to be important determinants of innovation. According to (Mel, Mckenzie, and Ruff, 2008) firm size has been found to play a bigger role in driving process innovation relative to product innovation. In another study (Subrahmanya, Mathirajan, and Krishnaswamy, 2010) used dummies to represent firm size as determinants of product innovation. In addition growth rate of capital and labour, percentage of innovative sales were also included as predictors of small manufacturing firms' technological innovations. (Manez, Rochina-Barrachina, Sanchis, and Sanches, 2013) found that introduction of process innovation among SMEs yielded productivity growth that is non-contemporaneous. In a a related study of determinansts of process innovation (Hervas-Oliver, Semepre-Ripoli, and Boronat-Moll, 2014) found the coefficient on expenditures on research and development were negative and statistically insignificant in explaining process innovation among SMEs. Instead coefficients on acquisistion of embodied technology, internal and external sources of knowledge and co-adoption of organisational innovation were found to be statistically significant and positively related to process innovation. Eventhough literature highlights foreign competition as stimulant for firm techonoligal inovations (Goedhuys, 2007) study in Tanzania, found weak linkage between foreign firm learning spill-over. Instead, the author found linkages among local firms, in-house research and development important determinants of product innovation among the small enterprise. Studies in Kenya such as that by (Walobwa, Ngugi, and Chepkulei, 2013) tested for significant relationship between the SMEs sales turnover with technological innovation. In another study, (Kiraka, Kobia, and

Katwalo, 2013) found that innovative activities for micro, small and medium enterprises were largely confined to an additional new product immediately after the loan period.

process. The KPF model managed to distinguish innovation inputs that consists of research and development, other related investments and the innovation outcomes.

Table. Results for the Determinants of MSEs technological innovation

VARIABLES	Product Innovation	Process Innovation	athrho
Log innovation expenditure (intensity)	-1.184*	(0.80)	
	(0.68)	(1.04)	
Proportion of employees using computers	0.01	0.0137*	
	(0.01)	(0.01)	
Log physical per employee	0.472**	0.18	
	(0.24)	(0.36)	
Size of MSE	0.02	(0.31)	
	(0.46)	(0.59)	
Age of MSE	0.103***	0.02	
	(0.03)	(0.07)	
Age of MSE Squared	-0.00125***	0.00	
	(0.00)	(0.00)	
Legal status	(0.48)	(0.83)	
Non listed company			
	(0.62)	(0.74)	
Sole proprietor	-0.993**	-1.426**	
	(0.46)	(0.69)	
Partnership	-2.444***	-2.165**	
	(0.79)	(1.03)	
Other	-8.850***	4.540***	
	(0.98)	(1.68)	
	-0.363**	-0.416**	
Listed company is the reference group			
Log local market size			
	(0.16)	(0.21)	
Own source of innovation funds(No)	0.85	0.90	
	(0.52)	(0.99)	
Commercial bank source of innov, funds	0.27	0.59	
	(0.41)	(0.46)	
Proportion of foreign ownership	0.170***	0.0780***	
	(0.03)	(0.02)	
Proportion of domestic ownership	0.00	0.01	
	(0.01)	(0.01)	
Presence of informal sector competition (No)	0.27	0.07	
	(0.66)	(0.81)	
Constant	-5.481*	-1.48	0.742**
	(3.04)	(3.85)	(0.36)
Observations	75.00	75.00	75.00

Notes: Dependent variable is the dummy variable which takes a value of 1 if MSE reported to have introduced a new product or a new process and 0 otherwise for the period 2010 to 2012.
*Statistical significance at 10%, ** Statistical significance at 5%; ***Statistical significance at 1%***
Wald chi2(32) = 3520.76; Log pseudo likelihood = -48.107187; Prob > chi2 = 0.0000; Wald test of rho=0: chi2(1) = 4.24973 Prob > chi2 = 0.0393 t- values in parentheses
Source of data: Own computation with data from (World Bank, 2013)

The study conclude that unfettered access to finance acts as a constraint to product innovation among MSEs. From the foregoing its is evident that among the factors that influence technological innovation for firms include characteristics of owner manager, participation in export-import trade which is thought to go beyond ordinary market transactions to influencing external relations that provide crucial knowledge spill over. The time dependent learning process, firm survival and growth is another aspect highlighted by the literature reviewed herein that emphasize age of firm is the firm technological innovation capability. Firms that have unique superior human skills and capabilities, some of which assume a tacit nature, enable certain MSEs to learn faster and outwit their competitors.

Approach

This paper adopts the Knowledge Production Framework (KPF) developed by (Pakes and Griliches, 1984) to analyze the relationship between innovation inputs and innovation outputs. According to (Pakes and Griliches, 1984) research and development (r) inputs are transformed into knowledge capital (K) or innovation outputs through the innovation

The authors estblished that innovation outcome y_i can be modelled as a function of lagged values of research nd development, r, and firm specific, f, variables. A notable departure from the KPF model, MSE in Kenya rarely carry out formal research and development yet they still innovate implying that other innovation inputs are responsible for MSE innovation outcomes. The current study thus augements research and development expenduture with innovation related activities such as purchases of innovation related equipment, training of innovation employees expenditures, (re).

The functional relatioships thus takes the form:

$$y_i = f\ (re, F, \varepsilon) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where y_i is the technological innovation outcome dummy that can take a value 1 if firm introduces a product or process innovation and 0 otherwise. The term re represents the expenditures on research and development, purchases of innovation related equipment, training of innovation employees expenditures; F represents firm specific variables

such as human skills levels, capital intensity and ε represents the error term. The estimation models for product and process innovation can thus be specified as:

$$\begin{cases} Nprodi = c_0 + \beta_0 \log inn\_exp_i + \beta_0 X_i + \varepsilon \\ Nproci = c_1 + \beta_1 log\ inn\_exp_i + \beta_1 X_i + \varepsilon \end{cases} \quad \ldots\ldots\ldots (2)$$

The model is estimated as a bivariate probit model where:

$Nprod_i$ represents new product innovation for ith firm;

$Nproc_i$ represents a new process innovation for ith firm; $\log inn\_exp_i$ represents log of innovation expnditures for ith firm;

X_i represents the firm specific variables for the ith firm; $\beta_1$and β_2 are coefficients to be estimated; c is a constant while ε is the error term. Innovation outcome y_i in this paper is captured as a binary dummy variable where a successful introduction of a new product or new productio process takes a value of 1, and otherwise a value of 0.

Equation 2 is estimated using a biprobit regression estimation technique.

Empirical analysis and interpretation of results

Determinants of technological innovation were analyzed using a bivariate probit model. Successful introduction of a new product or new process for the period 2010-2012 were taken as positive outcome indicating an MSE's product and or process innovation capability. Innovation intensity which represents an MSEs innovation expenditures divided by number of full-time employees. Firm specific variables of interest included physical capital intensity, human capital skills levels and market size. Other control variables including size, age, information technology levels and were also used in the estimation.

Results in Table 1 above indicate that MSEs with higher proportions of foreign ownership are associated with higher probabilities of technological innovations. They are more likely to have introduced new products or new process innovations between 2010 and 2012. This suggests that an external linkage, especially with other foreign firms, opens up local MSEs to technological innovations. Such MSEs are likely to become more receptive to introduction of new products and processes relatively to firms that are wholly locally owned. MSEs with a larger local market size are associated with less technological innovations. Such MSEs are likely to have introduced less new products and new process innovation relative to firms with fewer local market focus. This finding resonates with the idea that monopolistic firms are less innovative yet they have better chances of appropriating returns from innovation investments. The idea seems to suggest that MSEs that enjoy local markets such as the set aside preferential markets by government are likely to be less likely to have technological innovations. Higher physical capital per employee was found to be one of the factors that positively influence an MSEs likelihood of introducing a new products. This resonates well with the fact that most MSEs in the study are micro and even survivalists enterprises with minimal capital holdings. Boosting the capital holdings of such enterprises would thus improve their capability of introducing new products. Similarly, human skills especially the computing skills were found to positively impact on the probabilities of an MSE introducing a new process innovation. This perhaps suggests that MSE with computing skills have a richer menu of such resources as software's and external information that can be harnessed to improve business processes. The finding is line with the neo-classical firm growth theory that predicts that new knowledge capital in form new innovative products augments physical capital increasing its productivity (Romer, 1990). Results also confirm non-linear relationship between firm age and its chances of successfully introducing technological innovations. The younger the firm, the more likely it is to introduce a new product. On the converse, as the firm grows older, its chances of introducing new products seem to diminish. This finding emphasizes the important role of newly formed MSEs in spurring technological innovations. The legal ownership structure was found to be an important factor influencing technological innovation among MSEs. Non listed companies, partnerships and sole proprietor MSEs were found to be associated with less likelihood of engaging in technological innovations. This finding is important for Kenya where majority of MSEs are informal and largely family owned. They thus rely on internally generated funds to carry out most of their investment activities including innovation activities. This implies that with limited sources of funds, activities such as innovation which are not a priority rarely get financed. Thus by MSEs getting listed in the stock exchange, they would add a new source of financing in the name of capital markets availing more resources to finance innovation activities. Innovation expenditure per employee was found to be negatively associated with the probability of introducing new products. The finding is contrary to the expected finding. However, outcome of innovation expenditures in one period are unlikely to yeild desired results until in subsequent years. Lack of a number of waves of survey data could not allow the inclusion of subsequent periods. All the same, innovation expenditures among MSEs were found to low and highly dispersed across MSEs to make any meaningful statistically interpretation. The finding however seems to suggests that innovative MSEs mostly innovate without much expenditure going towards this activity. It is thus likely that the innovation activity is marginally incremental and constitutes imitations where costs are minimal.

Conclusions and recommendations

In conclusion the overall results seem to suggest that the legal ownership structure and the extent of foreign ownership are among the key drivers of technological innovation amongst MSEs. The finding is not surprising given that the MSE sector is largely informal where family ownership dominates. The two drivers of technological innovation thus imply that policies aimed at ensuring MSEs formalization especially with regard to legal ownership beyond family ownership, would open up new avenue for these enterprises to raise long term funds through capital markets and foreign direct investments. Such a move would enhance the ability of MSEs to invest in innovations of new products and processes, an undertaking that is usually characterized by uncertainties and risks. On the other hand, over reliance on local markets for MSEs products continues to inhibit technological innovations among these firms. Thus policies aimed at ensuring MSEs have access to markets for their products should be implemented with an aim of ensuring MSEs products and services are focused beyond

their local markets needs. Policies aimed at improving the human skills especially the computer skills as well as strategies to raise capital intensity among MSEs should be pursued. Such innovation policies should, however, target the newly established MSEs which are relatively more likely to engage in technological innovations compared to the old MSEs.

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