Effect of Knowledge Sources on Firm Level Innovation in Tanzania

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ABSTRACT

In this paper we analyse the impact of different sources of knowledge on product innovation in Tanzania using firm level data from 543 firms. Specifically, we assess the separate impacts of internal knowledge and external knowledge and the combined impact of both on a firm's likelihood of introducing product innovations. The analysis reveals that external research and development do not affect product innovation and the combined effect of internal and external knowledge on product innovation is greater than the separate effect of these types of knowledge on product innovation. Furthermore, external knowledge acquisition and firm spending on internal research and development facilitates product innovation more effectively for older firms and firms in the services sector than for relatively younger firms and firms in the manufacturing sector. Finally, interaction of external and internal knowledge raises the probability of a firm undertaking product innovation.

1. INTRODUCTION

Innovation is a process of translating ideas or inventions into goods or services with economic value. Apart from translating ideas or inventions, innovation also entails learning and adaptation of new technologies and techniques. Ideas and inventions are at the centre of innovation, and these in turn are significantly influenced by knowledge. Knowledge is a prerequisite for innovation as innovation involves the generation, exploitation and manipulation of new forms of knowledge by firms to create new products (Schulze and Hoegl, 2008; Katila and Chen, 2008).

Given the role of knowledge in innovation, knowledge sourcing is an important aspect of innovation. There are two main sources of knowledge for innovation that impact innovation differently, namely internal and external sources of knowledge (Lundvall, 1988; Cohen and Levinthal, 1989, 1990). The former involves the development and utilization of knowledge within a firm's boundaries while the latter involves acquisition of new knowledge from sources outside a firm. Internal knowledge development happens within boundaries of the firm through in-house knowledge dissemination, research and development, and internal education and training. External knowledge acquisition, on the other hand, involves the introduction of new knowledge from outside sources via purchase of machinery and equipment, recruitment of qualified personnel, conferences, training, and licensing.

External knowledge acquisition is useful to a firm only if it possesses an existing base of knowledge that enables it to utilize the external knowledge. A firm's capacity to utilize external knowledge is commonly conceptualized as its absorptive and transformative capacity with the former being the ability to recognize and exploit technological opportunities developed outside the firm (Cohen and Levinthal, 1990; Zahra and George, 2002) and the latter being the ability to continually redefine a product portfolio based on technological opportunities or skills within a firm (Garud and Nayyar, 1994).

The objective of this study is to determine the extent to which different knowledge sources (internal and external) contribute to firms' innovation performance. Specifically, the study analyses the direction and magnitude of impact of internal and external knowledge sources on firms' innovative performance and the impact of the interaction of factors influencing innovative performance.

The rest of the paper is organized as follows. Section 2 describes the relationship between innovation and knowledge. Section 3 presents the methodology of the study describing the data,

variables, and empirical specification. Section 4 presents the study results and Section 5 provides the main study conclusions.

2. INNOVATION AND KNOWLEDGE SOURCES

Joseph Schumpeter was the first economist to define innovation and outline its importance to growth via employment, economic growth and economic development emanating from increased firm output from existing inputs (Schumpeter, 1912). Schumpeter explained innovation in the context of "creative destruction" where entrepreneurs had incentives to pursue new innovations to replace old ones in response to declining profit margins resulting from copying of innovations.

Various other models have been put forward to explain the relationship between knowledge sources and innovation such as the linear innovation model of innovation and the interactive model of innovation. The linear model of innovation asserts investment in research and development was the main driver of innovation performance with a direct link between research and development expenditures, innovation and productivity gains (Abramovitz, 1956; Arrow, 1962). The interactive model of innovation (Nelson and Winter, 1982; Rosenberg, 1982; Baptista and Swan, 1998; Cooke and Morgan, 1998) on the other hand asserts that innovation did not only result from investment in research and development but also from knowledge acquisition from production activities and through firms' ability to acquire knowledge via building of strong links with other firms and interactive learning with other actors. Interactive models can account for innovation dynamics whereas linear models fail to do so.

Given the importance of knowledge to innovation, empirical research on innovation has focused on technological learning processes influencing innovation and the conditions for successful innovation. Research has examined the issue of sourcing knowledge internally and externally with regards to their merits concluding external and internal knowledge sources were substitutes, which firms could adapt as innovation strategies (Beneito, 2003; Malerba, 1992). Other studies emphasized the role of internal competency in utilizing external knowledge implying complementarity between internal and external knowledge (Lundvall, 1988; Cohen and Levinthal, 1989, 1990). These studies suggested that apart from generating innovation, internal knowledge also improves a firm's capacity to identify and utilize external knowledge for generating innovation. Other studies investigated the relationship between internal and external knowledge more specifically finding firms with significant involvement in internal research and

development had greater external links and greater capacity to acquire and utilize external knowledge sources (Edquist, 2004; Lowe and Taylor, 1998).

Various studies have investigated the link between knowledge and innovation in Tanzania. Using a case study of two manufacturing firms in Tanzania, Portelli and Narula (2003) found technological upgrading occurred in Tanzania as a result of foreign investment with its magnitude determined by capabilities within the industrial base in Tanzania. Szogs (2004) and Mahemba and De Bruijn (2003), however, point out that there is only a limited transfer of knowledge between firms in Tanzania.

Using firm level data on product innovation and learning in Tanzanian manufacturing and commercial farming, Goedhuys (2005) found that larger and foreign owned firms invested significantly more in human and physical capital than local SMEs, but these collaborated more intensively with other local firms on product development, marketing, and on the input market and upgrade technology. Such collaboration enabled SMEs to scale disadvantages they faced in competing for new machinery and specialized skills required for product innovation in imperfect markets.

Apart from examining the link between innovation and knowledge in Tanzania, empirical work in Tanzania has also focused on factors impacting innovation in the country. Augbert and Wanga (2007) identify constraints to innovation in Tanzania as poor governance and business environment, lack of innovative dynamism, inadequate innovative policies, poor dissemination of new technologies, and low sustainability of services oriented to upgrade technologies from institutions that support SMEs. Historical reasons such as foreign exchange shortage, intermediate goods shortage and currency overvaluation, and lack of profit motive amongst state owned firms have also impacted innovation behaviour in Tanzania (Wangwe et. al, 2014; Doriye, 1994; Danielson and Mjema, 1994; Wangwe, 1983).

Hence, empirical literature has revealed the complementary nature between internal and external knowledge in Tanzania via the role of internal competence in utilizing external knowledge, improvement of a firm's capacity to identify and utilize external knowledge for generating innovation, and enhanced external links. Furthermore, larger and foreign owned firms in Tanzania invested significantly more in human and physical capital than SMEs which however had greater local collaboration on product development, marketing, and on the input market and upgrade technology.

This study analyzes innovation based on the existence of complementarity between internal and external knowledge by examining the impact of internal knowledge, external knowledge, and market factors on innovation practices in Tanzania. The study adds value to previous studies by also examining market factors that are not analyzed in most studies that examine factors impacting innovation.

3. DATA AND METHODOLOGY

3.1 Data

The study employs data from the World Bank, namely the Tanzania Enterprise Survey (ES) 2013 and an Innovation Follow-up Survey conducted in 2014. The former provides a wide range of firm-level variables including information on recruitment, training and R&D practices within the firm. The innovation follow-up survey provides evidence on the nature, role and determinants of innovation in Tanzania. Specifically, it contains information on the innovation output and innovation-related activities, such as product innovation, process innovation, organizational innovation, and marketing innovation for 543 Tanzanian firms.

3.2 Variables

Dependent Variables

The study focuses on product innovation. However, since innovation is a process rather than an instantaneous event, researchers should not just consider the innovative products themselves, but also the attempt to develop innovative products. In light of this, the dependent variable is measured as a firm's attempts to develop innovative products (PROD). PROD is a dummy variable.

Independent Variables

There are various knowledge sources embodying different types of knowledge. Knoben and Oerlemans (2010) distinguish between firm internal, external business knowledge, external technological knowledge, and external codified knowledge noting that utilization of different types of knowledge result in different outcomes with regards to firm innovativeness. In light of classification of knowledge, the study has the following sources of knowledge: firm internal knowledge (firm funding of internal research and development (IRD)); external technological

knowledge (firm funding of external research and development (ERD), firm purchase of equipment, machinery or software (PEQP) and purchase of intangible technology (PINT)); business knowledge (recruitment of staff for innovation purposes (RECRUIT) and staff training (TRAIN))

Apart from variables pertaining to firm internal, external technological, and business knowledge, other independent variables for the study pertain to motives for pursuing innovation (cost reducing motive for engaging in innovation (MCOST) and market share enhancement motive for engaging in innovation (MSHARE)), the sector of the economy a firm belongs to (SECTOR) i.e. a manufacturing dummy, and year of establishment of the firm (YEAR) which controls for variation in ability of different firms to innovate as pursuit of innovative activities requires a firm be established for some time.

IRD, ERD, PEQP, PINT, RECRUIT, TRAIN, SECTOR, MCOST, and MSHARE are all dummy variables while YEAR is a continuous variable.

3.3 Empirical Specification

Three binary logit models are used to achieve the objectives of the study in line with Vega-Jurado et al. (2009). The first model analyses the effect of external knowledge sources on a firm's innovation performance without considering its internal technological capabilities. The second model analyses the extent internal technological capabilities influence firms' innovation without considering external knowledge. The third model analyses how the effect of external knowledge on innovation is affected by firm effort on internal research and development. Given the objectives of the study, we use the following empirical models.

$$PROD = b_0 + b_1 ERD + b_2 PEQP + b_3 PINT + b_4 MCOST + b_5 MSHARE + b_6 YEAR + b_7 SECTOR \quad (1)$$

$$PROD = b_0 + b_1 IRD + b_2 TRAIN + b_3 RECRUIT + b_4 MCOST + b_5 MSHARE + b_6 YEAR + b_7 SECTOR \quad (2)$$

$$PROD = b_0 + b_1 ERD + b_2 PEQP + b_3 PINT + b_4 IRD + b_5 TRAIN + b_6 RECRUIT + b_7 MCOST + b_8 MSHARE + b_9 YEAR + b_{10} SECTOR \quad (3)$$

Model (1) analyses the impact of external knowledge on a firm's product innovation decision ignoring its internal knowledge capacity. Model (2) analyses the impact of internal knowledge on a firm's innovation ignoring its external knowledge capacity, and Model (3) analyzes the extent internal knowledge impacts innovation and its effect on external knowledge in influencing innovation. Apart from identifying impact of knowledge sources on innovation performance, estimation results from Models 1, 2, and 3 also facilitate better identification of the relationship between internal and external sources of knowledge with regards to impact on innovation.

4. RESULTS

4.1 Descriptive Statistics

Discussion of features characterizing the data used for the study is necessary before discussing the empirical results in order to identify patterns in the data. Table 1 summarises statistics of the variables used in the models and their correlation coefficients.

Most of the firms in the sample were established in 2010 or 2011 and have thus had adequate time to at least attempt to develop new product innovations. About half of the sampled firms are involved in manufacturing. Table 1 reveals that only about a fifth of the sampled firms undertake or attempt product innovation with firms investing about seven times more in internal knowledge and business knowledge than in external knowledge. Firms invest more in external technological knowledge via purchase of equipment, machinery or software and tangible technology than in business knowledge through staff recruitment and training. Market factors are important considerations for firms in making innovation decisions. Over half of the firms see and increased market share as a reason for undertaking product innovation and for more than a quarter of the firms decreased costs are the reason for undertaking product innovation.

Table 1: Descriptive Statistics and Correlation Coefficients of Variables Used in the Models

	Mean	SD	PROD	COMM	IRD	TRAIN	RECRUIT	ERD	PEQP	PINT	MCOST	MSHARE	YEAR
PROD	0.214	0.410											
IRD	0.223	0.417	0.403	0.150									
TRAIN	0.250	0.434	0.132	0.040	0.359								
RECRUIT	0.225	0.420	0.114	0.029	0.271	0.143							
ERD	0.035	0.184	0.149	0.055	0.439	0.173	0.219						
PEQP	0.400	0.490	0.326	-0.047	0.429	0.511	0.084	0.258					
PINT	0.158	0.365	0.139	0.217	0.190	0.242	0.208	0.209	0.270				
MCOST	0.270	0.446	0.159	-0.221	-0.099	0.015	-0.024	-0.148	-0.118	-0.040			
MSHARE	0.551	0.446	0.035	0.116	0.183	0.263	-0.109	0.122	0.311	0.236	-0.062		
YEAR	2010.809	0.767	-0.312	0.199	-0.069	-0.073	-0.148	-0.131	-0.088	-0.138	-0.080	-0.019	
SECTOR	0.501	0.500	-0.350	0.186	0.011	0.048	-0.121	-0.080	-0.027	-0.043	-0.229	0.204	0.195

The correlation coefficients in Table 1 reveal a far higher correlation between product innovation and internal research and development compared to product innovation and external research and development. This may hint at a greater impact of internal knowledge than external knowledge on product innovation. Product innovation has higher correlation with external technological knowledge than with business knowledge indicating that firms may have a preference for buying technology over investing in internal research and development to produce them. There is significant correlation between internal knowledge (IRD) and external knowledge (ERD and PEQP) as well as a significant correlation between business knowledge (TRAINING) and external research and development (ERD). This may indicate complementarity between internal knowledge and external knowledge in impacting product innovation (Mohnen and Roller, 2005; Cassiman and Veugelers, 2006).

4.2 Regression Analysis

Table 2 shows the logit model estimation results for Models 1, 2 and 3. Chi-square values for all the three models reveal we can reject the null hypothesis that all parameters beside the constant are equal to zero implying the explanatory variables in the three models can adequately explain variation in product innovation. Furthermore, Pseudo R^2 values for the three models are sufficiently high further indicating changes in product innovation significantly result from changes in the explanatory variables.

Table 2: Logistic Estimation Results of Product Innovation

	Model 1				Model 2				Model 3			
	Coeff	**SE**	**Z-Value**	**dy/dx**	**Coeff**	**SE**	**Z-Value**	**dy/dx**	**Coeff**	**SE**	**Z-Value**	**dy/dx**
ERD	.389487	1.24119	0.31	.09652					-1.61	1.542	-1.05	-.3525
PEQP	1.56190	.570509	2.74	.37173					1.438	.7271	1.98	.3434
PINT	.182763	.62827	0.29	.04565					.4484	.7444	0.60	.1104
IRD					3.181884	.904803	3.52	.58899	3.520	1.101	3.20	.6180
TRAIN					-.234211	.675871	-0.35	-.0584	-1.11	.8560	-1.30	-.2707
RECRUIT					-.506381	.714763	-0.71	-.1257	-.535	.7684	-0.70	-.1329
MCOST	.742168	.585272	1.27	.18246	-.679882	.599866	-1.13	-.1697	-.811	.6392	-1.27	-.2024
MSHARE	-.035313	.561599	-0.06	-.0088	-.153872	.585922	-0.26	-.0384	.0208	.6473	0.03	.0052
YEAR	-.746266	.342400	-2.18	-.1865	-.96713	.387757	-2.49	-.2415	-1.03	.4018	-2.59	.2593
SECTOR	-1.37875	.541443	-2.55	-.3313	-1.76601	.591155	-2.99	-.4123	-1.88	.6389	-2.95	-.4352

Model 1	**Model 2**	**Model 3**
Number of obs = 89 LR chi2 (7) = 28.84 Prob > chi2 = 0.0002 Log likelihood = -47.266625 Pseudo R2 = 0.2337 Probability of positive outcome (product innovation) = 0.49440608	Number of obs = 89 LR chi2 (7) = 38.38 Prob > chi2 = 0.0000 Log likelihood = -42.49566 Pseudo R2 = 0.3111 Probability of positive outcome (product innovation) = 0.51607459	Number of obs = 89 LR chi2 (10) = 44.07 Prob > chi2 = 0.0000 Log likelihood = -39.647363 Pseudo R2 = 0.3573 Probability of positive outcome (product innovation) = 0.523503

4.3 Impact of External Knowledge on Product Innovation

Model 1 shows firm expenditure on external research and development and purchase of intangible technology does not influence product innovation. Purchase of equipment, machinery or software (PEQP) however significantly increases the probability of a firm undertaking product innovation. External knowledge in Tanzania thus emanates more from purchasing machinery, equipment and software than from acquiring external knowledge as an input to supplement internal knowledge in producing innovative products.

Purchasing machinery, equipment and software is more common than investing in external knowledge to enhance internal knowledge to produce innovative products probably because of low levels of technological capability that constrain firms' capacities to undertake adequate internal research and development. This finding is consistent with Narula (2003) and Szogs (2004).

Model 1 also shows that the longer a firm has been in existence, the higher the likelihood of it undertaking product innovation with recently established firms being less likely to undertake product innovation. This indicates that newly established firms mostly produce products already existing in the market for some time, as they need time to establish themselves in the market before attempting to undertake product innovation. Firms need to establish themselves in the market prior to attempting to undertake product innovation because such attempts must be accompanied by adequate internal technological capacity acquired through internal research and development, training and recruitment (Cassiman and Veugelers, 2006). Firms however tend to prioritize business sustainability by focusing on quick win activities over long term win activities such as investment in internal knowledge. It is only after business stability is attained that firms may desire to venture into innovation.

Belonging to the manufacturing sector reduces the probability of a firm undertaking product innovation by about 33 percent. The size of the service sector is more than four times larger than the manufacturing sector in Tanzania, which implies a higher likelihood of product innovation occurring in the service sector than the manufacturing sector. Furthermore, service firms require less capital than manufacturing firms because production in the service sector tends to be less costly than in the manufacturing sector. This being the case, product innovation in the services sector tends to be less costly than in the manufacturing sector. As service firms require less financial resources to innovate, they tend to have less financial barriers to innovation than

manufacturing firms (Baldwin and Gellatly, 2004; Savignac, 2006). This makes product innovation easier to undertake in the services sector.

Finally, model 1 shows that market factors do not influence a firm's decision to undertake product innovation. This indicates that when firms are established, their objective is to gain a foothold in the market through adapting to the situation in the market rather than through introducing innovative products, which comes after establishment in the market.

4.4 Impact of Internal Knowledge on Product Innovation

Model 2 shows the impact of internal knowledge of product innovation ignoring external knowledge sources. It shows that internal knowledge accumulated from firm spending on internal research and development is significant in a firm's decision to undertake product innovation while business knowledge and codified knowledge do not influence a firm's decision to undertake product innovation. Production innovation processes in Tanzania are thus more driven by internal development of knowledge rather than internal development of processes and skills when analyzed in an internal knowledge source perspective.

Firms may prefer to generate knowledge through investing in internal research and development than through training and staff recruitment because output of internal research and development tends to be more sustainable than knowledge generated through training and staff recruitment. This is because knowledge obtained from staff training and recruitment may be depleted or totally lost in the face of employee turnover. Such sustainability is essential as it creates knowledge that enhances capacity to utilize external knowledge by increasing a firm's ability to identify and take advantage of technological opportunities emanating from other firms by generating knowledge to do so (Soo et. al, 2002; Zahra and George, 2002).

The insignificance of business knowledge and codified knowledge in terms of training and recruitment may be a result of the fact that firms in the sample are still young in terms of existence with the oldest being established in 2010. Such firms first need to develop an internal knowledge base that can effectively enable them to acquire or develop further knowledge. Development of an internal knowledge base is better undertaken by investing in internal research and development than on business and codified knowledge, which are more effective only after development of an adequate internal knowledge base hence the influence of internal research and development on product innovation when external knowledge is ignored.

The probability of a firm undertaking product innovation in Model 2 is 51.6 percent compared to 49.4 percent in Model 1 implying internal knowledge (ignoring external knowledge) has greater impact on product innovation than external knowledge (ignoring internal knowledge) has. This is probably because of the young age of firms in the sample that results in poor absorptive capacity characterized by limited capacity to identify and exploit technological opportunities emanating from outside the firm (Lane and Lubatkin, 1998).

4.5 Interaction of External Knowledge Sources and Internal Knowledge Sources

Estimation results from Model 3 show the impact of external knowledge on firms' product innovation processes given firms' internal knowledge levels. The same variables that are significant in explaining product innovation in Models 1 and 2 are also significant in Model 3, namely purchase of machinery, equipment or software, year of firm establishment, sector firm belongs, and internal research and development. Marginal effects however reveal much about the interaction of external and internal knowledge in influencing product innovation.

First, the marginal effect of firm spending on internal research and development in Model 3 exceeds that in Model 2 by about 3 percent. This indicates external knowledge complements internal knowledge in product innovation and furthermore that the more developed a firm's internal knowledge base, the more effective external knowledge sourcing is in facilitating product innovation. This shows that despite the relative young age of the sampled firms, they have reasonable absorptive capacity necessary for effective utilization of external knowledge. This finding is consistent with Portelli and Narula (2003) who found magnitude of technological upgrading from external knowledge in Tanzania to be determined by capabilities within the industrial base. The fact that the sampled firms belong to the private sector implies they have a say on the nature of external knowledge acquired based.

Firms having a say on the nature of external knowledge acquired is important as it means firms can acquire external knowledge based on internal knowledge capabilities which is necessary for raising technological capabilities through product innovation. This enhances capacity to adequately utilize external knowledge as opposed to reforms undertaken in the 1980s and 1990s in Tanzania, which failed to raise the level of technological capabilities because of failing to take into account the depth of existing internal knowledge (Wangwe, 1993; Wangwe et. al, 2014).

Second, the marginal effect of purchase of machinery, equipment or software on a firm's decision to undertake product innovation in Model 3 is lower than in Model 1 indicating lower influence of purchase of machinery, equipment or software in the presence of internal knowledge. This can be explained in the context of the relationship between purchase of machinery, equipment or software and firm spending on internal research and development. Fig.1 shows the predictive margins of PEQP and IRD.

Fig. 1: Predictive Margins of PEQP and IRD at 95% C.I.

Figure 1 shows that the effect of the purchase of machinery, equipment or software increases on a firm's decision to undertake product innovation depends on whether the firm performs internal research and development. The increased impact of internal research and development can explain the lower effect of purchase of machinery, equipment, and software on product innovation because firms may undertake such purchases not only to facilitate product innovation but also to facilitate development of its internal knowledge base via enhanced internal research and development outputs. Internal research and development and purchase of machinery, equipment, and software thus complement each other in product innovation processes.

Third, the marginal effects of YEAR and SECTOR in Model 3 exceed those in Models 1

and 2 implying the interaction of external and internal knowledge enhance the impact of these explanatory variables on a firm's decision to undertake product innovation. Fig. 2 and Fig. 3 show the predictive margins of YEAR and PEQP and SECTOR and PEQP respectively.

Fig. 2: Predictive Margins of YEAR and PEQP at 95% C.I.

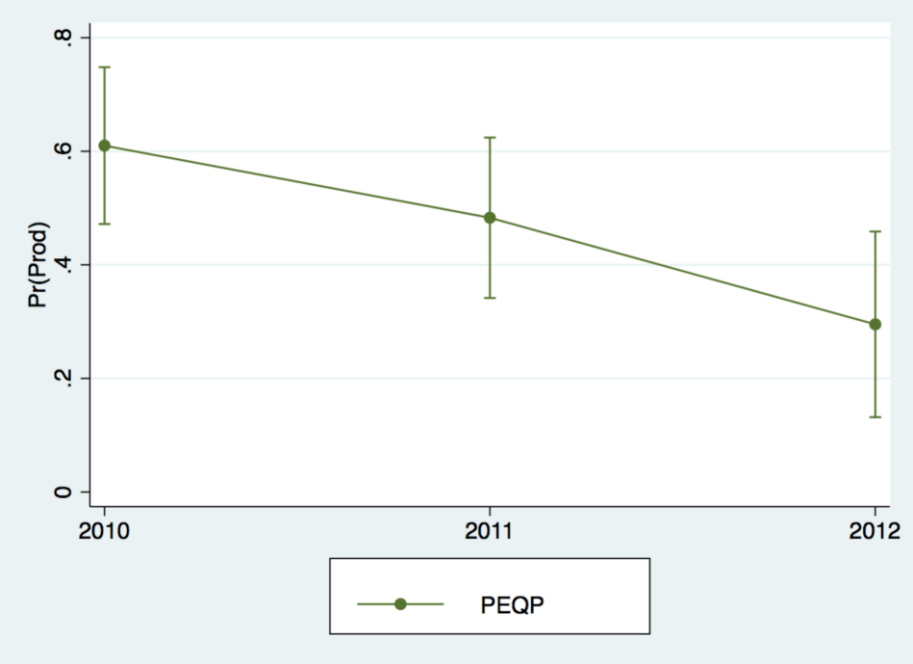

Fig. 3: Predictive Margins of SECTOR and PEQP at 95% C.I.

Figure 2 and Figure 3 show that external knowledge acquisition through purchase of machinery, equipment, and software is more effective in facilitating product innovation for older firms and firms in the services sector than for relatively younger firms and firms in the manufacturing sector. This may be explained by the fact that older firms have begun to undertake measures to develop an internal knowledge base that can effectively enable them to acquire external knowledge or invest in internal research and development that enhances the probability of undertaking product innovation.

Purchase of machinery, equipment, and software furthermore enhances services firms likelihood of undertaking product innovation probably because of their lower capital needs relative to manufacturing sector firms which make them less costly with respect to financial resources to innovate than manufacturing firms.

Figure 4 and Figure 5 show the predictive margins of YEAR and IRD and SECTOR and IRD respectively.

Fig. 4: Predictive Margins of YEAR and IRD at 95% C.I.

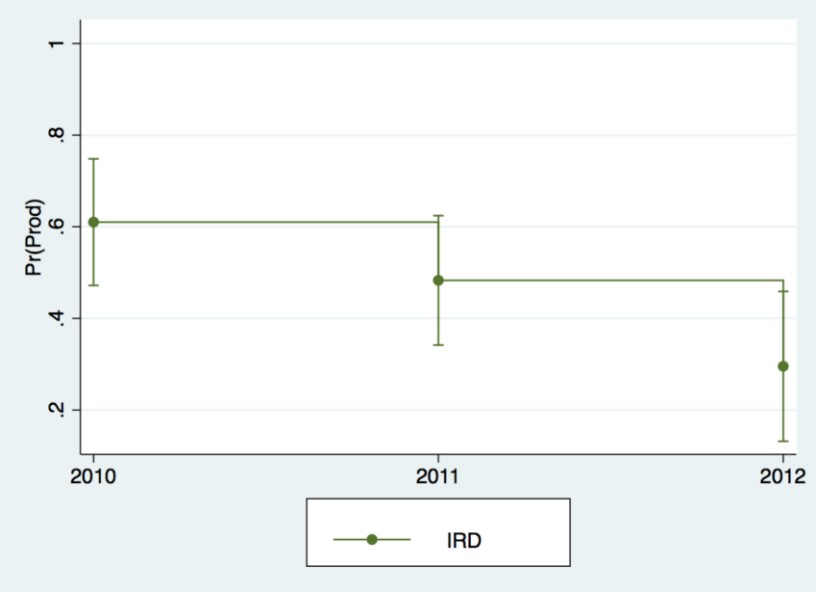

Fig. 5: Predictive Margins of SECTOR and IRD at 95% C.I.

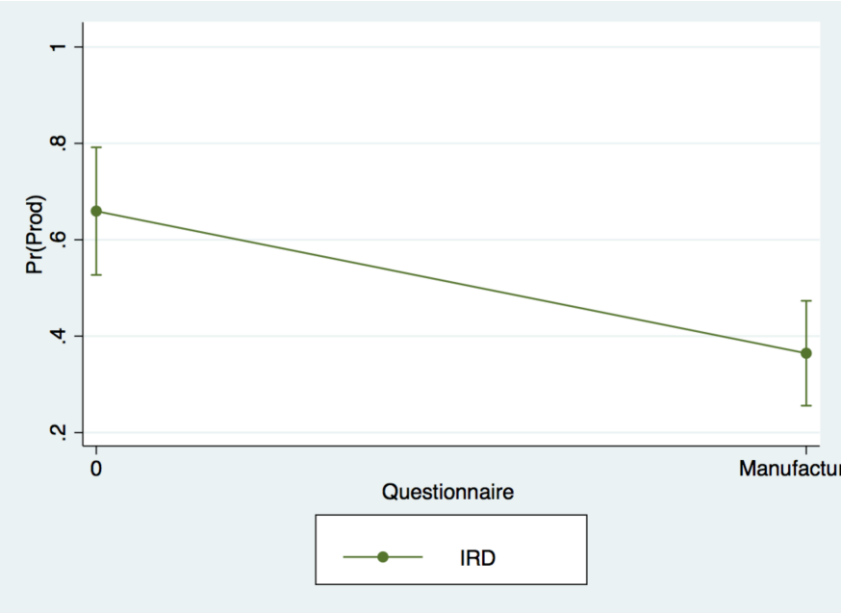

Figure 4 and Figure 5 reveal that firm spending on internal research and development has greater impact on a firm's decision to undertake product innovation the older a firm is and if a firm is in the services sector rather than the manufacturing sector. This may be because older firms have had more time to develop their internal knowledge base and are thus in a better position to identify and utilize technological opportunities emanating from outside the firms. In terms of the sector production innovation occurs, services sector firms have lower capital needs relative to manufacturing sector firms which make them less costly with respect to financial resources to innovate than manufacturing firms resulting in them facing less financial barriers

Purchase of machinery, equipment, and software furthermore enhances services firms likelihood of undertaking product innovation probably because of their lower capital needs relative to manufacturing sector firms that enable them to have more resources to invest in internal research and development. Availability of such resources implies service sector firms are more likely to have more developed internal knowledge bases in a shorter period than manufacturing firms that lead to greater impact on product innovation than for manufacturing firms.

The probability of a firm undertaking product innovation in Model 3 exceeds the probabilities in Model 1 and Model 2 indicating the interaction of external and internal knowledge raises the probability of a firm to undertake product innovation. This is because apart

from external knowledge being utilized to undertake product innovation, it is also utilized to enhance the internal knowledge base required to effectively identify and utilize external knowledge for product innovation.

5. CONCLUSION

Innovation in developing countries usually involves two aspects, the development of an internal knowledge base and acquisition of external knowledge. Although both aspects can influence innovation in their own ways, existing literature reveals combination of both aspects of knowledge lead to higher likelihood of innovation (Szogs, 2004; Cassiman and Veugelers, 2006; Lokshin, Belderbos and Carree, 2006). External knowledge can thus enhance innovation by improving development of internal knowledge while internal knowledge can facilitate effective utilization of external knowledge with regards to innovation. This study has analysed the impact of internal knowledge and external knowledge on product innovation in isolation as well as the combined effect of both to assess how they interact to impact product innovation.

Purchase of equipment, machinery or software (PEQP) is the main external source of knowledge in Tanzania while firm investment in external research and development does not influence product innovation. This is probably because the relatively young age of sampled firms, which have low technological capabilities that constrain them to undertake adequate external research and development. Service sector firms and firms that have been established in the market for some time undertake product innovation more than manufacturing firms and relatively old firms probably because such firms face less financial barriers to innovation than manufacturing and young firms.

The main source of internal knowledge in Tanzanian firms is firm spending on internal research and development while business knowledge and codified knowledge do not influence a firm's decision to undertake product innovation. This is probably because output of internal research and development tends to be more sustainable than knowledge generated through training and staff recruitment that may be depleted or totally lost in the face of employee turnover. Furthermore, development of an internal base of knowledge is better undertaken by investing in internal research and development than on business and codified knowledge, which are more effective only when an adequate internal knowledge base is developed.

The impact of internal knowledge (ignoring external knowledge) on product innovation is

greater than the impact of external knowledge (ignoring internal knowledge). This is probably because of the young age of firms in the sample, which still have poor absorptive capacity that limit their capacity to identify and exploit technological opportunities emanating from outside the firm.

The interaction of external and internal knowledge raises the probability of a firm to undertake product innovation because apart from a firm utilizing external knowledge to undertake product innovation, it also uses it to enhance the internal knowledge base required to effectively identify and utilize external knowledge for product innovation. External knowledge complements internal knowledge in product innovation and the more developed a firm's internal knowledge, the more external knowledge sourcing is more effective in facilitating product innovation. Thus despite the relative young age of the sampled firms, they have reasonable absorptive capacity to effectively utilize external knowledge for product innovation.

Firm spending on internal research and development reduces the influence of purchase of machinery, equipment or software on product innovation. This can be explained by the fact that firms do not purchase of machinery, equipment or software just with the objective of utilizing them to undertake product innovation, but also to facilitate development of its internal knowledge base by utilizing them to enhance internal research and development efforts.

External knowledge acquisition through purchase of machinery, equipment, and software is more effective in facilitating product innovation for older firms and firms in the services sector than for relatively younger firms and firms in the manufacturing sector. This is probably because older firms have more experience than relatively younger firms in undertaking measures to develop internal knowledge that improve acquisition and utilization of external knowledge. Furthermore, firm spending on internal research and development has greater impact on a firm's decision to undertake product innovation for older firms and for firms in the services sector because older firms probably have had more time to develop their internal knowledge base and are thus in a better position to identify and utilize technological opportunities emanating from outside firms. Purchase of machinery, equipment, and software furthermore enhances services firms likelihood of undertaking product innovation probably because of their lower capital needs relative to manufacturing sector firms that enable them to have more resources to invest in internal research and development.

The study had several limitations as well. First, the data used for the paper provided information only on firms established between 2010 and 2012. This made it impossible to analyse the sustainability of innovativeness of firms and dynamics of knowledge acquisition. Second, the data used did not reveal firms prior innovation history, which could have indicated the basis for firm innovation and the importance of prior innovation to current innovation over time. Third, the data prevented analysis of the mechanisms of making knowledge acquisition decisions that could have revealed factors driving such decisions.

Given the limitations of the study, there are several areas for future research. One area for future research can focus on analysing knowledge acquisition by firms over a longer period of time to analyse the sustainability of firm innovativeness and knowledge acquisition dynamics. Analysis of prior innovation history and basis of previous innovation is another area for future history that can help identify basis of knowledge acquisition decisions and their impact on current innovation. Another area for future research is the analysis of impact of knowledge sources on innovation by sectors, size of firms and nature of human capital in firms in order to determine the impact of these factors on knowledge acquisition and innovation.

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