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# **Factors Affecting Engagement and Commercialization of Innovation Activities of Firms in Tanzania**

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# **Factors Affecting Engagement and Commercialization of Innovation Activities of Firms in Tanzania**

## **ABSTRACT**

In this paper, we analyse the commercialization of innovations in Tanzania using firm level data. Specifically, we assess the relative importance of firm, innovation and environmental level factors in commercialization and how innovation is linked with commercialization. Environmental level and innovation level factors all impact commercialization of innovation in Tanzania while firm level factors not influencing commercialization. Cooperation with domestic firms, an environmental level factor has the greatest impact on commercialization followed by the cost-reducing motive of engaging in product innovation and firm funding of external research and development. The analysis reveals engaging in product innovation with a goal of reducing cost and firm funding of external research and development are the only factors impacting both product innovation and commercialization of innovations in Tanzania implying enhancement of firm efficiency and internal knowledge base is the main link between product innovation and commercialization of innovations. Market factors such as changes in promotion and advertising methods surprisingly do not influence commercialization of innovations.

## 1. INTRODUCTION

Innovation basically involves the generation, exploitation and manipulation of new forms of knowledge by firms to create new products or services (Schulze and Hoegl, 2008; Katila and Chen, 2008). Innovation is, however, only relevant if the products or services created have economic value that can be realized by the successful commercialization of the new products and services. Commercialization is the process of converting technologies and techniques emanating from innovation into viable high quality products that can adequately be manufactured cost effectively. Commercialization involves a series of processes for the development, manufacturing, and marketing of products and ensures that innovations meet performance, reliability and economic requirements, which imply that successful innovation manifests itself in commercialized products that add value to consumers and firms (Balachandra et. al, 2010). As such, commercialization can serve as an important aspect of satisfying consumers (Zahra and Nielsen, 2002).

It is important to realize, however, that although there are many innovations, not all of them are successfully brought to the market. In fact, only a very low proportion of raw ideas culminate into successful commercial products due not only to technical issues but also flaws in and understanding of the commercialization process (Stevens and Burley, 1997; Chiaroni et. al, 2010). Successful commercialization enables firms to enhance market penetration, dominance and exploitation of new markets, which enhances economic performance and leads to growth (Datta, 2011; Zahra and Neilsen, 2002; Cohen and Levinthal, 1990). In addition, it is an important aspect of broader economic growth, because it is the avenue through which innovations generate value and through which economic growth and economic development are stimulated (as already described by Schumpeter, 1912). As such, the successful commercialization of innovations may be particularly important for firms in developing countries.

Given the significance of commercialization to both firm and broader economic growth and development and the low success rate of commercialization, a more complete understanding of successful commercialization with respect to factors driving it is necessary. Previous studies have explored a variety of antecedents of technology

commercialization (Park and Ryu, 2015), such as resources (Chen, 2009), capabilities (Dougherty and Hardy, 1996), networks (Park and Rhee, 2013), entrepreneurial culture (Conceicao et al., 2002), and entrepreneurial activities (Datta et al., 2012). Yet, we lack a more comprehensive perspective on successful commercialization, especially in developing countries.

In light of this, the objective of this paper is to identify factors determining the commercialization of innovations in Tanzania. Specifically, the paper analyses the relative importance of firm, innovation, and environmental level factors for commercialization and how innovation is linked with commercialization. We focus on these factors as research has shown these three to be the most relevant groups of factors explaining innovation in developing economies (Wang and Lin, 2013). We extend that research by assessing the relative importance of these factors for the commercial success of innovations.

The remainder of the paper is structured as follows. Section 2 describes the relationship between innovation and commercialization. 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. INNOVATIONS AND COMMERCIALIZATION**

As innovation entails translation of ideas or inventions into products with economic value the market demands, it is incomplete until innovative products resulting from innovation are accepted and adapted by the market. Market acceptance and adaption of innovative products is the core of commercialization, which is the final piece of the innovation puzzle. Innovation and commercialization are therefore closely linked, as the former is a prerequisite for the latter while the latter completes the former.

The close link between innovation and commercialization has led many studies to assume they go hand in hand where commercialization is assumed as long as innovation has

taken place (Vega-Jurado et al., 2008; Burgelman et. al, 2006; Dahlin and Behrens, 2005; Portelli and Narula, 2006; Danielson and Mjema, 1994; Chandler, 1977). Although innovation is a necessary condition for commercialization by leading to development of new products, it is not a sufficient condition for market success, which depends on other factors different from those driving by innovation.

Other studies have separated innovation and commercialization in recognition of the fact that they are not necessarily determined by the same factors (Bogers and West, 2012; Nerker and Shane, 2007; Baldwin and von Hippel, 2011; Dahlander and Gann, 2010; Chesbrough, 2006). Since commercialization is the culmination of innovation, it is a function of all the stages preceding it. Various scholars (Datta et al., 2012; Balachandra et al., 2010; McCoy et al., 2009; Andrew and Sirkin, 2003, Nerker and Shane, 2007; Jolly, 1997; Corkindale, 2010; Sigel et. al, 1995) describe commercialization as consisting of stages preceding and following market adaption of innovative products such as investigation, development and commercial phases.

Literature on innovation and commercialization indicate existence of a variety of factors that impact commercialization in different directions and magnitude. Some studies have grouped factors influencing the decision of firms to commercialize into environmental level, firm level and innovation-level factors (Teece, 1986; Arora et al., 2001; West and Bogers, 2014; Chesbrough, 2003; Herzog and Leker, 2010; Baldwin and von Hippel, 2011). This paper adapts such a grouping to analyse factors influencing commercialization of innovations in Tanzania.

### **3.1 Environmental Level Factors**

Environmental factors are strength of appropriability mechanisms that make commercialization profitable, availability of markets for technology, institutional framework facilitating knowledge accumulation, and industry structure. Firm level factors are availability of complementary assets (manufacturing, distribution, marketing, sales, and support capabilities), internal knowledge base, knowledge acquisition, and corporate culture. Innovation level factors pertain to alignment of that innovation to a

firm's business model, nature of firm's product, communication costs, and absorptive capacity.

Rasmussen (2008) and Behboudi et al. (2011) assert governments enhance institutional framework facilitating knowledge accumulation and commercialization by creation of national innovation systems, reforms in the national research system and preparing for productive and commercialization capacities by creating markets by motivating the demands of various sectors in the economy. Datta et al. (2012) identifies the form of firm structure required for commercialization as ownership of technology in the process of commercialization and external networks that facilitate firm access to critical resources, knowledge, and capabilities.

### **3.2 Firm Level Factors**

Firm level factors are availability of complementary assets (manufacturing, distribution, marketing, sales, and support capabilities), internal knowledge base, knowledge acquisition, and corporate culture.

Various studies have analysed commercialization by examining market behaviour after innovation with regards to response to incumbents firms in the market (Gans and Stern, 2003; McCoy et al., 2009; Gans et al, 2002; Marx et al., 2014; Hsu, 2006) finding commercialization strategy is determined by market environment, uncertainty about an innovation's future value, incumbent's integration costs, friction, and access to complementary assets. Other studies examining the relationship between market strategy formulation by firms and commercialization (Gilson and Shalley, 2004; Weick, 1998; Brown and Eisenhardt, 1997) identified market creativity and market improvisation as important elements of commercialization of innovations because they enable firms to adapt to changing markets and technologies and innovate while innovating.

### **3.3 Innovation Level Factors**

Innovation level factors pertain to alignment of innovation to a firm's business model, nature of firm's product, communication costs, and absorptive capacity. Määttänen (2012) defines different phases of technology commercialization as idea generation, technology development, seeking market opportunities, market promotion, and sustaining commercialization. These involve planning, basic and applied research, design, engineering and manufacturing, market strategy and business planning, pre-launch and test marketing, and value assessment.

Datta et al. (2012) identifies the ability of a firm to absorb scientific or technological information as an important aspect of innovation and therefore enhances commercialization of innovations by facilitating production of high quality output with higher likelihood of being consistent with market demand. Furthermore, the previous experience of managers in bringing innovations to market which also impact firm decisions on innovation and subsequently commercialization. Given commercialization entails stages preceding and following market adaption of an innovative product, it is thus a function of technical, market and business factors. The technical side of commercialization involves innovation and factors affecting it. Innovation entails translating ideas into useful output and is determined by knowledge acquisition, which can be internal or external.

Internal knowledge involves development or acquisition of knowledge within a firm's boundaries through in-house knowledge dissemination and research and development, and internal education and training while external knowledge on the other hand involves introduction of new knowledge from sources outside a firm via external research and development and purchase of equipment or intangible technology. Existence of an adequate knowledge base is however necessary for a firm to successfully utilize acquired knowledge to innovate (Cohen and Levinthal, 1990; Garud and Nayyar, 1994; Zahra and George, 2002).



Various studies examining the link between sources of knowledge and innovation have found internal knowledge and external knowledge complement each other as the latter can enhance a firm's capacity to generate the former while the former can enhance a firm's capacity to adequately utilize the latter in innovation (Beneito, 2003; Lundvall, 1988; Cohen and Levinthal, 1990; Edquist, 2004; Lowe and Taylor, 1998; Portelli and Narula, 2006; Szogs, 2004; Mahemba and De Bruijn, 2003). Since innovation is a necessary condition for commercialization, knowledge acquisition is one of the factors that can determine commercialization of innovations by ensuring products are adequately developed in a manner that enhances their chances of penetrating the market.

Once a product is developed it has to be diffused and adopted by consumers in the market. This entails marketing the product to convince people of its usefulness. Nerker and Shane (2007), McCoy et al. (2009) and Moore (1991) consider successful commercialization as the sale of an innovative product not only to innovative product enthusiasts who are easy to convince but make up a small share of a market but also to innovative product pragmatists who are difficult to convince but make up a large share of the market. Successful commercialization is thus not just mere sale of an innovative product in a market but rather widespread sale implying wide adaption of the product. Marketing involves disseminating information in a targeted manner about a new product to demystify with regards to function, cost, and advantages over existing products in order to make it more acceptable to pragmatists who form a large segment of any market.

It is common for many firms to develop innovations without considering profiting from such innovations implying non-prioritization of commercialization from the onset. Products are however useless until they are commercialized implying it is necessary to carry out business models for commercializing new innovations. A business model links technical decisions and economic outcomes with alignment of choice of an innovation and its commercialization strategy with a firm's business model leading to profit (Chesbrough, 2006; Chesbrough, 2003).

### **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. It furthermore provides data on commercialization and commercialization related variables. Specifically, it contains information on the innovation output, innovation-related activities, commercialization and commercialization related activities such as sales of innovative products, product innovation, process innovation, organizational innovation, and marketing innovation for Tanzanian firms.

#### **3.2 Variables**

##### **Dependent Variables**

Although the study focuses on identifying factors determining commercialization of product innovations in Tanzania, it must be noted that innovation is a necessary condition for commercialization. The study thus also explores the factors determining product innovation in Tanzania. The study therefore has two dependent variables, one for commercialization and the other for product innovation.

As commercialization of innovations entails converting ideas and inventions into viable products demanded by the market, commercialization must be related to sales of innovative products. Given this, the dependent variable is percentage of a firm's total sales represented by sales from its main innovative product or service (COMM). The fact that COMM is only observable for some values of percentage of sales of innovative products ranging between 1 and 100 percent implies it is censored variable.

Innovation is a process rather than an instantaneous event, and therefore should not just consider actions that have led to development of innovative products but also attempts to develop innovative products as such attempts put ideas in practice. In light of this, the

dependent variable for product innovation is firm attempts to develop innovative products (PROD) which is a dummy variable.

### **Independent Variables**

There are two sets of independent variables, those that can influence commercialization and those that can influence product innovation. These are environmental level, firm level, and innovation level independent variables. Environmental level independent variables are cost reducing motive for engaging in innovation (MCOST) that indicates the economy has high production costs. Sector of economy firm belongs to (SECTOR) i.e. a manufacturing dummy.

Firm level independent variables influencing commercialization are changes undertaken by a firm in promotion of its products or services (PROMOTE), changes undertaken by a firm in advertising its products or services (ADVERT), knowledge acquisition through purchase of equipment, machinery or software (PEQP), and purchase of intangible technology (PINT). Innovation level independent variables are firm funding of internal research and development (IRD), firm funding of external research and development (ERD), recruitment of staff for innovation purposes (RECRUIT), and staff training (TRAIN).

### **3.3 Empirical Specification**

Since commercialization and innovation are related in the sense that successful product innovation is a prerequisite for commercial success of innovative products, we must use a model that takes into account the fact that product innovation is a necessary condition for successful innovation. This can be achieved using the Heckman selection model that considers observations as being ordered into two categories on the basis of whether a firm undertakes product innovation or not.

The Heckman selection model has two stages. The first stage (selection equation) defines a binary variable that indicates the category into which the observation falls while the second stage (regression equation) entails estimating the outcome of interest given the

first stage provided a positive outcome. First stage and second stage models are shown in equations (1) and (2) respectively.

$$ax + u_1 > 0 \quad (1)$$

$$y = bz + u_2 \quad (2)$$

The Heckman model involves estimating (1) using the probit maximum likelihood method to determine whether a firm undertakes product innovation and factors determining product innovation (selection equation) followed by estimating a Tobit regression of commercialization conditional on a firm undertaking product innovation (regression equation).

### **Selection and Regression Equation Variables**

The dependent variable for the selection equation is firm attempts to develop innovative products (PROD), a dummy variable (dependent variable) while the dependent variable for the regression equation is the percentage of a firm's total sales represented by sales from its main innovative product or service (COMM), a censored variable.

The selection and regression equations have the same independent variables. These are the sector of economy firm belong to (SECTOR) i.e. a manufacturing dummy, firm cooperation with domestic firms (CODF), and cost reducing motive for engaging in product innovation (MCOST) which are environmental level independent variables. Firm level independent variables are knowledge acquisition through purchase of equipment, machinery or software (PEQP), purchase of intangible technology (PINT), changes undertaken by a firm in promotion of its products or services (PROMOTE), and changes undertaken by a firm in advertising its products or services (ADVERT). Innovation level independent variables are firm funding of internal research and development (IRD), firm funding of external research and development (ERD), recruitment of staff for innovation purposes (RECRUIT) and staff training (TRAIN).

## **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 3 summarises statistics of the variables used.

Table 3 reveals innovative products account for just over a third of total sales of innovative firms indicating a satisfactory rate of commercialization of innovations. Only a small number of firms cooperate with domestic firms. Less than a fifth of firms undertook changes to the way they promote their products that indicate weakness in innovation promotion, which may hinder commercialization.

Table 3 furthermore 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 regard 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 3:** Descriptive Statistics and Correlation Coefficients of Variables

	Mean	SD	COMM	PROD	ERD	IRD	PINT	PEQP	TRAI N	RECR UIT	SECT OR	PROM OTE	ADVE RT	CO DF	MCO ST
COMM	6.36	17.1													
PROD	0.21	0.41	0.24												
ERD	0.04	0.18	0.05	0.19											
IRD	0.22	0.42	0.03	0.12	0.21										
PINT	0.17	0.38	0.13	0.18	0.15	0.08									
PEQP	0.40	0.49	0.03	0.13	0.11	0.45	0.21								
TRAIN	0.25	0.43	0.03	0.02	0.14	0.41	0.05	0.47							
RECRUIT	0.03	0.19	0.35	0.18	0.12	0.11	0.17	0.06	0.07						
SECTOR	0.50	0.50	0.09	-0.12	0.03	0.03	0.05	0.15	0.08	-0.02					
PROMOTE	0.16	0.37	0.24	0.15	0.11	0.04	0.04	0.03	0.03	0.01	-0.02				
ADVERT	0.15	0.36	0.22	0.18	0.14	0.22	0.17	0.24	0.16	0.16	0.05	0.39			
CODF	0.007	0.01	0.21	0.06	-0.02	-0.05	0.02	0.02	-0.001	-0.02	-0.08	0.08	0.08		
M COST	0.28	0.66	0.79	0.27	0.07	0.02	0.13	0.07	0.03	0.43	0.08	0.23	0.261	0.15	

The correlation coefficients in Table 1 reveal cost reducing motive for engaging in innovation (MCOST)) and recruitment of staff for innovation purposes (RECRUIT), changes undertaken by a firm in promotion of its products or services (PROMOTE), and changes undertaken by a firm in advertising its products or services (ADVERT) have the greatest correlation with commercialization of innovations indicating internal knowledge base and market factors may play significant roles in commercialization of innovations in Tanzania consistent with Goedhuys (2005). Firm cooperation with domestic firms (CODF) is also important in influencing commercialization.

Table 3 reveals cost reducing motive for engaging in innovation (MCOST) has the highest correlation with product innovation indicating product innovation may be mostly driven by market factors. Furthermore, the internal knowledge base has significant correlation with purchase of equipment, machinery or software (PEQP) and staff training (TRAIN) indicating the importance of both internal and external knowledge sources for innovation. Firm funding of internal and development (IRD) has significant correlation with external research and development (ERD) indicating the complementarity between internal and external knowledge (Mohnen and Roller, 2005; Cassiman and Veugelers, 2006).

#### **4.2 Regression Analysis**

Table 4 shows Results of Selection and Outcome Equations of the Heckman Model of Commercialization. The probability of the likelihood Chi-square values for the model indicates the models fit significantly better than models without regressors.

**Table 4:** Results of Selection and Outcome Equations of the Heckman Model of Commercialization

Selection Equation				Regression Equation				
	Coeff	SE	Z-Value	COMM	Coeff	SE	Z-Value	Marginal Effect
ERD	0.977***	0.335	2.92	ERD	-11.101*	5.728	-1.94	-17.47
IRD	0.129	0.176	0.73	IRD	1.849	3.281	0.56	1.96
PINT	0.386**	0.166	2.33	PINT	3.497	3.377	1.04	7.63
PEQP	0.363**	0.159	2.28	PEQP	-4.800	3.572	-1.34	4.50
TRAIN	-0.262	0.179	-1.46	TRAIN	4.844	3.745	1.29	4.94
RECRUIT	0.322	0.341	0.94	RECRUIT	6.946	5.171	1.34	7.63
PROMOTE	0.207	0.183	1.14	PROMOTE	-0.801	3.784	-0.21	-3.92
ADVERT	0.223	0.191	1.17	ADVERT	0.809	3.627083	0.22	-0.52
MCOST	0.448***	0.109	4.10	MCOST	16.689***	2.194	7.60	18.03
CODF	-0.023	0.659	-0.04	CODF	19.456*	10.700	1.82	19.46
SECTOR	-0.491***	0.136	-3.60	SECTOR	4.123961	3.483894	1.18	5.73
Number of obs = 543				rho = -0.5689904				
Censored obs = 424				sigma = 15.21377				
Uncensored obs = 119				lamda = -8.656488				
Wald chi2 (11) = 134.23								
Prob > chi2 = 0.0000								
*: p<0.10; **:p<0.05; ***:p<0.01								



### **Environmental Level Factors**

The cost reducing motive for engaging in innovation (MCOST) significantly impact both the selection and outcome equations with it increasing the chances of a firm commercializing the innovative product it produces by about 18 percent. The fact that cost reduction influences both production innovation and commercialization of innovative products indicates firms are concerned about high production costs that negatively impact firm revenue from a given product range. Such firms pursue product innovation to overcome high production costs by innovating and commercializing new products that will lead to increase in revenue.

Belonging to the manufacturing sector reduces a firm's chances of undertaking product innovation. This is probably because the size of the service sector is more than 4 times larger than the manufacturing sector in Tanzania implying there is 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 production in the manufacturing sector.

Product innovation is thus less costly to pursue in the service sector relative to the manufacturing sector implying less financial barriers to product innovation in the services sector than in manufacturing sector. Although the sector a firm belongs to influences chances of a firm undertaking product innovation, it does not influence commercialization of innovative products. This indicates the production costs differences between manufacturing and service sector firms do not influence commercialization, which is rather determined by firm level and innovation level factors.

Cooperation with domestic firms (CODF) significantly influences commercialization of innovative products although it does not influence a firm's decision to undertake product innovation indicating domestic firm links do not influence firms' decisions to undertake product innovation. Cooperation with domestic firms however significantly influences commercialization of innovations by increasing commercialization by about 19.5

percent, which is the highest for the three variables influencing commercialization of innovations. This is because it leads to greater benefits pertaining to building commercialization capabilities that are determined by such factors as marketing, distribution, and sales capacities and are crucial for commercialization. This is consistent with Marx et al. (2014), Datta et al. (2012) and Gans and Stern (2003) who identified complementary assets such as manufacturing, distribution, marketing, sales, and support capabilities as being crucial for commercialization. Domestic links are thus more important to a firm after it undertakes product innovation and has a product to offer than when it is pursuing product innovation because such links enhance commercialization capabilities like marketing, distribution, and sales capacities than it does production capabilities that are more influenced by external knowledge acquisition.

### **Firm Level Factors**

Firms' knowledge acquisitions through purchase of equipment, machinery or software (PEQP) and intangible technology (PINT) significantly enhance their chances of undertaking product innovation although they do not influence commercialization of innovations. Product innovation in Tanzania is thereby driven more by external acquisition of knowledge through buying technology than investing in internal research and development. This is probably because of low levels of technological capability that constrain firms' capacities to undertake adequate internal research and development. This finding is consistent with Portelli and Narula (2006) and Szogs (2004).

Marketing factors such as changes undertaken by a firm in promotion of its products or services (PROMOTE) and changes undertaken by a firm in advertising its products or services (ADVERT) do not influence firms' chance of undertaking product innovation or commercialization of innovations. This indicates most firms do not pursue product innovation market strategy formulation simultaneously that enable firms to adapt to changing markets and technologies and thereby enhance chances of firms successfully commercializing their innovated products.

For firms that pursue product innovation market strategy formulation simultaneously, insignificance of changes undertaken by firms in promotion and advertising of their products or services in influencing commercialization may be due to the fact that implementation of market strategies do not yield results overnight but rather take some time to yield expected results. The period of 3 years that the data focuses on may therefore be too short for a marketing strategy to yield results. However, once firms marketing strategies come to fruition, firms will likely be able to adapt to changing markets and technologies that will likely lead to commercialization of their innovation (Gilson and Shalley, 2004).

### **Innovation Level Factors**

Innovation level independent variables are firm funding of internal research and development (IRD), firm funding of external research and development (ERD), recruitment of staff for innovation purposes (RECRUIT) and staff training (TRAIN).

Firm funding of external research and development (ERD) significantly influences product innovation and commercialization of innovations although in opposite direction. Funding of external research and development enhances chances of firms undertaking product innovation by increasing the capacity of internal knowledge to influence product innovation (Portelli and Narula, 2006). Firm funding of external research and development enhances chances of firms undertaking product innovation by enhancing a firm's internal knowledge base.

Firm funding of external research and development reduces commercialization of innovations by 17.4 percent. This counterfactual result may probably be because funding of external research and development requires a longer-term commitment than purchasing equipment, machinery or software and intangible technology and is thereby more costly and requires more resources to pursue. Funding of external research and development thus tends to crowd out investment in other factors influencing commercialization such as developing and maintaining cooperation with domestic firms as well as shifting focus from cost reduction to development of new products which

significantly influence commercialization.

Although shifting focus of firms from cost reduction to development of new quality products may reduce commercialization of innovations in the short run, it is likely to increase commercialization in the long run because quality products eventually attract customers. The negative impact of firm funding of external research and development is thus most likely a temporary phenomenon in the short run as the result of funding of external research and development will likely enhance commercialization of innovations as long as it leads to introduction of quality products.

## **5. CONCLUSION**

Analysis of commercialization of innovations must take into account the fact that innovation is a necessary condition for commercialization and therefore must analyse it before proceeding to analyse commercialization. Environmental level factors influencing product innovation and commercialization of innovations are the cost reducing motive for engaging in innovation, the sector a firm belongs to, and cooperation with domestic firms

The sector a firm belongs to enhances chances of a firm undertaking product innovation while cooperation with domestic firms and the cost reducing motive for engaging in product innovation have the greatest impact on commercialization as they enhance commercialization of innovations by 19.5 percent and 18 percent respectively with the latter also enhancing chances of a firm undertaking product innovation.

Firm level factors influence a firm's chances of undertaking product innovation without influencing commercialization of innovations through the purchase of equipment, machinery or software and intangible technology. Firms may take such an approach to product innovation because of low levels of technological capability that constrain firms' capacities to undertake adequate internal research and development. Marketing factors surprisingly do not influence commercialization of innovations giving an indication that

most firms do not pursue product innovation and market strategy formulation simultaneously or that market strategies formulated by firms are yet to yield results.

The only innovation level factor influencing product innovation and commercialization of innovations is firm funding of external research and development with it enhancing chances of firms undertaking product innovation while lowering commercialization of innovations by 17.4 percent. Firm funding of external research and development may lower commercialization of innovations by crowding out investment in other factors influencing commercialization such as developing and maintaining cooperation with domestic firms as well as shifting focus from cost reduction to development of new products which significantly influence commercialization.

Given the specific objectives of the paper of determining the relative importance of firm, innovation and environmental level factors for commercialization and the extent to which innovation is linked with commercialization, environmental level and innovation level factors all impact commercialization of innovation in Tanzania with firm level factors not influencing commercialization. However, cooperation with domestic firms, an environmental level factor has the greatest impact on commercialization followed by the cost-reducing motive of engaging in product innovation and firm funding of external research and development.

With regards to the link between innovation and commercialization, cost reducing motive for engaging in innovation and firm funding of external research and development are the only variables that significantly impacts both product innovation and commercialization. Since cost is related to efficiency and external research and development enhances a firm's internal knowledge base, product innovation and commercialization are linked through enhancement of firm efficiency and internal knowledge base.

The study had several limitations. First, data used for the paper only provided information on firms established between 2010 and 2012 making it impossible to analyse the sustainability and dynamics of commercialization. Second, the data used lacked

information on firms prior commercialization history needed to capture the evolution of commercialization over time. Third, the data lacked sufficient information on managerial aspects of decision making which can play a significant role in commercialization.

Given the limitations of the study, there are several areas for future research. One area for future research can focus on analysing commercialization behaviour of firms over a longer period of time to analyse sustainability and dynamics of commercialization. Analysis of the evolution of commercialization over time and its impact on subsequent commercialization is another area for future research. Another area for future research is the analysis of commercialization by specific characteristics such as sectors, size of firms, and managerial characteristics in order to determine the impact of such factors on commercialization of innovations.

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