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Effects of Finance Sources on Innovation Activities in Manufacturing Sector in Kenya

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**THE KENYA INSTITUTE FOR PUBLIC POLICY
RESEARCH AND ANALYSIS (KIPPRA)**

**YOUNG PROFESSIONALS (YPS) TRAINING
PROGRAMME**

Effects of Finance Sources on Innovation Activities in Manufacturing Sector in Kenya

*Chore Kahuya Caroline
Wakhungu Hillary*

Kenya Institute for Public Policy
Research and Analysis

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Abstract

Innovation in the manufacturing sector is influenced by several factors, including the source of finance. In Kenya, financing of innovation activities has been lacking due to limited financial systems and market to fund innovation, yet innovation produces positive spillover effects to the economy. This study sought to determine the effects of financing sources on innovation activities among manufacturing firms in Kenya. Product, process and market innovation were considered due to their critical importance to competitive outcomes and expansion of the firm. Data from 455 manufacturing firms in Kenya as captured in the World Bank Enterprise Survey was used in this study. Logit regression models were used in the study using Stata software for explanatory variables to measure the effect of explanatory variables on firm innovation activities. The results showed that firms that use internal finance were less innovative, while those that use bank finance, non-bank, credit, government, and SACCO had a positive and significant product, process and market innovation activities among manufacturing firms in Kenya. Other firm characteristics such as size and age of the firm showed a positive influence on firms being innovative if they access their working capital from external sources. Policy makers should ensure review of legislation to attract firms to external sources of finance by coming up with financing products targeted to manufacturing firms. To help small and medium manufacturing firms, policy should be enacted to ensure smooth financing to the industries. Further, there is need to consider fast-tracking the adoption of proposed credit guarantees scheme regulation, which seeks to promote access to quality and affordable credit to micro, small and medium enterprise (MSMEs) and to alleviate the challenges faced by MSMEs while seeking credit.

Abbreviations and Acronyms

ADB	African Development Bank
CDF	Cumulative Distribution Function
FDI	Foreign Direct Investment
GDP	Gross Domestic product
GII	Global Innovation Index
ICT	Information Communication and Technology
ISIC	International Standard Industrial Classification
NIC	Newly Industrialized Country
NIP	National Industrialization Policy
OECD	Organization for Economic Co-operation and Development
PPPs	Public Private Partnerships
SACCO	Savings and Credit Cooperative
ST&I	Science Technology and Innovation
R&D	Research and Development
WBES	World Bank Enterprise Survey

Definition of Terms

Total finance: This is finance that is available to firms from both the internal sources such as retained earnings and external sources such as loans from banks, non-bank institutions, SACCOS, and government grants.

Product innovation: Defined as any goods, service, or idea that is perceived by its users as new.

Market innovation: Encompasses the exploitation of new territorial markets or the penetration of new market segments in the existing market.

Process innovation: Innovation adaptation existing production lines and the installation of entirely new infrastructure and the implementation of new technologies. Any changes in marketing, purchases and sales, administration, management, and staff policy are classified as organization innovation.

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1. Introduction

Innovation is one of the major drivers of economic development, especially the creation and diffusion of technologies for economic growth and welfare across all economies. According to Schumpeter (1930), innovation is defined as the introduction of new or qualitative change in existing products, processes, markets, sources of supply of inputs, and organizations. Innovation encompasses elements of novelty and creativity that require a multi-actor process that is complex and determined by several factors such as finance (Assink 2006; Boer et al., 2001).

Firms majorly rely on two methods of finance to fund their operations (Mamasioulas et al., 2020). The sources are mainly internal and external. Internal financing is where a firm uses its retained earnings or assets as a source of finance to fund investment or a new project. External financing to a great extent comes from outside the firm, which may include lenders and shareholders. Innovation being a critical component of firm operations, usually requires funds to be actualized. Studies have indicated that finance sources influence the ability of firms at all levels, including their capacity to be innovative (Benfratello et al., 2008). Literature shows that firms depend on internal and external sources of financing to fund innovation.

Manufacturing firms function in a very competitive environment as they are usually faced by severe global competition in terms of new products, production technologies, new materials, legislative, organizational, and business model developments. These factors usually force firms to rely on innovation to cope with the competition (Mamasioulas et al, 2020). The manufacturing sector is considered critical for innovation because of its flexibility to respond to new opportunities, capability to diversify their activities and entrepreneurial spirits to create new products, processes, and organization forms (Organization for Economic Co-operation and Development - OECD, 2013).

In Kenya, financing of innovation activities is a tall order due to limited financial system and market to fund innovation, yet innovation produces positive spillover effects to the economy. The MSMEs Survey 2016 revealed that a small proportion of firms in Kenya (7.38%) participated in innovation activities This has led to manufacturing firms in developing countries not competing with their international counterparts that innovate more often (Asiendu et al., 2021). The identified causes of firms not innovating included cost of innovation, limited access to financing and lack of human capacity, lack of awareness of sources of finance for innovation and technological support in the manufacturing sector.

Kenya has been making significant steps towards establishing a strong innovation-driven economy, particularly since 2008. The Kenya government and the private

sector efforts to steer the development of innovation has been witnessed by the various policy, legal and institutional frameworks formulated by the government in collaboration with the private sector. The Keny Vision 2030, which is an overarching development agenda for the country, has emphasized on science, technology and innovation as a key enabler to the realization of the country's development. This course has been reinforced by the "Big Four" agenda, which emphasizes on fostering innovation through the manufacturing sector.

Despite these efforts, innovation still faces bottlenecks in terms of access to finance. Currently, this is not the case since the recent statistics shows that ST&I receives approximately 0.79 per cent of GDP. In addition, finance which is limited, scarce and difficult to access has constrained firms from engaging in innovative activities. The capital structure of a firm and especially access to external finance play a key role in innovation, therefore any obstacle to access of finance in manufacturing firms derails the efforts of a firm being innovative.

The manufacturing sector operates in a competitive environment where they constantly face challenges such as introduction of new products. Changes in technological production, and introduction of new policy and legislation may severely hinder their performance. To stay put amidst this dynamism, the sector is forced to be innovative to counteract these challenges and stay competitive and safeguarding their market share, both regional and globally. Finance is an important aspect in the manufacturing sector, and the sources of finance in this sector includes internal and external finance. Finance and innovation are highly intertwined; therefore, financing sources can influence a firm's capacity to be innovative (Benfratello et al., 2008). Access to internal and external finance to fund innovation activity in this sector is limited, and this has resulted in low uptake of innovation activities among manufacturers. The African Development Bank (2011) report indicates that developing countries such as Kenya usually face low innovation, and access to finance remains the biggest challenge. This has constrained firms to engage in innovative activities. In addition, firms in developing countries are ranked poorly in terms of innovation compared to developed countries who are viewed as innovation giants (ADB, 2008; GII 2019).

Kenya has made significant steps towards establishing a strong innovation-driven economy, particularly since 2008. For instance, the implementation of the Kenya National Innovation Agency (KeNIA) that was established under the Science, Technology and Innovation (STI) Act, No. 28 of 2013 that is responsible for co-ordination, promotion and regulation of the National Innovation Ecosystem has helped to reinvigorate Kenya's innovation dream. The Acts also advocate for ST&I activities to be funded up to 2 per cent of GDP. Currently, this is not the case since recent statistics show that ST&I receives approximately 0.79 per cent of

GDP. In addition, the draft public finance management (credit guarantee scheme) regulations, 2020 which seek to promote enterprise development through access to quality and affordable credit to Micro, Small and Medium Enterprises (MSMEs) and alleviate the challenges faced by manufacturers when accessing credit has been developed by the government.

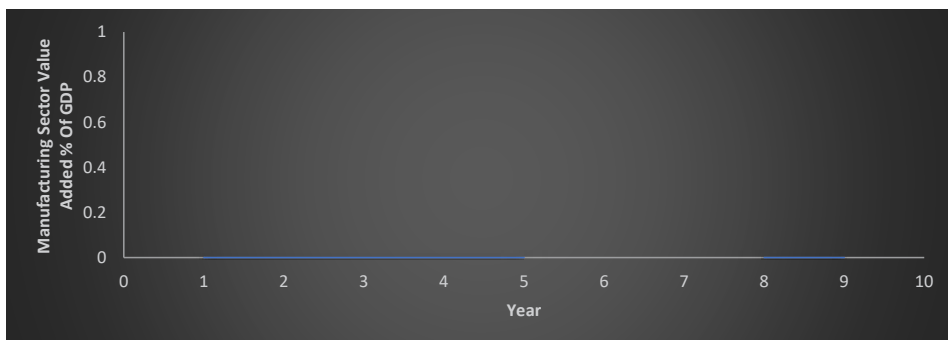
Despite these efforts by government and relevant stakeholders, financing of innovation still faces bottlenecks in terms of funding. Yet, there is little evidence on how firm's sources of finance affect firm innovation in Kenya (Ayyagari et al., 2011). Any obstacle to access of finance in manufacturing firms derails the efforts of a firm being innovative. On this backdrop, this paper examines the effects of financing sources on innovation activities in the manufacturing sector in Kenya. Specifically, the study will assess the effects of finance sources on process, product and market innovations among manufacturing firms in Kenya.

The rest of the paper is organized as follows: Section 2 gives more information on the manufacturing sector in Kenya; section 3 gives a review of the literature and section 3 presents the methodology that was followed in the study. Section 4 presents the results of the study and section 5 provides the conclusion of the study.

2. Status of Manufacturing Sector in Kenya

The manufacturing sector plays an important role in economic growth and development through its contribution to national output, employment creation, poverty alleviation, Foreign Direct Investment (FDI) and building a country's export competitiveness. The importance of the sector has seen the government investing in infrastructure development and policy frameworks such as "Big Four" agenda to support its growth. However, despite the initial plans to revitalize it, the sector has been registering declining value addition to the GDP since 2010 (Figure 1).

Figure 1: Contribution of manufacturing sector value added to GDP in Kenya



Data Source: World Bank National Accounts Data 2010-2019

The Kenya Innovation Survey (2012) report probed the activities of innovation through the collection of data on various aspects of innovation to develop relevant innovation indicators and specific innovation policies for the country. The key findings from the survey indicated that innovative firms in various sectors tend to have a high rate of turnover than non-innovative firms. The comparison of the rate of turnover change between innovative and non-innovative firms (Table 1) in both product and process innovation showed that the manufacturing sector was lagging behind in innovation, with financial and ICT sectors taking the first two positions in innovation turnover. The declining performance of manufacturing relates to the sector's limited innovation output (Kenya Innovation Survey, 2012).

Studies have shown that firms find it very difficult to access suitable financing sources and particularly the external funding to spur their innovation (Giebel and Kraft, 2019; Adeboye and Iweriebor, 2018; Regasa, et al., 2021). This often forces these firms to rely on the internal finance, which is usually limited, hence hindering their innovation investment and growth (Asiendu et al., 2021). This situation is even worse in Sub-Saharan Africa where there is limited financial

sources to finance innovation, coupled with information asymmetry and lack of collateral, ultimately resulting to innovation investment impediments (Kaur et al., 2020).

Table 1: Rate of turnover change for innovative and non-innovative firm between 2008-2011 per sector

Sectors	Innovative firms		Non-innovative firms	
	% products turn over change	% process turn over change	% products turn over change	% process turn over change
Manufacturing	16.742	14.904	3.931	5.970
Education	2.356	2.234	0.100	0.062
Professional services	0.111	0.100	0.000	0.000
Financial	33.093	35.352	4.300	-
Wholesale	0.600	0.500	-	0.161
ICT	17.459	18.609	0.012	0.050
Agriculture	1.467	1.611	0.030	0.030
Electricity	2.264	2.408	0.599	-
Water supply	0.079	0.100	0.100	0.189
Hospitality	1.000	1.100	0.471	0.506
Health	0.838	0.909	-	0.000
Others	14.467	15.466	0.059	0.046

Source: Kenya Innovation Survey (2012), Firms that usually engage in

In developing countries and predominantly in Africa, innovation is usually low and access to finance sources remains the biggest challenge (African Development Bank, 2008). According to the Global Innovation Index (2019), African countries usually perform poorly in the innovation front, yet studies focusing on access to finance sources for innovation are limited (Ayyagari et al., 2011). Nevertheless, most studies conducted focused on the macro level effect of innovation, basing on large, publicly traded firms in advanced economies with very partial focus on developing economies (Aghion et al., 2005).

3. Literature Review

3.1 Theoretical Review

Theories have been put forward to explain the capital structure of firms and how it adds value to the firm. The study reviewed the theories with the intention of understanding the factors related to firm working source of capital and innovation.

3.1.1 Modigliani and Miller theory

The theory points to the effects of capital structure on firm value. The theory holds that in a perfect capital market, the capital structure does not affect a firm's value; the capital structure of a firm is irrelevant when a firm depends on the ability of its assets to create value and is irrelevant if the assets originate in internal capital or external capital. Modigliani and Miller (1963) took taxation under consideration and proposed that firms should employ as much debt as possible. Based on this assumption, innovative firms are most likely to use external sources of finance to fund its innovation as they will be more likely to benefit from tax shield if they use debt over equity.

3.1.2 The pecking order theory

The theory is grounded on the concept that firms have a particular preference order for capital used to finance their businesses (Myers and Majluf, 1984). Due to adverse selection problem, this theory assumes that firms prefer internal finance than external finance. Given this assumption, suppose that a firm is seeking for sources of finance to fund its operations; there is a high chance that a firm will prefer utilizing its retained earnings other than debt or equity. The reasons behind the preference choices are that retained earnings has no adverse selection problem, debt has minor adverse selection problem, while equity has major adverse selection problem. If firms issue no new security but only use retained earnings to support investment opportunities, the information asymmetry can be resolved. This implies that issuing equity becomes more expensive as asymmetric information insiders and outsiders increase. Firms that have large information asymmetry should issue debt to avoid selling underpriced securities (Myers and Majluf, 1984).

3.1.3 Demand-pull theory of innovation

The theory stipulates that innovation begins from a demand side rather than a supply perspective, which implies opportunities pulling from market and needs

arising from the people other than supply pull forces where technological innovation pushes forward from scientific discovery. From this perspective, firms are triggered to innovate in terms of products, process and market innovation regarding specific demands that arise from consumers and the market. When this need arises, firms will be forced to seek means of financing these innovations. In addition, the concept posits that a firm borrows from external sources to finance its innovation activities only if it is necessary and have exhausted its internal finance (Schmookler, Kleinknecht and Verspagen, 1990).

3.2 Empirical Literature

The economic literature has used different classification of innovation. Although the most common used approach is underscored on the OECD definition, which distinguishes between process, product, and market organization innovation (OSLO, 2018). Product innovation is defined as any goods, service, or idea that is perceived by its users as new. Process innovation includes the adaptation of existing production lines and the installation of entirely new infrastructure and the implementation of new technologies. Any changes in marketing, purchases and sales, administration, management, and staff policy are classified as organization innovation. In addition, market innovation encompasses the exploitation of new territorial markets or the penetration of new market segments in the existing markets ((Baregheh et al., 2012; Boer and During, 2001; Varis and Littunen, 2010).

Innovation is theorized to be intertwined with effectiveness of credit and capital markets. Schumpeter (1934; 1950) emphasized that the cost of involving in innovative activities is enormous for enterprises and thus often a privilege to large enterprises. This means that if a firm cannot meet the cost of innovation from its internal sources, it has no option than to seek external source of finance to undertake innovation.

It is extensively held that innovation activities are difficult to undertake in a freely competitive marketplace (Hall and Lerner, 2010), coupled with challenges in access to finance. In Africa, firms are severely constrained to engage in innovation activities due to the scarcity of finance, weak financial structures, slow technology advancement, lower level of production, and managerial skills (Goedhuys, 2007; Goedhuys and Sleuwaegen, 2010). A lot of firms in Africa depend on external funds for innovation after exhausting internal sources. However, the financial institution considers lending to firms a risky venture due to the intangible nature of innovation (Hall, 1992; Hall and Lerner, 2010).

Studies (Beck 2006; Demirgüç-Kunt, 2012) show that firms that are financially constrained find it hard to engage in innovation activities. Difficulty to access finance has hindered firms particularly in Africa to innovate. Therefore, the capital

structure of a firm plays a crucial role in innovation outcomes (Kerr and Naranda, 2014). Even though most literature focuses on the effects of capital structure, most of the findings are skewed towards debt and equity; little has been done on the effect of different sources of financing and their effect on innovation. Fazzari and Petersen (1983) provided evidence on financial constraint. In their study, they established that in a fixed investment regression, the effect of endogenous capital investment is negative due to working capital competing with fixed investment for limited finance.

Empirical studies show that access to finance aids innovation. Therefore, finance affects the ability of firms to be innovative. However, literature on effect of finance on innovation has been contradictory. Ayyagari et al. (2011) and Nanda and Nicholas (2011) find a positive relationship between finance and innovation, whereas Fang et al (2014) and Cornaggia et al. (2012) confirm a negative relationship.

Studies have been carried out to establish the relevant sources of firm working capital and assess their interrelationship with innovation activities. For instance, in a study to examine firm source of working capital and their relationship to innovation involving 529 firms, Asiendu et al. (2021) found external funding sources as the most crucial funding source for innovation activities among the firms in DR Congo manufacturing. In addition, the study established a transmission mechanism of firm innovation through the availability of active credit line on firm productivity. Fombang et al, (2018) examined the importance of access to finance in firm innovation by using firm-level data from the World Bank Enterprise Survey (WBES) on selected African countries. The findings showed that finance in the form of overdraft overwhelmingly drives innovation. The findings also indicated that trade credit enhances innovation among firms in Nigeria, South Africa and Cameroon, while asset finance drives innovation among firms in Cameroon, Nigeria and South Africa. Empirical studies (Fazzari and Petersen, 1983; Clementi and Hopenhayn, 2006; Nikolov et al., 2021) have assessed the effects of working capital sources on firm investment and growth potentials. Their findings affirmed that investing in innovation has an important implication for firm value.

Firm characteristic is an important determinant on financing of innovation. Literature found that several firm characteristics relate to firm innovation. Individual firms seek for finance more often than subsidiaries or affiliated firms (Mina et al., 2013), hence larger firms significantly impact innovation. The size and age of the firm has been extensively studied on the relationship to innovative activities. Brown and Guzmán (2014) examined 2078 Mexican manufacturing firms and found that large manufacturing firms had a higher innovation tendency, with high high-tech capacity and market control. Other studies by Czarnitzki (2006) and Ughetto (2008) found that investors consider the size of a firm while

financing innovation. Moreover, large and medium size firms easily access to external fund compared to small firms who are financially constrained.

In terms of age of the firm, Mahendra et al (2015) observed that older firms are more likely to engage in product innovation. This finding contradicts the findings by Ayyagari et al. (2011). In another study, Paunov (2012) found that newly established firms abandon innovation projects more often. Investors consider firm size while financing but ignore age (Mina et al., 2013). The reviewed literature has shown that studies that have been carried out focused on finance sources and innovation while utilizing aggregate innovation, although the findings have conflicted and contradicted each other. However, minimal studies have been conducted on the effects of firm working capital source on innovation while using disaggregate innovation. Therefore, against this backdrop this study is focused on the effects total finance source has on process, product and market innovation. It is necessary to carry out this study to add literature on the minimal knowledge on effects of working capital source for manufacturing firms using disaggregate innovation.

4. Methodology

4.1 Empirical Framework

Financing of innovation activity in the manufacturing sector is very imperative and should be given priority since it enhances the ability of a firm to innovate and positively contributing to the growth of the firm. The importance of innovation in the manufacturing sector and existing gap in literature on financing of innovation activity has motivated this study to examine the effects of firm's finance sources on innovation activities among the manufacturing sector in Kenya. To achieve this objective, logit model, which is estimated using maximum likelihood method, was adopted in this analysis as the dependent variable is binomial as presented by Hall and Lerner (2010) and Liu (2015). Empirical studies (Asiendu et al, 2021; Kaur et al., 2021) have utilized this model to examine the effects of financing on innovation performance of firms in Congo and Indi, respectively. The logit model had binary dependent variable, which takes the option of 1 if there was innovation in process, product, and marketing strategies or otherwise 0. The binary logit model takes the form:

$$Y_i = B'X + \varepsilon \quad (1)$$

Where Y_i is binary variable, ($i = 1, \dots, n$) represents process, product and market innovation, $X_i (X_{i1}, \dots, X_{in})$ is a vector for explanatory variable. B is the corresponding dimensional vector and ε is the error term. The logit model assumes the cumulative distribution function (cdf) of the logistic distribution (Katchova, 2013). Therefore, the logit model expression is given as follows (Asiendu et al., 2021)

Therefore:

$$P(y_i = 1) = \frac{\exp(x\beta)}{1 + \exp(x\beta)} = \frac{e^{x\beta}}{1 + e^{x\beta}} \quad (2)$$

$$P(y_i = 0) = 1 - P(y = 1) = 1 - \frac{\exp(x\beta)}{1 + \exp(x\beta)} = \frac{1}{1 + \exp(x\beta)} \quad (3)$$

Equation 2 and 3 demonstrate a binary logit model equation, which shows the probability choices of it shows the choice ($y_{i=k, k=0,1}$).

The general model specification is demonstrated below:

$$Pr(y_i = k) = \frac{e^{x'B}}{1 + e^{x'B}} \quad k = 0, 1 \quad (4)$$

4.2 Estimation of the Model

Equation 5-7 takes model specification to analyse the objectives of the study as follows:

$$\text{Process_innovation} = \alpha + B_1 \text{Internal_finance} + \text{Bank_finance} + \text{Credit} + \text{Non_bank} + \text{GOVF} + B_2 X + \mu_i \quad (5)$$

$$\text{Product_innovation} = \alpha + B_1 \text{Internal_finance} + \text{Bank_finance} + \text{Credit} + \text{Non_bank} + \text{GOVF} + B_2 X + \mu_i \quad (6)$$

$$\text{Market_innovation} = \alpha + B_1 \text{Internal_finance} + \text{Bank_finance} + \text{Credit} + \text{Non_bank} + \text{GOVF} + B_2 X + \mu_i \quad (7)$$

Where:

Process_innovation = Process innovation

Product_innovation = Product innovation

Market_innovation = Market innovation

Internal_finance = Access to internal finance/retained earnings of the firm

Credit = Credit finance from credit institutions

Non_bank = Finances from non-bank institutions such as microfinance

GOVF = Grants and loans from the government

X = a vector of control variables which are SIZE, AGE and Femo

The dependent variables *Process_innovation*, *Product_innovation* and *Market_innovation* refer to firms' recording presence or absence of these innovation activities within the reference period (3 years preceding the survey). The variable is measured when a firm has recorded a significant new or improved on process, product or market innovation, denoted as 1 or otherwise "0". The explanatory variables used included the external sources of finance, which were: bank for banking finance, non-bank that denoted finance from financial institutions such as microfinance, internal finance for internal finance, credit for credit from customers or suppliers. The control variables for these objectives were *SIZE* that is measured by the number of employees (categorical), and *AGE* for the number of years the establishment has been in existence (continuous), (Table 2).

4.3 Description of the Variables used in the Study

4.3.1 Data source

This section presents a description of data sources and variable descriptions that re used in this analysis. Firm level data of 455 manufacturing firms in Kenya as captured in the World Bank’s Enterprise Survey Database conducted between May 2018 and January 2019 will be used. The sample for 2018 Kenya Enterprise Survey was selected using stratified random sampling where the population included all manufacturing sectors according to the group classification of ISIC Revision 3.1.

The World Bank Enterprise Survey Data has a set of questions on sources of financing that firms seek for its working capital. These questions include questions on sources of funding (that was financed from each of the following sources: K.3) and extends it to questions on the firm’s innovation activities where: H.1 asked if the firm has introduced new or improved product or service in the last three years; H.2 if the firm introduced new marketing strategy that was new to the firm; and H.5 if the firm introduced any new or improved process.

4.3.2 Descriptive statistics of independent and control variables

Table 4 shows the descriptive statistics for explanatory variables and control variables. It can be noted that the mean age of the firms was 26 years with the oldest firm being 103 years at the time of the survey.

Table 2: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Product innovation	455	0.466	0.499	0	1
Process innovation	455	0.319	0.466	0	1
Market innovation	212	0.726	0.447	0	1
Internal finance	455	0.912	0.283	0	1
Bank	455	0.409	0.492	0	1
Credit	455	0.36	0.481	0	1
Non bank	455	0.068	0.252	0	1
Govt	455	0.899	0.302	0	1
Sacco	455	0.991	0.093	0	1
AGE	454	26.328	18.66	0	103
SIZE	455	1.96	0.806	0	3

Source: Authors compilation from World Bank (2018) Enterprise Survey Data

4.3.3 Dependent variable

The dependent variable for the current study will be the innovation activity of the manufacturing firms in Kenya in the reference period, three years preceding the time of data collection. According to Organization for Economic Co-operation and Development - OECD (2013), new innovation is defined as the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations. In the World Bank Enterprise Survey 2018, a firm is innovative “1” if it records innovative activities (product or process and marketing innovation), and “0” if it is not innovative; that is, the firm do not record any innovative activities in the reference period.

4.3.4 Explanatory variable

Sources of firm’s working capital is explanatory variable and are measured from “what is the proportion of this establishment’s working capital that was financed from each of the following sources?”

4.3.5 Control variable

We control for the age of the firm (AGE), and size of the firm (SIZE). The firm’s age is measured from the year the firm has been in existence. The size of the firm is measured by the number of employees.

Table 3: Variable description and measurement

Variable name	Variable description	Variable type	Unit of measurement
Dependent			
Innovation	Product_innovation (ProdIn) was measured by “1” if the firm introduced a significantly new product in the last three (3) years, otherwise zero (0) Process_innovation (ProcIn) was measured by “1” if the firm introduced a significantly new process in the last three (3) years, otherwise zero (0) Market_innovation (MarketIn) was measured by “1” if the firm introduced a significantly new marketing strategy in the last three (3) years, otherwise zero (0)	Dummy	1=Innovative 0=No innovation

Variable name	Variable description	Variable type	Unit of measurement
Explanatory			
<i>Internal_finance</i>	Is the working capital that is internal generated	Dummy	1= Internal Finance 0=None
<i>Bank_finance</i>	Is the wirking capital that is borrowed from banks.	Dummy	1= Bank Finance 0=None
<i>Non-bank_finance</i>	Is the working capital that is borrowed from non-banking institution	Dummy	1=Non-Bank Finance 0=None
<i>Credit</i>	Is the working capital that is borrowed from Credit/advance from suppliers	Dummy	1=Credit Finance 0=None
<i>GOVF</i>	Government financing such as grant or loans	Dummy	1=Govt Finance 0=None
<i>SACCO</i>	Is the working capital borrowed from SACCOs	Dummy	1= sacco 0=None
Control			
<i>AGE</i>	Age of the firm is measured number of years in existence since establishment.	Continuous	Years
<i>SIZE</i>	The size of the firm is measured by the number of employees	Categorical	1=Micro 2=Small 3=Medium 4=Large

5. Findings

5.1 Main Findings

To assess effects of finance source on process, product, and market innovation among manufacturing firms in Kenya

The results on the effects of sources of finance on process, product, and market innovation are presented in Table 4. The results show the marginal effects of the logit model. The dependent variable was binary variable represented as product, process and market innovation. The explanatory variables (internal finance, bank, credit non-bank, government and SACCO) and control variables (age of the firm and the size of the firm) were included in the model. From estimation model 5-7, the parameter estimates showed that product, process and market innovation were either positively or negatively affected by the source of finance applied by the firm. The magnitude of coefficient was used to interpret the results.

5.1.1 Internal finance

Internal finance coefficient is not significant in all the three models. The relationship between internal finance and product and market innovation were negative while process innovation was positive, showing a less likelihood of firms engaging in product and market innovations while employing internal finance as compared to process innovation. Firms employing internal finance were 4.2 and 71.7 per cent points less likely to engage in product and market innovations, but more likely to engage in process innovation by 11 per cent. The results could be attributed to the competing nature of internal finance where firms depend on internal finances to fund other costs in the firm, hence giving low priority in engaging to innovation activities. This finding contradicts earlier findings that postulated that internal financing is positively and significantly associated with firms being innovative (Kaur et al., 2021). In the study by Kaur et al. (2021), it was assumed that firms use their internal source of finance to meet other operating costs of the firm other than giving priority to funding innovation.

Table 4: Marginal effects of the sources of financing on process, Product, and market innovation

Variable Names	Column 1 (Product Innovation)	Column 2 (Process Innovation)	Column 3 (Market Innovation)
	dy/dx	dy/dx	dy/dx
Internal_finance	-0.042 (0.087)	0.117 (0.084)	-0.717 (0.672)

Bank	0.085* (0.053)	0.070 (0.049)	0.648** (0.376)
credit	0.061 (0.053)	0.001 (0.048)	0.654** (0.368)
Non_bank	0.161 (0.109)	0.018 (0.095)	0.419** (0.184)
govt	0.020 (0.081)	-0.038 (0.072)	-1.764** (0.786)
sacco	0.113 (0.273)	0.236 (2.436)	2.436 1.801)
Age	0.0003 (0.001)	0.001 (0.001)	0.017* (0.009)
Size	0.122*** (0.032)	0.028 (0.028)	0.026 (0.209)
No. of Obs.	454	454	212
Prob>Chi2	0.001	0.472	0.003
Pseudo R2	0.051	0.013	0.096

*Note: Robust standard errors in Parentheses. *** $p < 0.01$, ** $p < 0.05$, $P^* < 0.1$*

5.1.2 Bank finance

Among the external sources of firm finance, bank finance is the most preferred source among the manufacturers. The coefficient for model five and seven were significant. The relationship between bank finance and product, process and market innovation were positive, meaning that firms applying bank finance are more likely to engage in product, process and market innovation. Firms that use bank finance are more likely to engage in product, process and market innovation by 8.5 per cent points, 7 per cent points and 6.4 per cent points, respectively. These findings corroborate with those of Asiendu et al. (2020) who reported a significant positive relationship between external funding sources such as bank finance and innovation activities among 529 manufacturing firms in the Democratic Republic of Congo. Other earlier studies by Fernandez (2017), and Ayyagari et al. (2011) also establish a positive role of external funding sources for firm innovation among manufacturing firms. These findings also confirm the position that firms prefer external financing from banks to invest in risky activities such as innovation (Freel, 2007). Innovation activities are high-risk because of their unpredictable nature, especially in terms of output.

5.1.3 Credit finance

Credit finance increases the ability of firms becoming innovative as it lowers the cost of capital and facilitates smooth and efficient running of an organization (firm). From the results in Table 5, credit finance is significant in column 3. The relationship in the three models is positive, alluding that firms that take credit finance are more likely to engage in the three forms of innovations. The coefficient of the three models indicates that firms that use credit finance are more likely to engage in product, process and market innovation by 6.1 per cent points, 0.1 per cent points and 6.5 per cent points, respectively. In this case, credit financing had higher magnitude to influence market innovation. This agrees with Qi and Ongena (2020) who found out that credit financing is key in boosting innovation in firms in emerging economies, and a lack of access to credit stifles innovation. Contrary findings by Gielbel and Kraft (2020) showed that credit financing stifles innovation activities.

5.1.4 Non-bank finance

From the analysis, model seven is statistically significant under non-bank finance. In addition, there is a positive relationship between the three model and non-bank finance showing that manufacturing firms who sought their working capital from non-bank institutions have higher likelihood to indulge in innovation. The coefficient of the model proves that firms that use non-bank finance are more likely to improve their product innovation by 16 per cent points, process innovative by 1.8 per cent points and 41 per cent points market innovative. These findings are supported by an earlier study by Francis et al (2012) who observed a positive and significant influence of non-bank financing on the innovation capacity of firms in the US due to lower loan spreads and better non-price-related loan terms.

5.1.5 Government finance

The results show that model seven is statistically significant when it comes to government finance. However, the effects of government financing on market innovation are negative. Thus, manufacturing firms that depend on government financing such as grants from government are 17 per cent points less likely to engage in market innovation. Although the findings were not significant, firms that depend on government financing are 0.2 per cent points more likely to engage in product innovation and 0.3 per cent points less likely to engage in process innovation. The negative effects of government financing on innovation can be attributed to the dwindling budget allocation to innovation activities in the

country, with reports showing that budget allocation to innovation activities in the country is 0.79 per cent of GDP as opposed to 2 per cent that was envisioned in the ST&I Act, No. 28 of 2013. These findings are in agreement with a study by Da Fonseca and Veloso (2018) who reported a positive influence of government financing on innovation activities in firms in the USA and Brazil.

5.1.6 SACCO finance

SACCO financing is one of the fastest growing financing sources for manufacturing firms in Kenya (Feather and Meme, 2019). From Table 5, SACCO financing sources had a positive effect on innovations in all models. Even though it was not significant, manufacturing firms that use SACCO financing for their innovation purposes have 11.2, 23.6 and 243 per cent points more likely to engage in product, process and market innovation, respectively. This can be attributed to the ease of accessing funds from SACCOs, flexible repayment time and low interests charged on loans as espoused by Karagu and Okibo (2014). This result affirms the findings of Fombang and Adjasi (2018), who found that firms that source their finances from flexible external sources such as SACCOs are most likely to be innovative.

5.1.7 Firm characteristic

The firm's characteristics were added on in the model 5, 6 and 7, including firm size and age. Age of the firm, which had 0-113 years were all positive across the three models, with age of the firm having a significant effect on market innovation. The age of the firm was more likely to influence market innovation in the manufacturing sector by 1.7 per cent points. Additionally, firm age had a positive influence on product and process innovation, with process innovation showing a 0.1 per cent points likelihood. These findings are similar to Coad, Segarra and Teruel (2016), who found that firms in existence for a long time have higher chance of engaging in innovation and are more competitive to control their market, with relatively young firms engaging in innovation to expand their market control and be more profitable.

Table 4 illustrates that the size of the firm is more likely to influence product innovation. From the findings, size of the firm is positive and significant in model 5. This indicates that size increases the likelihood of a firm in the manufacturing sector engaging in product innovation by 12.2 per cent points.

6. Conclusion and Policy Recommendations

6.1 Conclusion

This study aimed at examining the effects of financing sources of firm's working capital on innovation activities among the manufacturing firms in Kenya. According to the main findings, firms that have access to internal finance are less likely to engage in process, product, and market innovation. It was also noted that bank, non-bank and credit financing has a positive effect on product, process, and marketing innovation among firms in Kenya. Other firm characteristics such as size of the firm and age had a positive influence on firms being innovative if they access their working capital from external sources (bank, non-bank and credit).

6.2 Policy Recommendations

1. The external source of funding promotes innovation in manufacturing firms, thus policy makers need to enact legislation that attracts firms to external sources of finance by coming up with financing products targeted to manufacturing firms.
2. Because size of the firm influences innovation capacity, small firms are less innovative than large firms, which indicates higher constraints to smaller firms in acquiring funds. Policies that promote small-and medium-sized manufacturing could be enacted to ensure smooth financing to the industries.
3. There is need to fast-track the adoption of proposed credit guarantee scheme regulations, which seek to promote access to quality and affordable credit to micro, small and medium enterprise (MSMEs) and to alleviate the challenges faced by MSMEs while seeking credit.
4. Financial institutions should be incentivized to come up with financing products targeted to manufacturing firms.
5. The government could subsidize financial institutions (credit institutions, banks) to enable them extend favourable finances to manufacturing firms.

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Appendix 1: Stata output results

	Model 5 (Product Innovation)			Model 6 (Process Innovation)			Model 7 (Market Innovation)		
	dy/dx	Std. Err.	p> z	dy/dx	Std. Err.	p> z	dy/dx	Std. Err.	p> z
<i>Internal_finance</i>	-0.042	0.087	0.626	0.117	0.084	0.165	-0.717	0.672	0.283
<i>Bank</i>	0.085*	0.053	0.112	0.070	0.049	0.147	0.648**	0.376	0.083
<i>credit</i>	0.061	0.053	0.250	0.001	0.048	0.983	0.654**	0.368	0.073
<i>Non_bank</i>	0.161	0.109	0.139	0.018	0.095	0.847	.419**	.184	0.023
<i>gout</i>	0.020	0.081	0.803	-0.038	0.072	0.597	-1.764**	0.786	0.020
<i>sacco</i>	0.113	0.273	0.679	0.236	2.436	0.491	2.436	1.801	0.169
<i>Age</i>	0.000	0.001	0.761	0.001	0.001	0.311	0.017*	0.009	0.079
<i>Size</i>	0.122***	0.032	0.000	0.028	0.028	0.337	0.026	0.209	0.900
Obs.	454			454			212		
Prob>Chi2	0.001			0.4715			0.0025		
Pseudo R2	0.0508			0.0134			0.0956		

Robust standard errors in Parentheses ***p < 0.01, ** p < 0.05, P* < 0.1

Appendix

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