African development finance journal http://uonjournals.uonbi.ac.ke/ojs/index.php/adfj/index
July Vol4 No.2, 2020 PP 132- 146 ISSN 2522-3186

The Link between Financing Decisions and Investment in Research and Development in Kenya

Linet Nyanchama Arisa* and Moses Mwenda Muthinja**

* Dr. Linet Nyanchama Arisa |Market Support and Linkages Officer |Youth Enterprise Development Fund Nairobi, Kenya| P.O. Box 48610-00100 Nairobi-Kenya| Cell phone +254712472483| E-Mails: larisa@youthfund.go.ke, arisalinet14@gmail.com

** Dr. Moses Mwenda Muthinja[1] | Lecturer| Department of Public Policy and Administration| Kenyatta University, P.O. Box 43844-00100 Nairobi-Kenya| Cell phone +254788208020| E-Mails: muthinja.moses@ku.ac.ke, muthinjam@gmail.com

Abstract

This paper examines the link between firm financing decisions and investments in research and development among Kenyan firms. Thus, we investigate which financing source is more likely to trigger firms to invest in research and development and whether other firm characteristics are important. We employ the logistic regression methods using the 2019 World Bank Enterprise Survey data for Kenya. The results of the study suggest that the use of bank and non-bank debt to finance investment tends to increase firm's initiative to invest in research and development as compared to those firms that rely on internally generated finance. In addition, larger and more profitable firms are more likely to invest in research and development, as compared to smaller and poor performing firms. While firms are reluctant to use money borrowed from friends and relatives to carry out R&D, such firms are willing to money borrowed from the government for the same. We argue that MSMEs may not use funds borrowed from family and friends to carry out R&D due to short repayment periods and high risk of default but are free to use government funding for R&D since it comes with many concessions and minimal risk of default.

Key words: Financing decisions, research and development

[1] Corresponding author

1.0 Introduction

Kenya's economy has been on the rise in the recent past, due to its sufficient economic reforms that have led to sustained economic growth. The economy still remains as the most attractive with very accommodating business environment across Africa (World Bank, 2020). The country has prioritized the president's "big four" development priorities in manufacturing, universal healthcare, affordable housing and food security, effectively expanding activities both locally and internationally (World Bank, 2020). Kenya's economy has nonetheless not grown in tandem employment rates especially among the youth. Majority of the youth are either unemployed or under employed. Unemployment rate is still projected to rise with the increased loss of jobs as a result of the coronavirus pandemic.

There is evidence to suggest that Investment in business growth can be a catalyst for job creation in the Kenyan economy. Consequently, this has created a shift in government and development partners' efforts towards deliberate interventions aimed at fostering sustainability of business enterprises. For instance, the government has set aside interest free enterprise funds such as the Youth Enterprise Development Fund, for establishment and growth of business enterprises which are aimed at generating more entrepreneurial jobs. In addition, a vibrant private banking sector that offers financial services to firms and households is a major feature in Kenya.

The Kenyan firms therefore have a wide range of financing options, considering that the Kenyan financial sector is highly developed and diversified (Beck & Fuchs, 2004). These financing options range from informal financing sources, government agencies to private financial service providers. Despite the wide range of available business financing, most of these firms either remain stagnant or die before their first anniversary (Kamunge, Njeru, & Tirimba, 2014). While many firms fail owing to lack of business finance, many others fail in spite of having sufficient funding. As such, a lot is unknown as to why these businesses fail to flourish even though they have access to finance whether from internally generated funds or from external sources.

Though research and development (R&D) helps mitigate the risk of business failure, R&D comprises costs that may be out of reach of micro small and medium enterprises (MSMEs). Further, even where the firm may have the funds to invest in R&D, the decision to invest in

R&D may be largely influenced by how the business is financed. Using World Bank Enterprise Survey data, we examine the link between firm financing and investment in R&D. The focus of the study is Kenya, the economic hub of the East African region and which fairly represents the firm behavior in the region.

2. Literature Review

The economics of research and development dates back to the time of Nelson (1959), who argued that firms spend on research and development because they expect a given flow of benefits over time, which they would not have attained if they chose not to invest in research and development. The firm managers in this case expect market research to create marginal social value in excess of that collectable on the free market. However, spending on research and development means we forgo other investments on other activities that can as well generate future benefits. This implies that investment in research and development has a social cost associated to it. Firms therefore need to allocate resources to research and development at that point where they maximize social profit after taking care of social cost.

Under certain circumstances, firms invest in R&D due to market forces, increased competition and technological advancement. They are also incentivized by various interventions such as government support of research and development, tax incentives on research, research partnerships and intellectual property provides firms with incentives to conduct research and development. Firms also invest in R&D because it helps firm managers to predict facts about future phenomena prior to experimentation and observation. The investment in R&D helps to predict results of trying alternatives, which leads to invention and innovation, thus creating new products and processes (Trott, 2001). Focused research increases knowledge of the relevant field of operation, thus helping in finding a satisfactory path that reduces number of tried alternatives, which in the long run lowers the cost on invention and innovation.

Firm characteristics also play a role on firms' associated value towards investing in research and development. Large firms for instance are full of new product ideas, which are scarce among small firms. This may explain why large firms hesitate to invest in research and development (Trott, 2001). Firms that are part of a multinational also do not invest in research and

development because they rely on their parent companies' innovations. In addition, firms listed in the stock exchange market invest more on research and development, as compared to those that are not listed, because they access variety of financing sources and in addition to receiving government subsidies (Blass & Yosha, 2010).

2.1 Financing research and development

In a freely competitive market, R&D activities are difficult to finance. This is because the R&D outcome is unpredictable, and its use/benefit cannot be restricted to the firm undertaking research (Hall, 2002). The use of research by one firm does not limit other firms from using the technology/innovation. According to Romer (2012), knowledge gained from investment in R&D is non-rival. This implies that the production and allocation of knowledge cannot be completely governed by competitive market forces. The marginal cost of supplying an item of knowledge to an additional user once the knowledge has been discovered is zero (Romer, 2012).

Since knowledge cannot be kept secret, the returns to R&D investment cannot be associated only to the firm undertaking the investment. This makes most firms reluctant to provide funds for R&D due to the spillover effects (Hall, 2002). In addition, the benefit of R&D is not assured since its benefits (if any) materialize much later in the firm's lifecycle and the benefit is therefore time lagged. Regardless of these arguments, R&D is a very important intangible firm asset, which is expected to add into firm value (Chan, Lakonishok, & Sougiannis, 2001). This is because investment in R&D can take various forms. For instance it can be the spending on wages and salaries for highly educated scientists and engineers, whose effort is geared towards creating an intangible asset that forms the firm's knowledge base. This complicates the decisions to finance R&D, since this knowledge disappears the moment these employees leave or are fired (Hall, 2002).

There is always a difference in the expected rate of return for an entrepreneur who uses his own funds finance R&D, and those that use external funds. Unless the firm is profitable enough, some innovations may not be provided for, because of the high cost of external capital (Hall, 2002). This contradicts Modigliani and Miller's 1958 argument that the amount spent on investment should yield same future expected rate of return, regardless of the source of financing. Economic

theory also explains the existence of a gap between external and internal costs of capital. This may be as a result of information asymmetry between inventor and investor, moral hazard on the part of the inventor, and tax considerations that drive a wedge between retained earnings and external finance (Hall, 2002).

Financing patterns of R&D intensive firms may differ from comparable firms that are not R&D intensive. This is because R&D activities are intangible and hard to monitor by external financial providers, thus making retained earnings or internally generated finance a major financing source for firms engaging in R&D (Blass & Yosha, 2010). This argument however does not hold in some countries and has generated mixed reactions. For instance Hall (2002) study of U.S firms finds that R&D intensive firms prefer internally generated funds, while Blass and Yosha (2010) finds contradicting results on Israeli firms. This study looks at the African context to compare with this stream of literature. We use survey data which gives unique evidence considering most of the work previously done in this area has relied on financial statements data.

3. Problem Statement

The literature on how corporate financing decisions influence investment in R&D is vast, but much has been done on listed firms especially in the developed and emerging economies (see for example Blass & Yosha, 2010; and Hall, 2002). Limited work has been done in developing African countries, Kenya included. Many MSMEs in Kenya are not listed in the stock exchange and therefore face unique financial access challenges. As such, those who rely on equity finance majorly use retained earnings as well as principal owner contributions. Most Kenyan firms are neither able to issue shares to the public nor issue corporate bonds due to Nairobi securities exchange stringent listing conditions. In addition, most of these firms do not value investment in R&D due to cost implications.

Kenya has however increased its funding for R&D in the last decade, as a strategy for creating jobs and supporting innovation. Kenya has become a leader in information technology in Africa, through the adoption of digital technologies that have brought new change processes and transformative ways of doing business (Ndemo & Weiss, 2017). The country's technological feat has been credited for leading Kenya into attaining its middle income status (World Bank, 2020).

Many Kenyan firms have embraced new and innovative products to capitalize on technological developments at macro level.

However, the 2019 World Bank enterprise survey observes that most firms do not invest in R&D and do not prefer to take advantage of government financing options that appear to be cheaper and flexible. In effect, many young firms have collapsed due to duplication of efforts and product imitation as opposed to product innovation anchored on R&D. Our review of literature is inconclusive as to what drives investments in R&D by Kenyan firms' and whether such investments are influenced by how the business is financed. Further, the literature suggests that other firm specific characteristics are important in making decisions regarding investments in R&D. This paper investigates the link between firm financing decisions and investment in R&D, and assesses how other firm characteristics can also influence such investment decision. The study also examines the magnitude of financing as a constraint in R&D and analyses possible ways to overcome this, thus informing policy decisions.

4. Methodology

This study uses the 2019 World Bank Enterprise Survey data, collected from 1,001 Kenyan firms. This is a cross sectional data covering firms of all sizes from small, medium to large firms in multiple countries. The data also covers manufacturing, services, and transport and construction sectors and is standardized, comparable across regions and time, due to the global standard methodology used in the data collection. The data which covers major regions and towns in the country, specifically the largest centers of business enterprises is appropriate for this study. This is because it has information on firms' characteristics, investment on market research and development, innovation, firm financing sources, and other likely factors that may affect R&D investment. The data on market research has been used as the proxy for R&D in this study. The data is however subject to some caveats, especially non response. This is due to the fact that the survey questions are voluntarily answered and sometimes the questions posed may be perceived differently by the respondents. We focus on both listed and unlisted firms in Kenya.

4.1 Definition of variables

We use firm's investment on R&D as the dependent variable which assumes a binary form in which a firm either spends on R&D or not. From the reviewed literature, investing in R&D is incentivized by the profitability or performance of the enterprise, government incentives and subsidies on R&D, tax incentives, available financing sources, firm size and listing status. Taking cognizance of this and the data permissibility, we use the following key variables as summarized in Table 4.1.

Table 4.1: Description of key variables

Variable	Description
Change in sales	Real annual sales growth (proxy of firm performance/profitability)
Listed	Dummy variable=1 if listed in stock markets 0 otherwise
Firm size	Dummy variable for small (5-19 workers), medium (20-99 workers) and large(100+)
Investment in research	Dummy variable whether a firm invests in research and development or not
Financing source	This is a variable for various financing sources (Bank, Non-Bank, SACCOs, Government, Trade credit and informal sources like Family and friends.

Source: Author's compilation based on the enterprise survey data

Since the outcome variable (investment in research and development) is binary, we employ a logistic regression approach. Logistic Regression uses the log odds ratio rather than probabilities and an iterative maximum likelihood method rather than a least squares to fit the final model. This gives us more freedom when using logistic regression since the method is more appropriate for non-normally distributed data or when the samples have unequal covariance matrices. Logistic regression also assumes independence among variables, which is not always met in most datasets. We however recognize its limitation of not producing typicality probabilities, that can be useful for forensic casework, but we shall incorporate nonparametric methods for robustness checks.

The basic aim of our analysis will be to describe the way in which investment in research and development varies by firm characteristics, and the choice of financing source. We consider a binary outcome variable y_i that assumes values of one and zero with probabilities μ_i and $1-\mu_i$ respectively. We represent this compactly as:

$$Pr\{Y_i = y_i\} = \mu_i^{y_i}(1-\mu_i)^{1-y_i} \qquad (2.1)$$

Here y_i is the realization of a random variable Y_i. Suppose we classify firms into groups depending on factors of interest such as firm size or listing status. In this case we have k groups, in such a way that all firms in a group are of the same characteristics or have identical values of the covariates. Let n_i denote the number of observations in group i, and let y_i denote the number of firms which have the attribute of interest in group i. For example, let

y_i = number of firms investing in research and development in group i.

In this case we view y_i is the realization of a random variable Y_i that takes the values $0,1,\dots\dots\dots,n_i$. If the n_i observations in each group of firms are independent and they all have the same probability μ_i of having the attribute of interest (for example size or listing status), then the distribution of Y_i is binomial with parameters μ_i and n_i, represented as:

$$Y_i \sim B(n_i, \mu_i). \qquad (2.2)$$

In this case the probability distribution function is given by:

$$Pr\{Y_i = y_i\} = \binom{n_i}{y_i}\mu_i^{y_i}(1-\mu_i)^{n_i-y_i} \qquad (2.3)$$

Where $y_i = 0,1,\dots\dots\dots,n_i$, and $\binom{n_i}{y_i}\mu_i^{y_i}(1-\mu_i)^{n_i-y_i}$ is the probability of obtaining y_i firms investing in research and development, and $n_i - y_i$ firms that fail to invest in research and development. In our logistic regression, our interest in this case is to transform the probability μ_i into the *odds* as:

$$odds_i = \frac{\mu_i}{1-\mu_i} \qquad (2.4)$$

We then take logarithms, calculating the *logit* or *log-odds* as:

$$\pi_i = logit(\mu_i) = log\frac{\mu_i}{1-\mu_i} \qquad (2.5)$$

As the probability goes down to zero the odds approach zero and the logit approaches $-\infty$. At the other extreme, as the probability approaches one the odds approach $+\infty$, and so does the

logit. Thus, logits map probabilities from the range (0, 1) to the entire real line, thus logistic regression does not assume that the independent variables are normally distributed.

Solving for μ_i in equation 2.5 gives:

$$\mu_i = logit^{-1}(\pi_i) = \frac{e^{\pi_i}}{1+e^{\pi_i}} \quad (2.6)$$

We thus obtain the correct probability value by exponentiating the logit value.

4.2 Summary statistics

Tables 4.2 provide a summary of the financing patterns of firms' working capital by firm size, while Tables 4.3 and 4.4 summarize the percentage of firms investing in research and development by firm size and listing status respectively. Table 4.2 summary table stems from the survey question in which enterprise managers were asked for the percentage of working capital that they finance from each of the sources. In each case, the sum of the proportions adds up to 100%. The sample has a total of 1,001 firms, most of which reported to be using retained earnings and internal finance in their working capital, making it the most dominant source of financing (see Table 4.2).

For the percentage of funds used as working capital, approximately 72% of firms reported to be relying on internal finance/retained earnings, 14% rely on banks, while only 1% rely on other non-bank financial institutions, 10% use trade credit, 2% of the firms rely on money lenders, friends and relatives, while about 1% use Savings and Credit Cooperatives (see Table 2). Despite having a very well established financial system, the Kenyan data confirms that most firms rely on their own equity capital than debts. It also contradicts most literature that confirms that most small firms rely on informal financing sources from family and friends.

Table 4.2: Financing patterns among Kenyan firms by size (% of firms using each financing source on Working Capital)

Firm size	Total number of firms	Retained Earnings	Banks	Non-bank financial institutions	Trade credit	Other Money Lenders, Relatives & Friends	SACCOs
Small	422	73.93	11.61	1.18	9.48	2.84	0.96
Medium	369	74.53	14.63	0.81	8.67	1.36	0.00
Large	210	66.19	18.57	0.48	11.43	2.38	0.95
Total	1001	72.63	14.1	0.90	9.58	2.19	0.60

Tables 4.2 and 4.3 show how firms reported on whether they invest in research and development or not. In this variable, 5 firms were dropped due to missing values as a result of non-response. Of the 996 firms, only 19% reported to have invested in research and development, while 81% do not invest in research and development. This raises a lot of questions considering that literature reports Kenya to be highly investing in research technology and innovations (Ndemo & Weiss, 2017). One could have imagined that more firms invest in research and development that those which do not. On the listing status, those firms listed in the stock exchange are only 32, while 964 firms are not listed in the stock exchange (see Table 4.3). This confirms how the stock market is underdeveloped in most African countries (Gwatidzo & Ojah, 2013).

Table 4.3: Percentage of firms investing in research and development by size

Firm Size	Total number of firms	% not investing in R&D	% investing in R&D
Small	412	85.44	14.56
Medium	377	81.17	18.83
Large	207	70.53	29.47
Total	**996**	**80.72**	**19.28**

Firm size was measured in terms of the number of employees in the firm. Small and Micro were grouped together, being those firms with less than 20 employees, medium have 20-99 workers and large are those with more than 100 employees.

Table 4.4: Percentage of firms investing in research and development by listing status

Firm Listing status	Total number of firms	% not investing in R&D	% investing in R&D
Not listed	964	80.81	19.19
Listed	32	78.13	21.88
Total	**996**	**80.72**	**19.28**

Listed firms refer to the firms whose ordinary shares are freely and publicly traded in the (Nairobi) securities market and vice versa.

We employ a logistic regression, where investment in research and development is expressed as a function of firm characteristics, and firm financing source (in this case internal financing/retained earnings, bank financing, non-bank financial institutions, financing from family and friends, government, SACCOs and trade credit).

5. Regression Results

The regressions are presented for all the firms excluding the nonresponse issues in the data. The results presented are based on the 2019 World Bank Enterprise Survey data for Kenya, in which we considered all firms in the sample from all regions across the country. We compare firms using various financing sources to investment in R&D and use firm characteristics as control variables. Table 5.1 shows the logistic regression results for a model that we calculate the marginal effects of the explanatory variables on the dependent variable.

Table 5.1: Regression results for financing sources as a function of investment in research and development with firm characteristics as controls.

Outcome Variable	Independent/control Variables	Logit results
Investment In	Firm Size	0.450***
Research and		(0.106)
Development	Listing	-0.149
		(0.444)
	Sales Growth	0.138***
		(0.0528)
	Internal Finance	-0.00363*
		(0.00217)
	Bank Finance	0.0370**
		(0.0186)
	Non-Bank F Is	0.0276**
		(0.0125)
	Trade Credit	-0.00174
		(0.00719)
	Family & Friends	0.00519
		(0.0105)
	Government	0.0622*
		(0.0370)
	Observations	996

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5.1 presents the logistic regression results of the marginal effects of the explanatory variables on the decision to invest or not to invest in research and development. The results suggest that firms which rely heavily on internal financing are less likely to invest in research and development compared to those which use less of internal finance. On the other hand, the firms that use bank and non-bank financial institutions are more likely to invest in research and

development. This inconsistent with the literature that portrays firms that use retained earnings as heavy spenders on research and development. For instance Blass and Yosha (2010) argue that since research benefits are intangible, external financiers lack a way of monitoring them, and thus invest less on research and development activities. It can as well be explained by the moral hazard theory where firms take blind risks when they are dealing with debt financing than when they deal with their own retained earnings or internally generated funds.

Further, the results show that holding all factors constant, medium and larger firms are more likely to invest in research and development compared to small firms. This is inconsistent with Trott (2001)'s assertion that large firms do not invest in research and development because they have a lot of ideas and thus do not need to invest in research and development. The listing status is however not significant in our sample. Perhaps this could be due to the fact that the listed firms are very few compared to unlisted firms.

Firm performance as measured by profitability highly influences the firm's decision to invest or not to invest in research and development. In addition, our results show a significant positive influence of sales growth and the decision to invest in research and development. The higher the profitability, the more likely the firm is to invest in research and development and vice versa. This supports the evidence in the literature that profitability is an incentive for firms to invest in research and development (Hall, 2002).

The firms using government financing are also more likely to invest in research and development since government financing is associated with less monitoring and less costly. This could trigger firms to use it for research and development than other forms of finance. Sometimes it is also accompanied with some government subsidies and reliefs, which motivates firms to invest in research and development. Financing from family and friends and trade credits were however not significant in this sample. It may be expected that MSMEs may not use funds borrowed from family and friends to carry out R&D due short repayment period and the risk of default.

6. Conclusions and Policy Recommendations

The choice between debt and equity is one of the most important corporate financing decisions that a firm needs to take. According to Modigliani and Miller (1958), firm's investment decision is independent of its financing decision and that capital structure should not affect firm value in a frictionless market. Whether a firm chooses to finance its working capital using debt or equity should be irrelevant in the firm's growth prospects. Assuming perfect markets, debt and equity finance are perfect substitutes. *Ceteris paribus*, a decrease in equity finance should not lead to decline in investment, since the firm will substitute it with debt finance. Using the 2019 World Bank Enterprise Survey data for Kenya, this study used the logistic regression methods to establish the link between firm financing decisions and investment in research and development. The study tested the influence of other firm characteristics on the investment decisions by firms.

We find that the use of bank and non-bank debt to finance investment tends to increase firm's initiative to invest in research and development, as compared to those firms that rely on internally generated funds/retained earnings. Despite the well-developed financial system in Kenya, the results suggest that firms largely rely on owner contributions and equity financing than the use of debt and other informal financing sources. This could be as a result of unfriendly lending terms, or government regulations among other influencing factors. We also find that firms using government financing as well as well performing and larger firms are more likely to invest in research and development. Our study highlights the importance of government lending in fostering investment in R&D by Kenyan firms. The Kenya government lending to the youth through the Youth enterprise development fund (YEDF) and to women through Women enterprise fund (WEF) may have implications for investments in R&D by Kenyan firms.

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