

THE FIRM RISK STRUCTURE, INNOVATION, AND ACCESS TO CREDIT NEXUS IN THE EAST AFRICAN COMMUNITY: THE CASE OF SMALL AND MEDIUM SCALE ENTERPRISES

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ABSTRACT

The paper investigates the nexus between the firm's risk structure, innovation, and access to credit by SMEs in the EAC using the World Bank Enterprise Survey data collected between 2011 and 2014. The overall results are based on the Heckman Probit Model and provide evidence that Innovation increases the likelihood of accessing credit from financial institutions by 4.2% statistically significant at all conventional levels. In addition, the presence of risk reduces the chances of accessing credit by 1.9% statistically significant at 5% conventional level. Furthermore, study findings show that the chances of accessing credit are lower for smaller firms compared to medium firms while they increase for firms owned and operated by women. In regards to the age of the firm, the older the firm, the higher the chances of accessing credit from financial institutions. The study recommends an increase in government support for research activities, as well as strengthening the linkages between the various research institutes and firms to enhance both product and process innovation directly and indirectly through the spillover effect. The paper also proposes the enhancement of knowledge on risk management among entrepreneurs and also building a risk management culture whereby employees and other stakeholders consider risks in their decisions.

Keywords: Access to credit, Heckman Probit, SMEs, EAC.

JEL CLASSIFICATION CODES: O12, D22, C31, C35

1. Introduction

Small and Medium Enterprises (SMEs) constitute the bulk of the business landscape in the East African Community (EAC). Definitions of the nature of SMEs vary from country to country with major distinctions based on the number of workers, company turnover, and assets, among others. However, the most widely used definition for SMEs is the one that is based on the number of workers in a company or an organization. For example in Burundi, Rwanda, and Tanzania, Small enterprises employ a maximum of 10, 30, and 40 workers, respectively while employing a maximum of 50 workers in both Kenya and Uganda. Medium enterprises or firms in Uganda and Rwanda employ a maximum of 100 workers while employing a maximum of 50 and 99 in Burundi and Tanzania, respectively (see details in appendix A).

Hence, SMEs do not only account for more than 95% of the global businesses and employ roughly 6% of the private sector workforce (Ayyagari et al., 2011)but also provide business linkages for foreign and local businesses (EAC, 2016).At the regional level, SMEs account for more than 90% of business establishments and provide over 60% of job opportunities in EAC. Specifically, Kenya’s SMEs account for 75% of businesses, contribute 20% of the GDP, and offer 80% of jobs while they account for 90% of business establishments, 75% of GDP, and offer 90% of jobs in Uganda. In addition, SMEs also account for 99% and 98% of business establishments, 20.5% and 27% in GDP, and offer 41% then 36% of the jobs in Rwanda and Tanzania, respectively as summarized in Table 1.

Table 1: Contribution of SMEs to the EAC Economy

Country/Contribution to	GDP (Percentage)	Employment (%)	Business establishment (%)
Kenya	20	80	75
Rwanda	20.5%	41	99
Tanzania	27	36	98
Uganda	75	90	90

Source: East African Community 2016

The ability of SMEs to achieve their potentials depends on their ability to access finance in their respective countries. Proponents of credit access argue that limited access to credit hampers SMEs’ ability to implement improved and modern practices due to their inability to buy the required inputs making it difficult to expand into new markets and products (Boomgard, 1989;

and Mutua, 1996). Countries such as India, Indonesia, Burma, and China made significant progress after resolving credit access issues for the majority of their people (Arinaitwe and Mwesigwa, 2015). However, the International Finance Corporation(2017) report shows that 31% of the industries in Europe and Central Asia are financially constrained. In addition, the AFDB (2018) report also indicates that access to credit in Africa is limited and continues to remain a primary impediment to the growth and competitiveness of these firms.

In East Africa, SMEs face the challenges of access to formal financing especially during their start-ups and operations hampering their progress (World Bank, 2019).In particular, few SMEs have been incorporated into *formal* capital markets, and many do not use credit or, the few that do, prefer to borrow from *informal* market lenders because the formal financial institutions employ more stringent screening procedures on SMEs and charge high-interest rates in exchange for taking on the high credit risk associated with them. Moreover, the maturities period for loans issued to SMEs by financial institutions in the EAC is often too short to enable any significant investment to be repaid (Kulabako, 2011) making it hard for SMEs to access credit from financial institutions. Hence the limited access to external formal financing among other factors subject most of the SMEs to external shocks that may lead to their collapse and increased levels of unemployment in the region.

In an attempt to appreciate the role played by SMEs, many EAC governments have established several policies and programs that are aimed at increasing credit accessibility to SMEs in their respective countries. These policies among others include: Liberalizing the financial sector, interest rate caps, and the inflation targeting-lite framework aimed at reducing the cost of credit.However, despite the various financial reforms, 68% of SMEs in the EAC are facing financial constraints that hinder their survival and growth (World Bank, 2019).

Several studies have been done on the determinants of access to credit but the majority are outside Africa and these include but are not limited to Dao and Nguyen (2016) in Vietnam, Lee et al. (2015) in the United Kingdom, Nabamita and Sushanta (2014) in India, Ashiqur et al. (2017)in the Czech Republic, Slovak Republic, and Hungary, and Freel (2007) in Northern Britain. The few studies carried out in Africa are mostly country-specific such as Mwabili (2014) in Kenya and Buyinza et al. (2018) in Uganda but have ignored the role of innovation and the firm's risk structure in influencing access to credit. In addition, there are a few studies carried out at the regional levels in Africa and these include Quartey et al. (2017) who used the ordered log it model to study the constraints of SMEs financing in the Economic Community of West African States (ECOWAS) and Buyinza and Bbaale (2013) who used a two-step probit model to study the determinants of access to credit by SMEs in East Africa (EA). These regional studies

looked at the firm sales, owner's education level, manager's experience, and gender of the owner among other determinants but did not also consider the role of innovation and the firm's risk structure in influencing access to credit by SMEs. The current paper extends the earlier works on the determinants of access to credit in the EAC by empirically examining the nexus between the firm's risk structure, innovation, and access to credit to SMEs. Specifically, the study investigates the effect of the firm's risk structure on access to credit, and the effect of innovation on access to credit by SMEs in the EAC. Hence this paper differs from that of Buyinza and Bbaale (2013) because it employs the Heckman Probit model using the World Bank Enterprise Survey data set for Uganda, Kenya, Tanzania, Rwanda, and Burundi collected between 2011 and 2014. In addition, while Buyinza and Bbaale (2013) looked at SMEs in the manufacturing sector, the current paper looks at SMEs in both the manufacturing and service sectors and disaggregates the factors affecting access to credit at the manufacturing and service sector level that was ignored by Buyinza and Bbaale (2013).

The rest of this paper is organized as follows. Section 2 presents the literature review while Section 3 presents the methodology. The empirical findings and policy recommendations are presented in Section 4 and Section 5, respectively.

2. LITERATURE REVIEW

Several theories explain the determinants of access to credit and these include financing constraint theory, the relation gender theory, and the industrial location theory. The financing constraint theory advanced by Evans and Jovanovic (1989) assumed that as firms grow over time, the elasticity of earnings to firm age is positive attracting financiers hence leading to increased access to credit (Cressy, 2006). This theory includes other factors such as collateral security, age of the firm, and firm size, which also affect access to credit (Levine, 2005). The industrial location theory advanced by Weber (1909) assumes that firms that are strategically located close to the factors of production tap into a pool of resources and have a large market for their products (Cyert and March, 1963). In addition, the relational gender theory developed by Bem (1981) assumes that women are disadvantaged in accessing credit in many countries not only because of their feminine nature but also their low engagement in formalized economic activity among other factors (Aterido and Lacovone, 2013). Marlow and Patton (2005) argued that while both men and women entrepreneurs face similar barriers in access to finance, these barriers are higher for women compared to their counterparts.

According to Alquier and Tignol (2006), risks can be categorized into Systemic or Unsystematic, endogenous or exogenous, market risk, financial risk, operational risk, business risks, and event

risks. SMEs' risks can be managed with the right actions, while others are entirely unpredictable and uncontrollable. Due to ineffective management, the risk that affects SMEs stems from both the market-related risk as well as business or operation risks. Studies show that a few SME owners and managers are risk-aware and their risk management efforts focus on fire, safety, health, and quality assurance programs (Smit and Watkins, 2012). Careful identification and mitigation of risks in business lead to successful and lucrative initiatives hence contributing to the nation's economic progress. However, managers that do not take risk management seriously face the performance problem that threatens the continued existence of their businesses making it hard to solicit funds from formal financial institutions (Anke, 2003).

There are four different types of innovation and these include product innovation, process innovation, marketing innovation, and organizational innovation (OECD, 2005). Dynamic companies suffer from relevant financial obstacles in developing innovations due to the nature of their investments. Innovative firms usually invest in high-risk and high-return projects whose expected returns are difficult to evaluate. The financial condition of innovative firms is typically worsened by high shares of intangible assets that cannot be pledged as collateral (Almeida and Campello 2007). Furthermore, the few investments in physical capital, designed to embody the results of research and development activities, are firm-specific and have little collateral value (Carpenter and Petersen 2002). All this increases firms' cost of funding and/or limits their borrowing opportunities. Finally, the peculiar nature of investment in innovation leads to exacerbation of the firms' financial position.

To examine the nexus between the firm's risk structure, innovation, and access to credit, this paper includes several control variables such as the age of the firm, firm size, firm location, and gender of the owner among others that have been used in earlier studies. For example, Dao and Nguyen (2016) employed a Logit model to investigate the possibility of credit accessibility by SMEs in Vietnam and found that manager's education and the distances between enterprises and credit institutions increase the probability of access to credit. Nabamita and Sushanta (2014) used Propensity Score Matching on the WBES to examine the dynamics of female firm ownership and access to finance in India. The study found that female-owned firms face fewer obstacles in accessing finance compared to male-owned firms. However, the study notes that firms that are dominantly managed by females face greater difficulty in accessing finance compared to their counterparts.

Quartey et al. (2017) employed an Ordered Logit model on the WBES to evaluate the constraints to SME financing in the ECOWAS region. The study revealed that access to finance is positively determined by firm size, foreign ownership, the strength of legal rights, the firm's export

orientation, and the experience of the top manager. Ashiqur et al. (2017) also employ Ordinary Least Square Regression to study the determinants of SME finance in the Czech Republic, Slovak Republic, and Hungary. Study results showed that risky enterprises and firms owned by women are usually charged higher interest rates on loans. In the same line of argument, Lee et al. (2015) employed a Heckman selection model on the UK Small Business Survey of 2007/8, 2010, and 2012 to study access to finance for innovative SMEs in the United Kingdom since the financial crisis. The study results showed that innovative firms are more likely to get access to credit.

Belas et al. (2017) used the Business Environment and Enterprise Performance Survey (BEEPS) of 2012 to 2014 and employed a logistic model to investigate the financial constraints experienced by innovative SMEs in the Czech Republic, Slovak Republic, Hungary, and Poland. The study findings showed that loan applications of experienced borrowers and service firms are more likely to be accepted. Hanedar et al. (2014) used the BEEPS and employed a Tobit model to investigate the determinants of collateral requirements for loans extended to SMEs in less-developed countries. The study findings showed that risky firms are required to provide more collateral. On the contrary, Freel (2007) used the 1998-2001 Survey of Enterprise in Northern Britain and employed a Tobit model to study the extent to which innovative firms are credit rationed. Study results showed that innovative firms are less successful in obtaining bank credit. While examining the financing of research and development, Hall (2002) revealed that small and new innovative firms experience high costs of credit and therefore, are credit constrained. Brancati (2014) used *the comprehensive survey of Italian companies (the MET dataset)* waves of 2008, 2009, and 2011 and employed a Bivariate Probit model to analyze the effect of financial constraints on innovation and the role of relationship lending. The findings indicated a stronger effect of financial constraints on the product than process innovations.

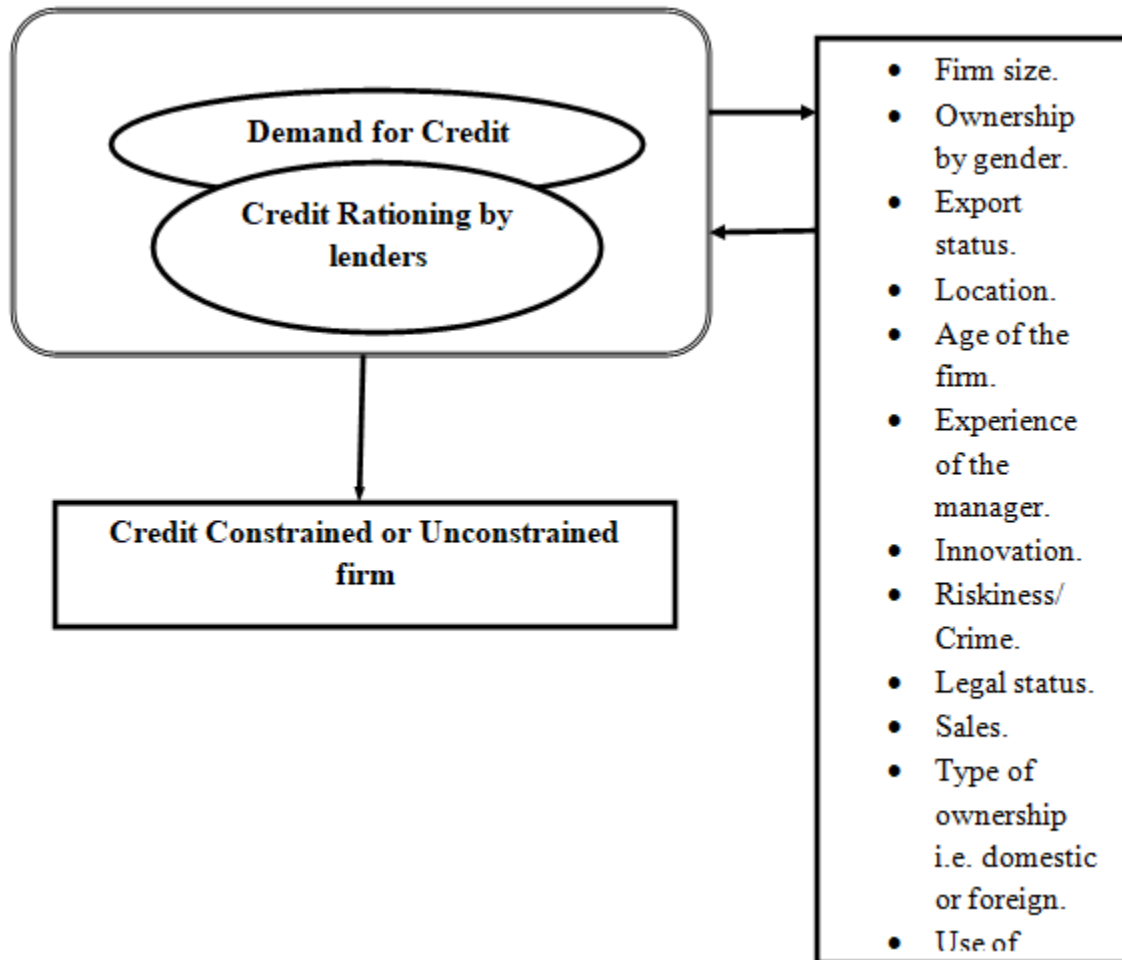
Mwabili (2014) employed a Heckman Probit model on primary data collected between August and September 2014 to analyze access to credit by SMEs in Kenya's informal sector. The study findings showed that women-owned SMEs are less likely to apply and receive credit compared to their counterparts while the firm turnover and length of operation of the firm increase the firm's chances of getting a loan. While employing a two-step Probit model to study the effect of credit constraints on the performance of manufacturing firms in the East African Region, Buyinza and Bbaale (2013) use the WBES of 2006 and find that larger and exporting firms are more likely to receive credit compared to smaller ones. In addition, Buyinza et al. (2018) used Gender Enterprise Survey and employed a Heckman Probit model to study the factors affecting access to formal credit by Micro and Small Enterprises in Uganda. Results showed that the

owner's education, use of the internet, and gender of the owner are positively associated with access to formal credit while experienced firms are less likely to access credit. To the best of our knowledge, there is no study the EAC that has looked at the nexus between the firm's risk structure, innovation, and access to credit in the region. Therefore this paper bridges the knowledge gap by incorporating the firm's risk structure and innovation in the firm's credit model.

3. Theoretical Framework

To conceptualize the factors that influence access to credit by firms, the paper borrows ideas from Beck and Torre (2007) and Zeller(1994) who argue that access to financial services is a function of both the supply and demand dimensions. In this case, the demand side deals with the decision of a firm to borrow from a financial institution or not being influenced by factors such as information asymmetry, age of the firm, firm size, state or foreign ownership, manager's education, location, sector, and business association membership (Byiers et al., 2010). On the other hand, the supply side is influenced by the gender of top management, firm size, export status, location, age of the firm, the experience of the manager, innovation, crime, legal status, sales, state or domestic ownership, use of internet and sector (Beck et al., 2006). SMEs are assumed to be rational if they accumulate enough savings to support their production activities and do not need to borrow as credit is associated with a cost (Awunyo-Victor, 2018). However, those who are unable to accumulate enough savings need to borrow and support their production activities. SMEs that apply for credit and are not offered the desired credit by financial institutions are classified as quantity-rationed in line with the theory of information asymmetry and transaction cost theory. Hence, activities within the credit market give rise to two groups of SMEs: those who are constrained in terms of access to credit and those that are not constrained (See figure 1).

Figure1: Theoretical Framework of Access to credit in EAC (Awunyo-Vitor, 2018)



3.1 Variables and Data Source

While examining the nexus between the firm’s risk structure, innovation, and access to formal credit by SMEs in the EAC, this paper uses control variables which include Age of the firm, Size of the firm, Manager’s experience, Firm’s usage of the internet, Gender of the owner, Location of the firm, the Export status of the firm, Country, Sector, and Legal status. The country dummy variable is included in the study to control for fixed effects and time differences as documented by Taylor and Naude (2000) while the sector dummy (International Standard Industrial Classification) controls for sector fixed effects. The study used the World Bank Enterprise Survey data of firms in the East African Community collected between 2011 and 2014. The dataset provides a representative sample of each country’s determinants of access to credit.

However, each country's survey was carried at different times. For example, Rwanda's survey was done in 2011, Uganda, Kenya, and Tanzania carried out their respective surveys in 2013 while Burundi had its survey in 2014. The survey sample consisted of firms engaged in the non-agricultural formal sector obtained from 139 countries following a global standardized methodology. Government agencies, business associations, business licensing bodies, and marketing databases were used in identifying the items in the sample. Formal firms with five or more employees in the manufacturing and service sector were the target of the survey, and responses were solicited from business owners and top managers. For this survey, a two-stage stratified random sampling design was utilized and covered 2754 enterprises in the region under study. Simple random samples were selected from each of the homogeneous population units and sample estimates were computed for each stratum with a specified level of precision or population estimates through attaching weights on the observation. Data for each of the countries considered in this study are merged to form one dataset that is used in the analysis.

A pair wise correlation matrix was used to test whether there exists multicollinearity among variables. In addition, a bivariate probit model was used to study if there is the presence of endogeneity or simultaneous causality (Heckman, 1978; and Bascle, 2008). The exogeneity condition is stated in terms of the correlation coefficient ρ , which can be interpreted as the correlation between the unobservable explanatory variables of the two equations. When $\rho = 0$, there is an absence of endogeneity, otherwise, endogeneity exists.

3.2 The Empirical Model

To study the nexus between the firm's risk structure, innovation, and access to credit in the EAC by SMEs in the EAC, a dichotomous dependent variable of access to credit is used. This variable represents SMEs that obtained credit and those that did not. In addition, the paper considers a selection variable of demand for credit which is dichotomous, and models firms that applied for credit and those that did not. This implies the presence of sample selection bias(Heckman, 1979). The use of standard Logit or Probit model techniques on equation (3.1) may produce biased results due to the presence of sampling bias (WPMM, 1981) hence a Heckman Probit model with sample selection is used(Heckman, 1974; Heckman, 1979; WPMM; 1981) in this paper. The model assumes that the main outcome variable is observed only if a selection condition is satisfied. In this application, the study used a dichotomous dependent variable coded as "1" or "0" depending on whether a firm has a line of credit with a formal financial institution or not.

SMEs that demand a loan are identified as those that applied for a line of credit in the previous year and are given a value of one while those that did not demand a bank loan thus did not apply

for a line of credit are given a value of zero (Rebel and Dietrich, 2017). A firm that decides to apply for a loan is either approved or denied credit by its prospective lender. In this stage of the model, only those firms that applied for credit are included. The binary Probit is generally motivated by reference to the latent (or unobservable) dependent variable and usually expressed as a linear function of a set of explanatory variables as follows:

$$y_i^* = x_i'\beta + u_{1i} \dots \dots \dots (1)$$

Where y_i stands for access to credit for i number of firms,

and β' denote β is a vector of parameters to be estimated,

Where y_i stands for access to credit for i number of firms, β' denote the coefficients to be estimated, while x_i' stands for a vector of variables to be estimated that include firm age, manager's experience, size of the firm, sales, innovation, legal status, ownership by gender, firm's risk structure, and internet use.

The selection equation is

$$y_j^{select} = z_j'\alpha + u_{2j} > 0 \dots \dots \dots (2)$$

y_j stands for the demand for credit for j number of firms,

Z_j' stands for firm age, manager's experience, size of the firm, sales, innovation, firm's risk structure, internet use, legal status, and ownership by gender,

u_{1i} and u_{2j} are error terms that are normally distributed with mean 0 and standard deviation of 1

The first stage of Heckman's sample selection model is the demand for credit and this is the selection model (equation 2). The second stage, which is the outcome model (equation (1)), is whether the firm has access to credit, depending on the first stage that it demanded a loan. From equation 1, the model

$$y_j^* = x_j'\beta + u_{1j}$$

Where

$$y = \begin{cases} 1 & y_j^* > 0 \\ 0 & otherwise \end{cases}$$

Such that only the binary outcome given by the Probit model as in equation 3.3 is observed

$$y_j^{probit} = (y_j^* > 0) \dots \dots \dots (3)$$

The dependent variable is observed only if the observation j is presented in the selection equation. Therefore, equation 2 becomes the selection equation from which all firms that demanded credit are selected. The values of the latent dependent variable are measured on the real line and in this study, it reflects the underlying propensity of a given SME to have access to bank credit. Thus, the probability of an event occurring can be linked to the latent dependent variables as follows:

$$\begin{aligned} \Pr(y_j = 1|x) \dots \dots \dots (4) \\ \Pr(y_j^* > 0) = \Pr(x'\beta + u > 0) = \Pr(u > -x'\beta) = \Pr(u < x'\beta) = \Phi(x'\beta) = \Phi(z) \end{aligned}$$

From equation (4), y_j is the dichotomous realization of the latent dependent variable which is either that the firm accessed credit or not in this study while Φ denotes the cumulative distribution function operator for the standard normal distribution and,

$$z = \frac{x'\beta}{\sigma} \text{ with } \sigma = 1 \text{ ie normally distributed.}$$

Given that u_{1j} and u_{2j} are normally distributed with mean zero and constant variance, if the, $corr(u_{1j}, u_{2j}) = \rho$ and $\rho \neq 0$, then the estimation of equation (3.4) yields biased results.

Estimating equation 1 using the Probit model with a sample selection model provides consistent and asymptotically efficient estimates for all of the parameters. In this model specification, whether an enterprise in the sample demanded a line of credit in the bank if $y_j = 1$ otherwise, for $y_j = 0$ implies that the enterprise did not demand any line of credit from the bank credit. Thus, in the selection equation (2), it is assumed that an enterprise demanded credit from the bank. In Equation (2), the demand for credit from the bank is assumed to be affected by firm and entrepreneur characteristics. Therefore, the outcome of equation (1), gives the status of the outcome of the loan application from the bank, that is, whether a firm received credit from the bank or not.

In the case of the Probit model with a standard normal probability where $\sigma=1$, marginal effects are interpreted instead of coefficients. This is because the coefficients are larger than the marginal effect and if interpreted lead to an overestimation of the model. In addition, the probability distribution function of a Probit model lies between 0 and 1 ($0 \leq f(x'\beta) \leq 1$) yet the coefficients often exceed this range(Cameron, 2005).

The model is estimated using the log-likelihood function defined as;

$$\ln L(\beta, y_j, x_j) = \sum_{i=1}^n \{y_j \ln \Phi(x'\beta) + (1 - y_j) \ln [1 - \Phi(x'\beta)]\},$$

Which is solved by examining the first and the second-order conditions. The estimation of $\hat{\beta}$ which maximizes the log-likelihood function is consistent, asymptotically normal, and efficiently provided $E(xx')$ exists and is not singular.

4. Empirical Findings

4.1 Descriptive Analysis

Descriptive evidence is presented in form of cross-tabulations showing the average percentage share of SMEs by background characteristics(see appendix B). The univariate analysis carried out shows the background characteristics of each variable used in the analysis.

It was observed that out of firms surveyed on the access to credit in EAC, 73% did not receive loans from financial institutions which confirms the slow utilization of credit by SMEs in the EAC. The results shown in appendix B indicate that the majority of firms are small in size making an average of 55% of the total sampled firms. This composition of SMEs in the EAC is similar to their composition in countries outside the region. It was observed that only 25% of the SMEs in the EAC use the internet in doing business which implies that communication between enterprises and lenders is limited. In addition, the study results indicate that only 25% of SMEs in EAC export their goods explained by the low quality of goods that makes it hard to compete in the international market. The results shown in appendix B indicate that only 37% of SMEs carry out their business within the city center. This limits the majority of the enterprises from accessing credit since most financial institutions are located in the city. Results show that on average, 33% of SMEs are owned by females which represents gender biases in entrepreneurial abilities a situation common in developing countries. It was observed that on average, the majority of firms are engaged in both product and process innovative activities (51%) while only 23% participated in either product or process innovation alone. In addition, 26% of the SMEs did not engage in any activity aimed at improving their product or production processes. This can be

explained by limited capital to fund any activity of innovation amidst limited access to external finance. In regards to the firm's risk structure, analysis shows that 23% of the SMEs in the EAC are high-risk firms. Sectoral characteristics of SMEs in this study show that the service sector constitutes the highest average percentage of SMEs (53%). This is because, in this study, the retail sector and other services have been merged to form the service sector. The manufacturing sector on the other hand constitutes 47% of the SMEs in the EAC. Finally, analysis in terms of the legal status of SMEs shows that economy is dominated by sole proprietorships (61%) followed by partnerships (27%), and the public limited companies are 12%. This can be explained by the increased participation of the private sector in the economy.

Cross tabulations (bivariate analysis) based on the different background characteristics and access to credit as shown in appendix B indicate that 38% of medium firms had loans while only 22% of small firms had access to credit. This can be explained by the lack of collateral security to acquire loans by these firms. In addition, the results indicate that only 26% of the SMEs that were risky, received a loan while 32% of the non-risky firms had access to credit. In terms of export status, the analysis shows that around 29% of SMEs that exported some of their output had a loan while 71% had no loans with financial institutions. Additionally, the study indicates that 35% of SMEs with loans use the internet. In terms of location, the study shows that SMEs operating in the capital city had more access to loans (35%) compared to their counterparts operating outside the capital city. This can be explained by the high concentration of financial institutions in the city compared to other areas outside the city center. In terms of the legal status of SMEs, results indicate that 45% of shareholding companies obtained loans while 29% of the partnerships had loans with financial institutions. On the other hand, only 22% of the sole proprietorships held loans with financial institutions. As well, in terms of gender, only 24% of male-owned SMEs had access to credit while 34% of those owned by females had access to credit in the EAC. Finally, results show that 30% of the firms that engaged in either product or process innovation had loans from financial institutions while 31% of the firms that engaged in both product and process innovation had loans with financial institutions. Only 17% of the SMEs that did not engage in any activity on innovation had access to loans in the financial institutions implying provide more loans to innovative firms than the non-innovative ones.

General descriptive analysis shows that the mean of all variables used in the model lies between the minimum and maximum values for each variable. The standard deviation is low meaning that there are no outliers in the model(See appendix C).

4.2 Diagnostic tests

Correlation analysis shows that the pairwise correlation coefficients are all below 0.8 in absolute value which means that there is no existence of multicollinearity between any two variables (see appendix D). On running the bivariate probit model, results indicate that $\rho = 0$ (see appendix E), implying that the model used in this study is free from endogeneity and therefore results obtained by the Heckman model are also consistent. Post estimation test results of the Heckman Probit model (See Appendix F) reveal that the explanatory power for the models is strong. The overall Wald test of independent equations in each model rejects the null hypothesis ($H_0: \rho = 0$), validating each of the estimated model specifications. The Chi-square test for each model estimated shows that the selected variables are significant in explaining credit constraint and the F-test qualifies the reliability of the estimated models.

4.3 Econometric Results

Table 2 presents the Heckman Probit regression results for the determinants of access to credit in EAC based on the full sample (SMEs), the manufacturing sector, and other sectors.

Table 2: Probit regression results showing the nexus between the firm’s risk structure, Innovation, and access to credit by SMEs in EAC (Marginal Effects)

VARIABLES	SMEs	Manufacturing sector	Other Sectors
Firm Size: Medium (Ref)			
Small	-0.049*** (0.016)	-0.094*** (0.028)	-0.025 (0.016)
Ownership by gender: Male (Ref)			
Female	0.056*** (0.016)	0.074*** (0.027)	0.045** (0.022)
Export status: Doesn’t Exports (Ref)			
Export	-0.004 (0.015)	0.027** (0.012)	
Location: Not in City (Ref)			
Located in Capital City	-0.020 (0.015)	-0.024 (0.019)	0.048*** (0.013)
Age of the firm	0.017* (0.009)	0.027* (0.014)	0.020* (0.011)
Experience of the manager	0.002 (0.006)	-0.005 (0.010)	0.005 (0.009)
Innovation: No Innovation (Ref)			

Product or Process Innovation	0.014 (0.012)	0.004 (0.009)	0.021 (0.017)
Product and Process innovation	0.042*** (0.011)	0.030** (0.012)	0.057*** (0.016)
Riskiness: No losses due to theft (Ref)			
Made losses due to theft	-0.019** (0.008)	-0.018 (0.016)	-0.013 (0.014)
Use of the Internet: No (Ref)			
Yes			-0.013 (0.012)
Country	YES	YES	YES
Sector	YES	YES	YES
Legal status	YES	YES	YES
Observations	2,071	1,007	1,041

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

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014

Study findings indicate that the estimated marginal effect for small-sized firms is negative and statistically significant at all conventional levels. This implies that running a small-scale enterprise reduces the chance of receiving a loan by 4.9% compared to running a medium-sized firm. This is because smaller firms are usually associated with information asymmetry since they may lack audited financial statements to give a clear picture of their performance and as well, they are less likely to be able to post collateral hence often are usually credit rationed (Beck, 2007). In terms of robustness, the results obtained are similar for firms in the manufacturing sector where the chance of accessing credit for a small firm is 9.4%. Buyinza and Bbaale (2013) and Mwabili (2014) also obtained results that lie in the same line of argument and find that the larger the enterprise, the higher the chances of getting a loan.

Study findings show that female-owned enterprises have a 5.6% more chance of receiving a loan compared to their male counterparts. This result is statistically significant at a 5% conventional level. This can be explained by the recent gender bias in the distribution of financial services and the financing environment that directly promotes female-owned enterprises in terms of access to credit for example banks sometimes create special loan packages dedicated to women entrepreneurs in a bid to encourage them to participate in the business. This result is consistent with the descriptives and robust in all other models (the manufacturing sector and other sectors). However, these findings contradict those of Nabamita and Shushanta (2014) who found that female-owned SMEs are more credit constrained compared to their male counterparts.

The marginal effect for the firm's age is positive and statistically significant at a 10% conventional level. The results indicate that staying an additional year in business increases the chances of receiving a loan by 1.7%. This is because the elasticity of earnings to firm age is positive which reduces the credit riskiness of the firm hence attracting financiers. The result is robust for SMEs in the manufacturing sector and other sectors where the chance of accessing credit increase by around 2.7%, and at 2% respectively. These results are consistent with those of Ashiqur et al.(2017) among other studies who found that older firms easily have access to credit due to their reduced level of credit risk.

In terms of Innovation, results obtained in the analysis show that product and process innovation has a positive and statistically significant marginal effect on access to credit. Other factors kept constant, small and medium enterprises that engage in both product and process innovational activities increase their likelihood of receiving a loan by 4.2%. This is because innovative firms usually have huge growth prospects that attract lenders. This result is consistent with the descriptives and robust in models for manufacturing firms and other services with an estimated marginal effect of around 3% and 5.7% respectively. The results are also consistent with Ashiqur et al. (2017) who inferred that commercial banks in the Czech Republic, Slovak Republic, and Hungary provide financial support to innovative firms due to the fact they have more growth prospects in the market.

In terms of riskiness, the findings of the study indicate that the level of risk of an establishment is negative and statistically significant at 5% for all SMEs. The results indicate that the presence of risk in form of crime reduces the chance of receiving credit by around 1.9%. This is explained by the threats posed by crime on SMEs' survival which may scare away potential lenders from providing financial support to these firms. The result is in line with those obtained by Hanedar et al. (2014) and Ashiqur et al. (2017), who finds a negative relationship between the firm's risk structure and its chances of access to credit.

5. Conclusion

This paper aimed at examining the nexus between the firm's risk structure, innovation, and access to credit in the East African Community. The regression results reveal that access to credit is significantly and positively associated with the age of the firm, firm's risk structure, product, and process innovating firms, as well as female ownership of the firm. This is because these factors are associated with a reduction in the credit risk of these firms. On the other hand access to credit is significantly and negatively associated with crime and small firm size. The study proposes that owners and managers of SMEs embrace innovations specifically product and

process innovations. This can be done through direct funding of government research facilities, provision of grants, and tax incentives to universities and private researchers. Government should as well strengthen linkages between the various research institutes and firms as these promote knowledge spillovers which may, in turn, lead to new products and processes thereby attracting financiers. Also, there is a need for organizations to build a risk management culture whereby employees and other stakeholders consider risks in their decisions. This can be through seminars, workshops, and training that enhance the level of knowledge of risk management thus creating awareness and understanding of the financial condition of the business. The current study also shows that small firms are constrained in terms of access to credit. Regional policies aimed at creating a stable and conducive microeconomic environment that can enhance the performance and growth of firms from small to medium then to large multinational enterprises can be undertaken. These include the enhancement of entrepreneurial training which increases the rate of entrepreneurship and by extension increase SMEs' participation in the credit market. Similarly, the study shows that majority of female-operated firms are less financially constrained. The study, therefore, recommends the removal of any barriers to entrepreneurship development and encouraging more women to participate because it allows better financial access by SMEs and achievement of greater financial inclusion and inclusive growth. Finally, the study shows that financial access increases with an increase in the age of the firm. To enable young SMEs to reduce their credit constraints, the study recommends that owners of these firms should open bank accounts before they commence business operations to maintain a good relationship with lenders. This is because the establishment of close ties between the owner of the enterprise and the lender can be used as a channel to enable the enterprise to acquire a loan from the lender (Brancati, 2014). In addition, the study recommends that these enterprises have to keep a good credit history to expand and maintain a large network of lenders. The study further proposes that young SMEs should join trade associations since these can easily access finance as a group compared to individually as an enterprise.

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APPENDICES

Appendix A: SMEs Definition Index of SMEs in the EAC Countries

Country	No. of people engaged	Investment capital	Sales/ turnover
Small enterprises			
Burundi	6-10	-	US\$ 15,000 – 31,000
Kenya	10- 50	US\$54,522 – 218,079	US\$ 5452 - 54,522
Rwanda	4 – 30	US\$ 696 – 20,892	US\$ 418 – 16, 713
Uganda	5 – 50	Maximum US\$ 118,033	Maximum US\$ 118,033
Tanzania	5- 49 people	US\$ 2,727 -10,909	US\$ 2,727 -10,909
Medium enterprises			
Burundi	11-50	-	US\$ 63,000- 630,000
Kenya	-	-	-
Rwanda	31-100	US\$ 20,892 -104,460	US\$ 16, 713 - 69,640
Uganda	51-100	US\$ 118,033- 1.875M	US\$ 118,033- 1.875M
Tanzania	50 – 99	US\$ 10,909 - 436, 862	US\$ 10,909 - 436, 862

Source: East African Community 2016

Appendix B: Average percentage share of firms by background characteristics.

Variable	Characteristic of the firm	All firms (univariate analysis)	Access to credit (bivariate analysis)	
			Yes	No
Access to credit	Yes	575		
	No	1,537		
Firm size	Small	1,480	297	1,076
	Medium	789	278	461
Use of internet	Yes	573	185	349

	No	1,679	389	1,178
Export status	Exports	564	154	377
	Does not export	1,705	421	1,160
Riskiness	Yes	512	154	323
	No	1,737	419	1,203
Firm's location	Capital city	1,426	258	535
	Other places	843	317	1,002
Legal status	Sole proprietorship	1,375	283	983
	Partnership	611	169	404
	Public limited companies	283	150	123
Gender of owner	Male	1,511	331	1,071
	Female	758	244	466
Innovation	Product or process	518	144	343
	Product and process	1,167	342	750
	Non	584	89	444
Sector	Manufacturing	1,073	296	728
	Other sectors	1,196	279	809

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014

Appendix C: Descriptive Statistics of variables

Variable	Mean	Standard Deviation	Min	Max
Access to credit	0.272	0.445	0	1
Firm Size	0.652	0.476	0	1
Use Internet	0.254	0.436	0	1
Ownership by gender	0.334	0.472	0	1
Export status	0.249	0.432	0	1
Capital city	0.372	0.483	0	1
Age	2.46	0.767	0	4.466
Gender of manager	0.149	0.356	0	1

Experience of manager	2.434	0.707	0	4.043
Innovation	1.257	0.84	0	2
Legal status	1.145	0.611	0	2
Firm's risk structure	0.228	0.419	0	1
Country	2.036	1.594	0	4
Sector	1.841	0.873	1	3

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014

Appendix D: Pairwise Correlation Matrix showing the relationship between variables used in the study.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Access to credit	1.000												
(2) Firm size	-0.171*	1.000											
(3) Use of internet	0.096*	-0.302*	1.000										
(4) Ownership by gender	0.114*	-0.050*	0.073*	1.000									
(5) Export status	0.023	-0.143*	0.174*	0.068*	1.000								
(6) Location	0.092*	-0.092*	0.123*	0.082*	-0.109*	1.000							
(7) Age of the firm	0.082*	-0.160*	0.055*	0.038	0.107*	-0.115*	1.000						
(8) Experience of manager	0.069*	-0.110*	0.020	0.056*	-0.007	0.011	0.487*	1.000					
(9) Innovation	0.128*	-0.160*	0.216*	0.084*	-0.004	0.113*	0.086*	0.080*	1.000				
(10) Legal status	-0.062*	-0.023	0.048*	0.065*	-0.008	0.081*	0.004	0.062*	0.060*	1.000			
(11) Riskiness	0.061*	-0.017	0.016	0.080*	0.044*	-0.064*	0.050*	0.088*	0.038	0.018	1.000		
(12) Country	-0.035	-0.006	0.035	-0.052*	0.057*	-0.338*	0.005	-0.012	-0.086*	-0.046*	-0.006	1.000	
(13) Sector	-0.013	0.078*	0.025	-0.001	-0.070*	0.068*	-0.214*	-0.188*	-0.069*	-0.029	0.007	0.011	1.000

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014

Appendix E: Coefficient table of the Bivariate Probit regression

Access to credit dy/dx	Coefficient	Standard Error	t-value	p-value	[95% Conf Interval	Sig]
Ob.firm size	0.000	.	.	.	.	.
Firm size	-0.225	0.072	-3.10	0.002	-0.367	-0.083 **
Ob.ownership by gender	0.000	.	.	.	.	.
Firm owned by a female	0.205	0.069	2.99	0.003	0.071	0.340 **

Ob.export status	0.000	.	.	.	.	.	.
Firm exports	-0.013	0.076	-0.17	0.868	-0.162	0.136	
Ob.capital city	0.000	.	.	.	.	.
Firm located in Capital city	-0.205	0.080	-2.55	0.011	-0.362	-0.047	**
Age of the firm	0.065	0.049	1.34	0.180	-0.030	0.161	
Experience of the manager	0.032	0.052	0.62	0.534	-0.069	0.133	
Ob.innovation	0.000	.	.	.	.	.
Product or process innovation	0.297	0.095	3.13	0.002	0.111	0.482	**
Both product and process Innovation	0.322	0.083	3.88	0.000	0.159	0.485	**
Ob.Riskiness	0.000	.	.	.	.	.
Firm risky	0.196	0.074	2.65	0.008	0.051	0.341	**
Legal status	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes.	Yes.	Yes.	Yes.	Yes.	Yes
Constant	-1.220	0.213	-5.73	0.000	-1.637	-0.803	**
Ob.firmsize	0.000	.	.	.	.	.
Small firm	-0.054	0.079	-0.69	0.491	-0.209	0.101	
Ob.ownership by gender	0.000	.	.	.	.	.
Firm owned by female	0.235	0.074	3.20	0.001	0.091	0.379	**
Ob.export_status	0.000	.	.	.	.	.
Firm exports	0.082	0.081	1.01	0.312	-0.077	0.241	
Ob.capitalcity	0.000	.	.	.	.	.
Firm located in capital city	-0.189	0.089	-2.13	0.033	-0.362	-0.015	**
Age of the firm	0.064	0.052	1.23	0.220	-0.038	0.166	
Experience of the	-0.055	0.055	-1.01	0.312	-0.163	0.052	

manager								
Ob.innovation	0.000	.	.	.	.	.	.	.
Product or process innovation	0.159	0.103	1.53	0.125	-0.044	0.361		
Both product and process innovation	0.251	0.091	2.76	0.006	0.073	0.429	**	*
Ob.riskiness	0.000	.	.	.	.	.	.	.
Firm risky	0.200	0.079	2.53	0.011	0.045	0.356	**	
Legal status	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-1.520	0.233	-6.54	0.000	-1.976	-1.064	**	*
Constant	0.784	0.053	14.71	0.000	0.680	0.888	**	*
Mean dependent var	0.192	SD dependent var	0.394					
Number of obs	2044.000	Chi-square	402.589					
Prob > chi2	0.000	Akaike crit. (AIC)	3608.230					

*** $p < .01$, ** $p < .05$, * $p < .1$

$p < .1$

Wald test of rho=0: $\chi^2(1) = 216.491$ Prob > chi2 = 0.0000

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014

Appendix F: Post estimation Diagnostic test results for each model used in the study

	SMEs	Manufacturing sector	Other Sector
Observations	2,071	1,007	1,041
LR test for independent equations ($\rho = 0$): $\chi^2(1)$	8.84	5.85	10.11

	(0.0036)	(0.0156)	(0.0015)
Wald chi ²	226.55 (0.000)	120.11 (0.000)	110.50 (0.000)
Log likelihood ratio	-1073.274	-558.8489	-500.7525
Censored observations	1688	795	893
Uncensored	393	215	176

NB: probabilities are in parentheses

Source: Author's calculations (2021) using WBES data collected between 2011 to 2014