

FINANCE AND FIRM PRODUCTIVITY IN AFRICA: BACKGROUND STUDY FROM WORLD BANK ENTERPRISE SURVEY DATA

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ABSTRACT

Access to finance has been considered to be one of the important factors in influencing firms' real activities and in promoting aggregates. However, literature on the relationship between finance and firm-level productivity is almost non-existent for African countries. This paper fills this gap by using cross-sectional firm-level data to estimate the effect of access to finance on labour productivity, total factor productivity (TFP), and the stochastic frontier trans-log model. This study estimates an instrumental variable (GMM) model to address potential endogeneity bias between access to finance and firms' productivity. The results obtained show that the lack of access to finance, especially overdraft facilities negatively affects the productivity of firms in Africa. Also, smaller firms and sole-proprietorships are mostly affected because they have less access to finance. This study suggests that the development of a balanced financial system should be of topmost priority to policy makers. This ensures that more finance is channeled towards those firms whose productivity depends heavily on the availability of finance irrespective of their characteristics. This would result in firms increasing their investments in productivity-enhancing activities, which would benefit long-term economic growth.

1. Introduction

The growth and competitiveness of Africa's enterprises are important catalysts for increasing rate of growth and development in Africa's economy (Becks et al., 2013). According to African Development Bank Group Report 2015, the informal sector¹ contributes about 55 percent of Sub-Saharan Africa's GDP. Predominantly, small and medium-sized enterprises (SMEs) are commonly recognised as drivers of economic growth, innovation, diversification, regional development, job creation, and contribute to more than 80 percent of output and employment in most African countries (Becks et al., 2013). However, a vast majority of firms in Africa are constrained by several factors such as limited access to stable energy service, skilled labour, business management, and access to finance for investment from both the formal and informal sector (Becks et al., 2013).

This study focuses on the finance constraint and examines the effect of access to internal and external finance² on firms' productivity. Although, there are diverse ways through which firms can finance their operations and growth, the choice of a particular method is determined by management preferences and available options (Gatti and Love, 2008). However, the availability of external finance is largely a component exogenous to the firm, determined by the wider institutional environment. The lack of internal finance may suggest that the firm is not profitable or profits have been exhausted on other projects and funds are not available for advancing new projects. The unavailability of finance both internally and externally is a major business obstacle firms face because firms require more finance to achieve higher levels of productivity and growth (Gatti and Love, 2008; Becks et al., 2013; Chen and Guarigila, 2013). This study explores the channels through which finance affects firms' productivity in Africa using cross-country and cross-firm level data from World Bank Enterprise Surveys.

An extensive range of internal and external factors determines the form, source and cost of finance to firms. The ability and expertise of firm managers, structured business plan, and risk analysis are essential internal resources needed for sourcing external financing (Becks and Honohan, 2008). However, the accessibility of external finance mainly depends on conditions outside the control of the firm. The availability of external finance depends mainly on the effectiveness and existence of a range of intermediaries and subsidiary firms that assist in pooling funds providers and users by improving their ability to curb information and agency

¹ The informal sector is defined as entities whose objective for producing goods and services is the generation of employment and income to the persons concerned.

² This study focuses on access to finance from the formal sector given the data available.

problems (Tirole, 2010). Firms face further constraints as a result of differing pattern and extent of finance needed by different firms in various countries (Becks and Honohan, 2008). Economists and policy makers place particular interest on the unavailability of external finance resulting from imperfect financial market because they have important implications for monetary policy transmission mechanism and tax policy (Chen, 2010).

According to Siedschlag et al. (2014) access to external finance is an essential factor for promoting investment and innovation which are important elements of firms' productivity. Some of the channels through which improved access to external finance affect firms' productivity and ultimately economic growth according to Beck et al. (2008) are: (i) the availability of external finances increases the number of start-ups – an essential measure of entrepreneurship, innovation, and dynamism of firms (Aghion et al., 2007, Ayyagari et al., 2011), (ii) finance is required by existing firms to allow them benefit from investment and growth opportunities and be able to achieve bigger equilibrium size (Beck et al., 2006b), (iii) for the acquisition of assets portfolio that are more efficient and productive and the choice of efficient forms of organization like incorporation (Demirgüç- Kunt et al., 2006).

Although, relatively ignored in existing literature, the availability of internal finance also affects firms' productivity. Firms experiencing difficulties in accessing external finance have to rely on their own internal finance (Chen and Guariglia, 2013). Particularly, limited access to external finance is usually available for firms in their infancy stage (i.e. start-up phase), thereby restricting them to internal equity capital and bank borrowing (Segarra-Blasco and Teruel, 2009). Access to internal finance helps to improve entry growth, reduces risk, promotes innovation, and increases equilibrium size (Beck et al., 2008). It also enhances the performance of the aggregate economy via stronger financial systems (Chen and Guariglia, 2013). Chen (2010) states that readily available internal funds would facilitate investment in productivity-enhancing projects by innovative firms. The availability of internal funds is essential for the daily operations of the firm and the achievement of long-term development goals and investment opportunities (Kira, 2013).

The contributions of this study are: firstly, it provides an empirical study on the effect of access to finance on firms' productivity in Africa. The review of existing literature shows that empirical analysis of this effect on African countries is almost non-existent. Secondly, while most existing literature on other countries focuses only on external finance, this study focuses on the links between both internal and external finance and firms' productivity in Africa. Thirdly, this study uses more direct measures of access to finance, such as having a checking

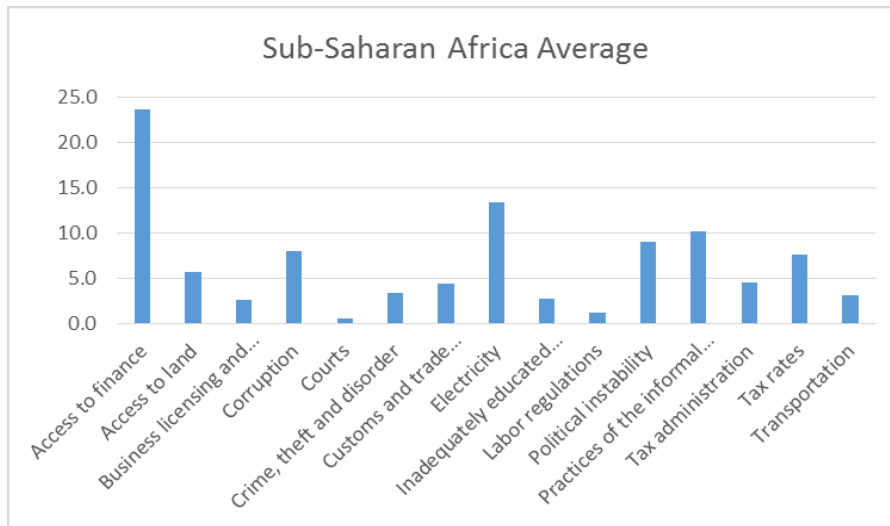
or savings account, the presence or absence of overdrafts and lines of credit. Fourthly, several firm-level studies estimate firms' productivity using only the Total Factor Productivity (TFP) model. This study improves on the existing literature by measuring firms' productivity using the TFP model, labour productivity, and the stochastic frontier Cobb-Douglas and translog model. To address potential endogeneity and OLS estimation bias, instrumental variable (GMM) model is used to estimate the TFP model using growth in sales and type of ownership as instruments.

This paper is structured as follows. Section 2 provides an analysis of the composition of finance across firms in Africa. Section 3 reviews existing theoretical and empirical literature. Section 4 provides details of the econometric methodology used and describes the data in the study. Section 5 reports and discusses the findings of the study. While the summary of findings and policy implications are presented in session 6.

2. The Composition of Finance across Firms in Africa

Figure 1 below shows the largest percentage of firms in Africa reported access to finance as the biggest obstacle they faced in their operations. Approximately 25% of firms surveyed in Sub-Saharan reported that access to finance was one of the biggest obstacles they face. This shows that access to finance is an essential element for firms' productivity in Africa.

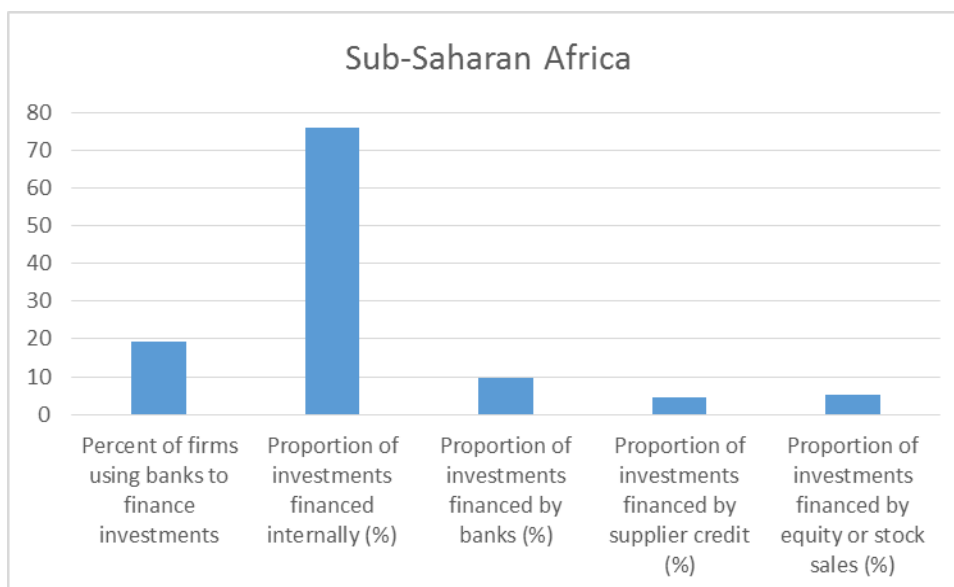
Figure 1: Biggest Obstacles faced by firms in Sub-Saharan Africa (%)



Source: World Bank Enterprise Survey (ES)

Figure 2 below shows the proportion of each source of finance used by firms in Sub-Saharan Africa for investment in fixed assets and financing working capital.

Figure 2: Proportion of Investments Financed by Various Sources of Finance



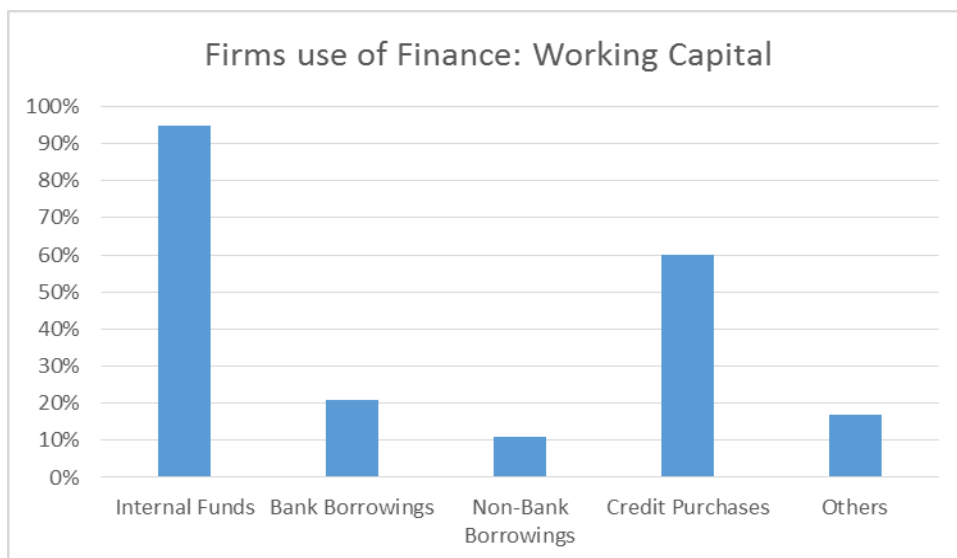
Source: World Bank Enterprise Survey.

The figure indicates that internal funds were the most utilised source of finance. Internal funds finance more than 70% of investment projects, a marginal 10% is being funded by banks, while just an average of 5% of investments is financed by supplier credit and equity or stock sales.

2.1 Usage of Finance Sources

The survey provides five sources (options) of finance that can be used to finance working capital and investment in fixed assets. The figure above shows the percentage of firms in this study that used each source of finance for working capital either alone or combined with other sources of finance. Figure 3 shows that 95% of the firms sampled used internal funds to finance working capital. 21% of firms used borrowings from banks, approximately 11% made use of non-banks financing, 60% used credit purchases as a source of finance and 17% used other sources of finance.

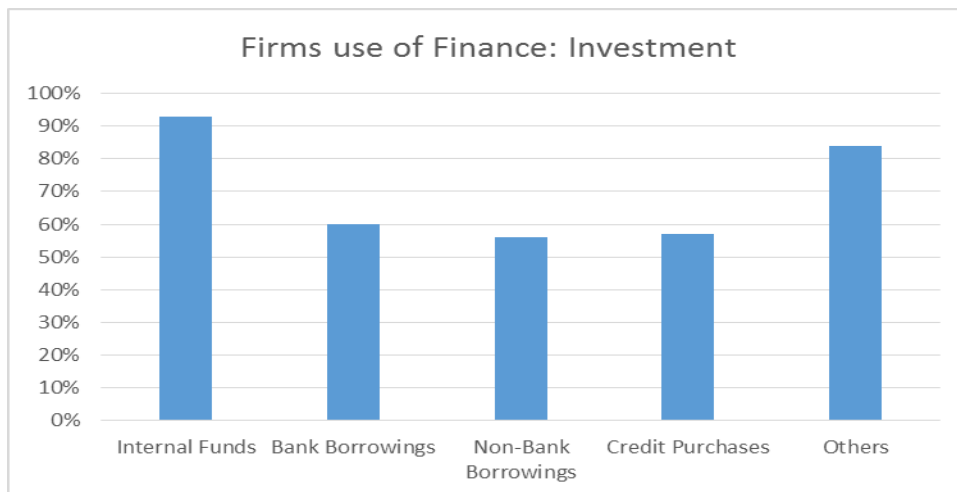
Figure 3: Percentage of firms using finance for Working Capital



Source: Author's estimates using ES data

Figure 4 below shows the number of firms in percentages that used each source of finance either alone or combined with other sources to finance investment in fixed assets. Approximately 93% of firms in this sample used internal funds, 84% of firms used other sources of finance, 60% of firms used bank borrowings, 56% and 57% of firms used non-bank borrowings and credit purchases to finance investments in fixed assets respectively.

Figure 4: Percentage of firms using finance for Investment

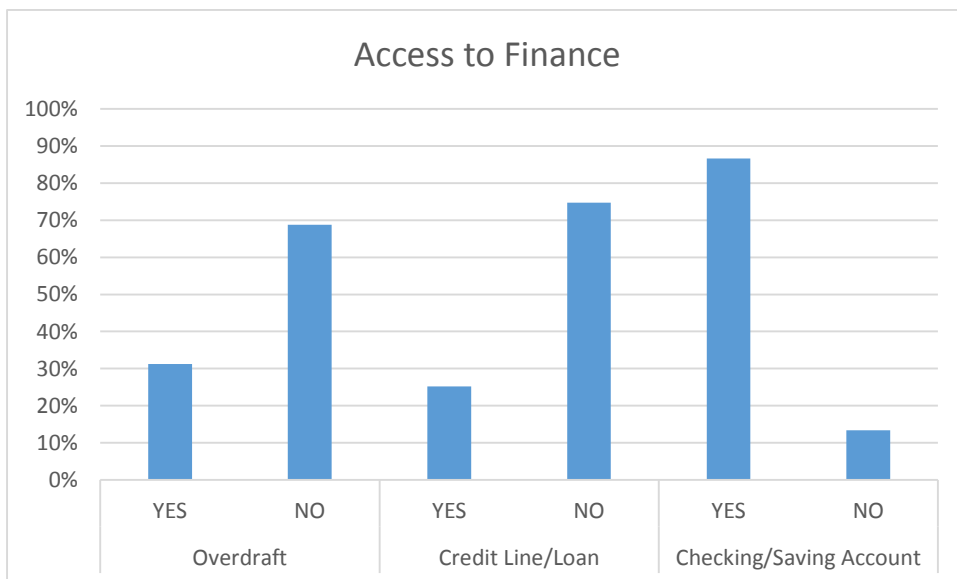


Source: Author's estimates using ES data

1.2 Access to Finance Sources

Figure 5 below shows the percentage of firms with access to available finance options: overdraft facility, credit line/loan facility and checking/saving account. Only 31% of firms in our sample reported having access to an overdraft facility at the time the survey was conducted while 69% do not have access to overdraft facilities. 75% of firms do not have a credit line or loan facility, only 25% have access to a credit line/loan facility from a bank. A large percentage of firms (87%) have checking/saving accounts while only 13% do not have.

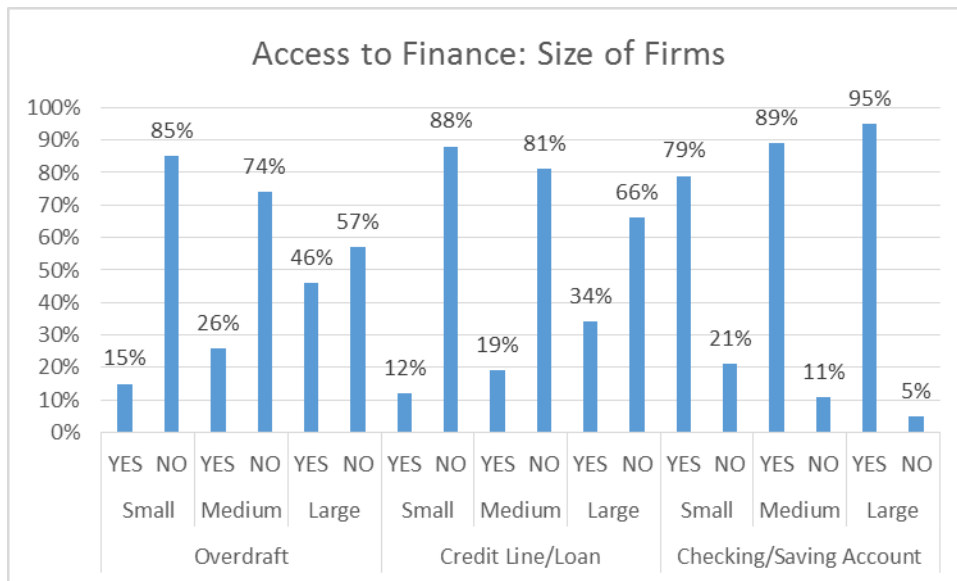
Figure 5: Firms Access to Finance.



Source: Author's estimates using ES data

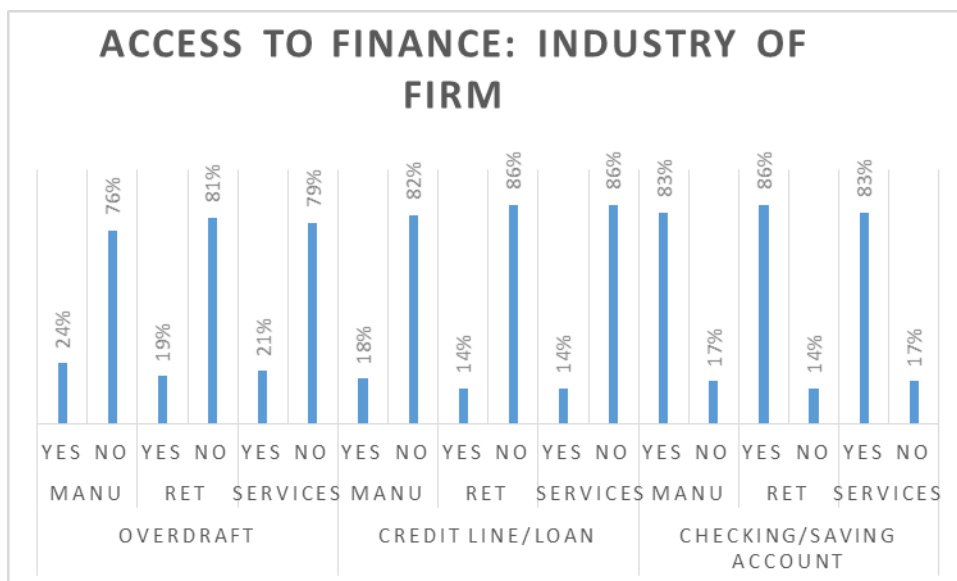
Figure 6 below shows how firms' access to finance differs according to their sizes. Smaller firms record the lowest access to overdraft and credit line/loan facilities (15% and 12% respectively). The highest percentage of firms with access to overdraft and credit line/loan facilities are large firms (46% and 34% respectively). Also, large firms account for the least number of firms without checking/saving account while small firms record the largest percentage. This shows that the size of a firm influences its ability to access finance.

Figure 6: Access to Finance based on Firm's Size



Source: Author's estimates using ES data

Figure 7: Access to Finance based on Firm's Industry



Source: Author's estimates using ES data

Figure 7 above shows how firms' access to finance differs based on the sector of they belong. Manufacturing firms record the highest percentage of firms with access to overdraft and credit line/loan facilities, firms providing other services have more access to overdraft facilities than firms in the retail sector. It is argued that manufacturing firms in comparison to firms in other sectors tend to have more access to finance because they undertake more innovation and R&D projects.

Table 1: Access to finance based on type of ownership

Type of Ownership	Overdraft		Credit Line/Loan		Checking/Saving Account	
	YES	NO	YES	NO	YES	NO
Incorporations With Traded Shares	35%	65%	28%	72%	90%	10%
Incorporations With Non-Traded Shares	36%	64%	28%	72%	93%	7%
Sole Proprietorship	14%	86%	11%	89%	79%	21%
Partnership	21%	79%	21%	79%	87%	13%
Limited Partnership	40%	60%	29%	71%	92%	8%

Source: Author's estimates using ES data

Table 1 shows firms' access to finance based on the type of ownership. Limited Partnership, incorporations with traded and non-traded shares firms have more access to finance compared to partnership and sole proprietorship. The following reasons were given by firms for not applying for loans or line of credit.

Reason 1: No Need for a Loan

Reason 2: Complex Application Procedures

Reason 3: Interest Rates Are Not Favourable

Reason 4: Collateral Requirements Are Too High

Reason 5: Size of Loan and Maturity Are Insufficient

Reason 6: Did Not Think It Would Be Approved

Reason 7: Other

Table 2: Reasons for not applying for loans or line of credit.

Reasons	All Sample	Small Firms	Medium Firms	Large Firms	Manu	Retail	Other Services	Traded Shares	Non-Traded Shares	Sole Prio.	Partner ship	Ltd Partnership
1	47%	37%	52%	67%	43%	45%	46%	66%	60%	39%	49%	53%
2	14%	17%	11%	6%	15%	14%	13%	3%	10%	17%	11%	8%
3	17%	20%	16%	11%	17%	19%	16%	14%	15%	18%	18%	20%
4	10%	13%	9%	4%	10%	11%	12%	7%	6%	13%	9%	7%
5	2%	2%	3%	1%	2%	2%	2%	2%	2%	2%	3%	1%
6	4%	5%	3%	1%	5%	4%	4%	3%	2%	5%	4%	3%
7	6%	6%	7%	8%	7%	6%	7%	5%	5%	6%	6%	8%

Source: Author's estimates using ES data

The table above shows the reasons for the lack of access to loans or lines of credits for the whole sample and based on firm's size, the sector of the industry and ownership. For the whole sample, the most common reason for not applying was that the firm didn't need a loan, followed by unfavourable interest rates and complex loan application process. In terms of size, large firms were the highest proportion of firms who didn't need loans while small firms were the least. Also, small firms reported a higher percentage of firms affected by unfavourable interest rates, high collateral and the likelihood of loan not being approved. The reasons do not differ significantly based on the sector of the industry a firm belong to. Regarding ownership, sole proprietors are mostly affected while incorporations and limited partnership are least affected.

To sum up, internal funds are the most used source of finance for firms in this study. This could be because 66% of firms in our sample are small sized firms. The analysis above shows that small firms have less access to finance compared to medium and large firms and face more difficulties in obtaining finance. Also, the industrial sector and type of ownership of a firm affect its ability to access finance.

3 Literature Review

3.1 Theoretical Framework

There are various channels through which access to finance affects firms' productivity, some of them would be discussed in this section. The violation of the Modigliani Miller (1958) theorem provides the foundation of the link between finance and firms activities (Chen, 2010). According to Myers and Majluf (1984), the advent of agency cost, information asymmetry, and tax policies resulted in creating a difference between the cost of internal and external funds, thereby favouring debt financing over equity financing³ (Chen, 2010). As a result, there has been ongoing debates amongst economic scholars on the links between finance and economic growth (Favarra, 2003; Levine, 2005; Becks, 2012). It is argued that one of the possible channels through which finance affects economic growth is via its effect on firms' productivity (Gatti and Love, 2008; Chen, 2010). Therefore, it is important to explore the mechanism through which finance fosters growth by promoting productivity, which is an essential intermediate link between firms activities and growth (Chen, 2010; Becks, 2012).

Gatti and Love (2008) state that the theoretical justification for the proposition that finance affects economic growth through its effects on productivity has been provided by several models. Some models postulate that technological innovation an important element of economic growth results from firm-level productivity brought about by access to external finance (Chen and Guariglia, 2013). In these models, information and transaction costs associated with external finance are alleviated following the provision of real services by the financial sectors to firms (Gatti and Love, 2008). The financial system plays an essential role of supplying innovative firms with capital and provides efficient services, thereby, making projects with longer gestation and higher return more attractive to firms (Levine. 1991; Bencivenga et al., 1995; Ayygari et al., 2007; Gatti and Love, 2008; Chen, 2010).

It is also important to study the effect of finance on productivity because at the macro-level total factor productivity (TFP) accounts for the cross-country differences in the level or growth of gross domestic product (GDP) per capita (Easterly and Levine, 2001). Total factor productivity (TFP) is assumed to be an essential element in enabling the understanding of economic growth. An increase in productivity infers that higher level of output is produced

³ Issuing additional equity to satisfy the firm's financial needs would lead to a dilution in ownership and control. The separation of ownership from professional management usually creates asymmetric information and agency cost. To retain full ownership and control of their firms, firm owners are more willing to source for debt financing over equity financing.

with the same amount of capital and labour input in an economy, which technically implies economic growth (Levine and Warusawitharana, 2014). Therefore, the evidence of a link between finance and productivity growth in the firm-level provides an important and additional mechanism through which the financial system can affect overall economic growth (Levine and Warusawitharana, 2014). Based on these, it becomes important to examine how finance affects growth through the direct promotion of firms' productivity.

Nevertheless, research and development (R&D) activities that enhance firms' productivity are associated with high risks and uncertainty; requiring substantial investments (Chen and Guariglia, 2013). In addition, firms committed to carrying out such innovative activities encounter difficulties in obtaining loans from banks because of the nature of the intangible assets they hold (Brown et al., 2009). Innovative firms have more intangible assets, which cannot be used as collateral. They relatively hold more "skilled labour assets" such as patents and knowledge than physical assets (i.e. lands and buildings) that are accepted as collateral. Therefore, it would be expected that the unavailability of external finance would strongly affect the productivity of these firms (Chen and Guariglia, 2013). According to Becks and Honohan (2008), one of the major challenges of firms' growth and productivity in developing countries is access to external sources of finance and the financial sector supports the development and growth of developing economies by providing financial services to firms with good growth prospects.

The magnitude of the effect of finance on firms' productivity is not uniform across all firms. Based on the size and structure of firms, the extent of the effect of financing constraint differs. Start-up, young, innovative, small-scale domestic firms, and more technologically advanced industries are assumed to feel the impact of these constraints more on their productivity (Siedschlag et al., 2014). Access to internal and external finance is positively related to the success of firms' start up and the possibility of firms' survival (Becks and Honohan, 2008). Barney (1991) builds on the strategic management literature and suggests that the productivity of a firm is determined by both the external analysis (environment) and internal analysis (characteristics) of a firm. The external analysis focuses on analysing a firm's opportunities and threats within its competitive environment while internal analysis involves the creation and implementation of strategies using individual firm resources (such as human capital, physical capital and organizational capital) to improve the firms' competitiveness (Barney, 1991). Therefore, the success, and in the long-run firms' productivity is directly affected by the lack of both internal and external financial resources (Stucki, 2014).

According to Beck and Robert (2014), a vast majority of firms in Africa fall into the category of SMEs with more than 50 percent of the labour force employed in companies with fewer than 100 employees and 95 percent of enterprises belong to the category of SMEs (Ayyagari et al., 2011). Siedschlag et al. (2014) states that Small and medium-sized enterprises (SMEs) tend to depend highly on banks loans and credit lines from domestic markets to finance their investment projects, contrary to large multinational enterprises that can obtain funds from international markets. Evidence from theoretical and empirical analysis indicate that SMEs encounter higher constraints concerning capital costs and credit conditions compared to larger enterprises. This is because SMEs are prone to a higher probability of failure and asymmetric information resulting from insufficient collateral, inadequate track record, and absence of credit guarantees (Siedschlag et al., 2014). Therefore, although SMEs constitute an important component of the private sector in the developing world, they report significantly higher obstacles to their operations and growth than large enterprises (Beck et al., 2006a).

For firms to be able to increase productivity and impact economic growth, there is the need to invest in fixed capital expenditure. Investing in productivity-enhancing inputs improves efficiency gains for the firm, also the productive capacity of the economy is enhanced (Siedschlag et al., 2014). Finance is required by already existing firms to be able to take advantage of investment opportunities and increase production capacity (Becks and Honohan, 2008). Access to external finance affects firms' ability to invest in tangible assets (Siedschlag et al., 2014; Becks and Honohan, 2008). The presence of market imperfections creates a disparity between the internal and external cost of financing, hence, firms may only be able to invest until internal funds are depleted (Stiglitz and Weiss, 1981). The responsiveness of investment to external finance is linked more too young and micro-sized firms. These firms are more likely to run short of internal funds and are unable to convince lenders to provide funds as a result of lack of collateral, track record or increased risk. This results to adverse effects on their growth potentials and chances of survival (Siedschlag et al., 2014).

The lack of access to finance implies that firms facing financial constraints are less able to sustain unexpected losses, even for a short period (Mata et al., 1995). Also, financially constrained firms are forced to cut cost to generate the resources they cannot obtain from the financial market. Therefore, lack of access to finance restricts the ability of a firm to invest in productivity-enhancing activities, leading to an adverse effect on firm success (Holtz-Eakin et al., 1994; Aghion et al., 2007). Also, a firm's productivity is affected by the lack of access to finance because financially constrained firms have limited access to other value-creating

services that accompany external financing especially venture capital investments (Jain and Kini, 2000; Manigart et al., 2002).

Another channel through which access to finance affects firms' productivity is via employment of labour. Highly skilled and competent workers are required to undertake productive activities and for the daily functioning and management of a firm. Nickell and Nicolitsas (1999) state the hiring of employees reduces as a result of increasing cost of borrowing. Lack of access to finance leads to a decrease in labour employment as a means of sustaining working capital. Also, already employed workers in firms see the lack of access to finance as a threat to their jobs. This could naturally lead to workers reducing their level of dedication to the job which impacts on the goods and services produced and in turn affects the firm's productivity.

Caggese and Cunat (2008), further argues that access to finance affects the terms of contract (that is fixed-term and permanent contracts) firms are willing to enter with employees. Financially constrained firms are more willing to employ fixed-term workers that are less productive compared to permanent workers. The effect of this is that fixed-term workers are flexible and do not have any firing cost associated with their contracts. They could easily leave half-way in a production process thereby hampering productivity. This indicates that access to finance affects the quality of workers a firm seeks to employ (Milanez, 2013). Firms that are financially constrained would encounter difficulties in employing workers with firm-specific knowledge but would be willing to employ workers with general skills because they are less expensive. Employees with high firm-specific skills are less likely to quit their job and bring in more expertise to the production process (Milanez, 2013).

Lastly, access to finance affects firm's productivity via export behaviour and export performance. The 'learning- by-exporting' hypothesis states that firms gain new knowledge and expertise because they enter the export market, which in turn improves their efficiency level and productivity (De Loecker, 2007). Access to finance has been considered as one of the factors that determine the differences in export behaviour and export performance across firms in an industry (Manova, 2008; Berman and Hericourt, 2010; Bellone et al., 2010; Chaney, 2013). Particularly, increased access to external financing enhances the effect of productivity on the selection of firms into export in imperfect financial markets, (Siedschlag et al., 2014).

Chaney (2013) states that due to the significant sunk cost linked with participating in export, only firms with easy access to finance can engage in export activities. On the other hand, engaging in export activities provides access to external funds in the international market

(Bellone et al, 2010). Lastly, exporting can facilitate the reduction of information asymmetries because of lenders/investors perceived notion of export as a sign of external competitiveness. (Ganesh-Kumar, 2001). Therefore, access to finance affects firms' productivity via exporting through more stable cash flows derived from international diversification of sales and lowering exposure to demand-side shocks (Bridges and Guariglia, 2008).

To sum up, it has been established in the theoretical literature that access to finance affects the productivity of the firm. Lack of access to finance impedes investment in high-quality projects leading to lower firm productivity (Moreno-Badia and Miranda, 2009). The mechanism of this effect is based on the role of well-developed financial markets in allocating funds to productivity-enhancing investments and that long-term productivity-enhancing projects are facilitated by liquid financial markets (King and Levine, 1993; Bencivenga et al., 1995; Levine, 2005). Also, export behaviour and performance affect firms' productivity because exporting improves the ability of a firm to access external finance. On the other hand, firms that are financially constrained are not able to participate in exporting activities, thereby hampering their productivity (Bricongne et al., 2012).

3.2 Empirical Review

There is only a small literature that has attempted to examine the effect of access to finance on firms' productivity. Most of the existing literature on the relationship between finance and productivity focus on the role of financial development and are conducted at the macro level.

Nickell and Nicholitas (1999) studied 670 manufacturing companies in the UK from 1972-1986 using data from EXSTAT data table. The results obtained show that firms productivity is positively affected by the measure of financial pressure (defined as the ratio of interest payments to cash flow). Schiantarelli and Sembenelli (1999) used data on firms in the UK and Italy to show that the performance of firms (measured as TFP, profitability, and sales growth) with a higher proportion of long-term debt in their capital structure increased. The results obtained are similar to studies for Ecuador by Schiantarelli and Jaramillo (1999) and India by Schiantarelli and Srivastava (1999).

Using World Bank survey data from Bulgaria, Gatti and Love (2008) estimated the effect of access to credit (proxy by a dummy variable indicating whether firms have access to a credit or overdraft) on productivity. The results obtained showed that access to credit positively and significantly affects productivity across firms. In contrast, Moreno-Badia and Slootmaekers (2009) in a study of firms in Estonia developed new methodologies to provide evidence of the

relationship between access to finance and firm-level productivity. Results obtained showed that although many Estonian firms are financially constrained, this does not affect the level of productivity in most of the sectors except R&D.

Chen and Guariglia (2013) evaluated the effect of internal finance on firm's productivity. Using data from annual accounting reports of industrial firms in China over the period 2001-2007, they found that the productivity of Chinese firms is positively affected by the availability of internal finance. The results suggest that at the firm-level, an increase in the accessibility of finance improves productivity. Ferrando and Ruggieri (2015), using firm-level data for euro area countries evaluated the effect of access to financial constraints on labour productivity for the period 1990-2011. The results obtained showed that the lack of access to external finance negatively affects labour productivity. The impact of this effect is felt mainly in the Energy, Gas, Water Supply, R&D, Communication and Information sectors, also on small and micro firms.

In contrast, Nunes et al., (2007) and Nucci et al., (2005) obtained results showing that access to finance negatively affects labour productivity. Nunes et al., (2007) applied a quantile approach in a study of 162 Portuguese firms for the period 1999 to 2003, results obtained showed that debt financing tends to decrease labour productivity for firms with low labour productivity and increase productivity for firms with high labour productivity. Using data on Italian firms, Nucci et al., (2005) found that the productivity of firms is negatively affected by debt-financing. The results obtained show that there exists a negative causal relationship between the level of debt in a firm's capital structure and its ability to be innovative.

Empirical studies on the effect of access to finance on firms' productivity are almost non-existent for African countries. The few existing studies investigate the effect of access to finance on efficiency (Ferdinand and Dasmani 2010). They used 2007 data from the World Bank Enterprise Survey to calculate firm level efficiency scores for 270 firms in Ghana. The study found that increase in access to finance makes firms inefficient. Another study on Nigeria by Obembe (2011), studied the effect financial constraints on productivity growth in 76 listed non-financial firms for the period 1997 to 2007. The results obtained showed that bank loans have positive effects on the productivity of firms. From a sample of micro and small firms in Kenya, Mwangi (2014) used data from the 2007 World Bank Enterprise Survey to show the insignificant effect of access to finance on firm productivity.

This study fills the gap in the literature by providing an empirical analysis of the effect of access to finance on firms' productivity in a number of African countries. It also uses more direct measures of access to finance, such as having a checking or savings account, the presence or absence of overdrafts and lines of credit.

4. Methodology and Analytical Framework

4.1 Model Estimation

The effect of access to finance on firms' productivity is estimated by regressing the equation below:

$$\ln Y_{it} = \beta_0 + \beta_1 AC_{it} + \beta_2 OB_{it} + \beta_3 F_{it} + \beta_4 C_{it} + \varepsilon_{it} \quad (1)$$

Where subscripts *i* and *t* denote the firm and year respectively. *Y* is the dependent variable measured by estimates of labour productivity and total factor productivity, *AC* is the main explanatory variables (the three measures of access to internal and external finance), *OB* is also an explanatory variable capturing firms' perceived effect of finance constraints, *F* is firm-level characteristics, *C* captures country characteristics and ε is the error term. We run various OLS estimation models to check for robustness and minimize possible biases.

Following Gatti and Love (2008) and Mwangi (2014), to address potential endogeneity problem between access to credit and firm productivity from equation 1 an instrumental variable (GMM) model is estimated. Particularly, measures of access to credit are potentially endogenous because banks are more willing to provide finance to firms with higher levels of productivity. Therefore, OLS estimates may be biased, a negative coefficient on access to credit can imply that less productive firms are less likely to access credit than lack of access to credit negatively affects productivity. The Generalised Methods of Moments estimator (IV-GMM) introduced by Hansen (1982) allows for heteroscedasticity of the disturbance term. It is more efficient than the 2SLS in the presence of heteroscedasticity standard errors and does not require that the assumptions on error terms are distributional (Hall, 2005).

This study uses the type of ownership and the sex of the owner(s) as instruments for access to credit. The type of ownership (i.e. sole-proprietorship, partnership, non-listed or listed companies) is likely to influence the ability of a firm to access credit (e.g. firms would willingly lend to listed companies with limited liabilities) (Kira and He, 2012). Also, the gender of the owner(s) influences a firm's ability to access finance. The 2016 making finance work in Africa report, shows that banks in Africa are more willing to lend to firms with male managers because of the perceived idea that women lack the financial capability and confidence to manage their finances. Therefore, listed companies and male manager dummies should be positively correlated with access to credit but not with the current levels of productivity.

Also, to solve the possible simultaneity bias and other measurement errors of OLS estimation, we run stochastic frontier analysis for Cobb-Douglas and translog production functions. The stochastic frontier approach makes allowance for stochastic errors due to statistical noise or measurement errors. The model was first introduced by Aigner et al., (1977) and Meeusen and van den Broeck (1977) and specifies output, cost, etc. in terms of a response function and a composite error term. The stochastic frontier model decomposes the composite error term into a two-sided error representing random effects outside the control of the firm (decision making unit) and the one-sided technical efficiency component.

According to Aigner et al., (1977), the random error effects represents random variations in the economic environment (such a weather, luck, machine breakdown, and variable input quality: measurement errors and omitted variable) that firms' face in the course of production. The efficiency component represents a range of features (such as skills and effort of management and employee, firm-specific knowledge, work stoppages, and material bottlenecks) that reflects if a production process is efficient or inefficient. Aigner et al., (1977) and Meeusen and Van den Broeck (1977) assumes that the distribution of the efficiency error component is asymmetric and has an exponential and half-normal distribution.

The stochastic frontier model can be specified as:

$$Y_i = f(X_i \beta) + \varepsilon_i \quad (2)$$

Where Y denotes the maximum output obtainable from X_i , a vector whose values are functions of inputs (non-stochastic inputs), β is a vector of unknown parameters to be estimated, and ε_i is the disturbance term. However, ε_i is equal to $V_i - U_i$, V_i refers to the random part of error, with normal distribution, independent and identically distributed and U_i is the part relating to technical inefficiency in production. In this study, the Cobb-Douglas functional form for the stochastic frontier is given as:

$$\ln Y_{it} = \beta_0 + \sum_i \beta_1 \ln X_{jit} + \beta_2 AC_{it} + \beta_3 OB_{it} + \beta_4 F_{it} + V_{it} - U_{it} \quad (3)$$

And the trans-logarithmic functional form for the stochastic frontier is given as:

$$\ln Y_{it} = \beta_0 + \sum_i \beta_1 X_{jit} + \frac{1}{2} \sum_i \sum_k \beta_{i,k} \ln X_{jit} + \beta_2 AC_{it} + \beta_3 OB_{it} + \beta_4 F_{it} + V_{it} - U_{it} \quad (4)$$

Where Y represents the quantity of output produced, X_1 represents the total labour cost (including wages, salaries and bonuses), X_2 is the net book values of machinery vehicles, equipment, land and building or the cost of raw material and intermediate goods used, AC is the main explanatory variables (the three measures of access to internal and external finance),

OB is also an explanatory variable capturing firms' perceived effect of finance constraints, and F is firm-level characteristics.

4.2 The Method: Estimating Productivity

Estimates of productivity can be gotten as the difference between actual output and output estimated by a production function using actual input quantities (Gatti and Love 2008). Productivity can be obtained from the regression of:

$$\ln Y_i = \alpha + \beta_K \ln K_i + \beta_L \ln L_i + \varepsilon_i \quad (5)$$

Where Y_i is firm's output, K and L are capital and labour, β_K and β_L are capital and labour shares and ε_i is the error term. TFP, the estimated residual, is obtained in this model as the difference between actual and predicted output, or $\hat{\varepsilon}_i = \ln Y_i - \ln \hat{Y}_i$. In this model labour is captured using the total labour cost (including wages, salaries and bonuses) and capital is captured using either the addition of net book values of machinery vehicles, equipment, land and building or the cost of raw material and intermediate goods used in production in the last fiscal year.

4.3 Description of Data

This study is carried out on 17 countries in Africa and consists of pure cross-sectional data for which information is available on all variables for our baseline regression. The countries studied, (sample size and survey year in brackets) are Angola (343 firms, survey years are 2006 and 2010), Botswana (177 firms, survey years are 2006 and 2010), Cameroon (199 firms, survey years are 2006 and 2009), Democratic Republic of Congo (DRC) (279 firms, survey years are 2010 and 2013), Ghana (491 firms, survey years are 2007 and 2013), Kenya (284 firms, survey years are 2007 and 2013), Malawi (151 firms, survey years are 2009 and 2014), Mali (466 firms, survey years are 2007 and 2010), Nigeria (615 firms, survey years are 2007, 2009, and 2014), Senegal (548 firms, survey years are 2003 and 2007), South Africa (1079 firms, survey years are 2003 and 2007), Tanzania (472 firms, survey years are 2006 and 2013), Uganda (563 firms, survey years 2006 and 2013), and Zambia (564 firms, survey years 2007 and 2013).

The descriptive statistics of the variables used in this study is reported in appendix 1. It shows that about 66% of firms in our sample are small firms (5 to 19 employees), 26% are medium (20 to 99 employees) and only 8% are large firms (more than 100 employees). Also,

approximately 79% and 83% of firms in our sample do not have overdraft facilities and loan respectively, while only 15% do not have checking/savings accounts.

4.4 Description of Variable

This study uses firm-level data from World Bank Enterprise Survey. We collect individual country data from 17 African Countries with data for at least two periods and build a pure cross-sectional data for the years ranging from 2006-2014. The total number of firms with data on all the required variables is 4682.

We construct the following three variables to measure the access to finance from the Enterprise Survey: (i) Overdraft - is a dummy variable equal to one if the firm has no overdraft facility at the time of the survey and zero otherwise, (ii) Credit line/loan - is a dummy variable equal to one if the firm has no line of credit or loan from a financial institution at the time of the survey and zero otherwise, and (iii) Checking Account - is a dummy variable equal to one if the firm has no checking or savings account at the time of the survey and zero otherwise. In this study, we assume that overdraft and credit line/loan capture firms' access to external finance because they are short-term (overdraft) and long-term (credit line/loan) debt services provided by financial institutions. Checking/saving account is used to capture access to internal finance based on the assumption that firms would keep retained earnings in a current account with banks or in a savings account to earn some interest until when the funds are needed.

We also construct variables to rank how firms perceive finance as an obstacle in their business operations. The following variables are constructed: (i) No obstacle is a dummy variable equal to one if finance is no obstacle to the firms' operation at the time of the survey and zero otherwise, (ii) Minor obstacle is a dummy variable equal to one if finance is a minor obstacle to the firms' operation at the time of the survey and zero otherwise, (iii) Moderate obstacle is a dummy variable equal to one if finance is a moderate obstacle to the firms' operation at the time of the survey and zero otherwise, (iv) Major obstacle is a dummy variable equal to one if finance is a major obstacle to the firms' operation at the time of the survey and zero otherwise, and (v) Very Severe obstacle is a dummy variable equal to one if finance is a very severe obstacle to the firms' operation at the time of the survey and zero otherwise.

Also, we use information from the Enterprise Survey to control for firm-level characteristics that might affect a firm's productivity and ability to access financial services. Particularly, dummy variables are constructed to capture firms' size (small, medium and large), publicly listed firms, sole proprietorships, firms' age (log values), and managerial experience (log

values). To control for country-level characteristics data from World Bank is used for individual countries and years of survey to capture GDP per capita and domestic credit to the private sector by banks (% of GDP). GDP per capita measures economic growth while domestic credit is a measure of the level of financial development of the economy the firm is operating.

5. Empirical Results

5.1 OLS Estimates: Total Factor Productivity Model

The baseline regression results for TFP model is presented in tables 3 and 4, while the results for labour productivity model is provided in table 8.

Table 3: Base Regression Results (OLS): Whole Sample

	(1)	(2)	(3)	(4)
Dependent Variable: Total Factor Productivity: Labour Cost and Material Cost (Log Value)				
Overdraft	-0.196*** (0.040)	-0.188*** (0.043)	-0.147*** (0.043)	-0.257*** (0.043)
Credit Line/Loan	-0.099** (0.050)	-0.082* (0.045)	-0.046 (0.045)	-0.047 (0.044)
Checking Account	-0.109** (0.047)	-0.111 ** (0.048)	-0.078 (0.048)	-0.141*** (0.048)
Moderate Obstacle		0.134*** (0.050)	0.165 *** (0.050)	0.069 (0.050)
Major Obstacle		-0.001 (0.047)	0.016 (0.046)	-0.082* (0.046)
Very Severe Obstacle		-0.138 *** (0.050)	-0.122 (0.049)	-0.236*** (0.049)
Small Firm			-0.294*** (0.067)	-0.799*** (0.057)
Medium Firm			-0.280*** (0.066)	-0.432*** (0.056)
Age of Firm (Log)			0.112*** (0.023)	0.232*** (0.038)
Managerial Experience (Log)			0.021 (0.024)	0.005 (0.024)
GDP Per Capita (Log)				0.445*** (0.024)
Domestic Credit				0.004*** (0.0004)
Observations	4976	4746	4682	4682
R-Squared	0.0107	0.0150	0.0163	0.0900

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

The table above presents results for the whole sample in this study using total factor productivity as the measure of firms' productivity. To derive total factor productivity - capital

is measured as the net book value of machines, lands and building. Labour is measured as the cost of labour. However, the data on net book value is limited and leads to loss of significant dataset, therefore, we proxy using cost of raw materials following studies like Ferdinand and Dasmani (2010); Mwangi (2014). The results using net book value and cost of labour are robust and reported in Appendix 2. The results are OLS estimates of the relationship between firms' TFP and the effect of lack of access to finance, proxy by the absence of credit line/loan, overdraft facility, and checking account. The results in table 3 show that irrespective of the control variables used the lack of access to finance negatively affects productivity of firms. When only access to finance and the perceived effect of financial constraint are measured (column 1 and 2) the results shows that the level of productivity of firms is reduced by 18.8%, 8.2% and 11.1% as a result of lack of access to overdraft facilities, credit line/loan and checking account respectively. Also, firms who perceive finance as a very severe obstacle experience a reduction in productivity by 13.8% while productivity increases by 13.4% for firms who rank finance as a moderate obstacle.

The results are similar when control variables are added to capture firm and country-level characteristics (column 3 and 4). When firm-level characteristics are added the negative effect of checking account and credit line/loan becomes insignificant, while only credit line/loan is insignificant when country-level characteristics are captured. The negative effect of the lack of overdraft facilities on firms' productivity remains significant at 1% in all cases. Also, the size and age of a firm affect its productivity small and medium sized firms experience a reduction in their productivity levels while older firms have increasing productivity levels. The experience of managers on firms' productivity is positive although this effect is insignificant. The level of economic growth and financial development in the economy a firm is operating in also affects its productivity. In table 4 country dummies are included to account for country differences and the results still remain the same. The lack of access to finance negatively affects firms' total factor productivity.

Table 3: Base Regression Results (OLS): Whole Sample with Country Dummy

	(1)	(2)	(3)	(4)
Dependent Variable: Total Factor Productivity: Labour Cost and Material Cost (Log Value)				
Overdraft	-0.337*** (0.043)	-0.320*** (0.045)	-0.131*** (0.045)	-0.144*** (0.045)
Credit Line/Loan	-0.133*** (0.043)	-0.112** (0.046)	-0.010 (0.045)	0.167*** (0.019)
Checking Account	-0.230*** (0.052)	-0.224*** (0.053)	-0.142*** (0.053)	-0.135*** (0.052)
Moderate Obstacle		0.023 (0.050)	0.082* (0.049)	0.048 (0.049)
Major Obstacle		-0.128*** (0.047)	-0.054 (0.047)	-0.055 (0.046)
Very Severe Obstacle		-0.289*** (0.051)	-0.189*** (0.050)	-0.187*** (0.050)
Small Firm			-0.825*** (0.058)	-0.790*** (0.057)
Medium Firm			-0.448*** (0.056)	-0.413*** (0.056)
Age of Firm (Log)			0.120*** (0.039)	0.168*** (0.040)
Managerial Experience (Log)			0.006 (0.025)	-0.027 (0.025)
GDP Per Capita (Log)				0.136 (0.108)
Domestic Credit				0.040*** (0.005)
Observations	5086	4836	4682	4682
R-Squared	0.039	0.048	0.103	0.123
Country Dummy	YES	YES	YES	YES

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

5.2: Robustness Checks

To access the robustness of the results above alternative measures of total factor productivity are used (capital is measured as net book value of machinery vehicles and equipment and labour is measured as the number of fulltime employees).

Table 4: Base Regression Results (OLS): Whole Sample

Dependent Variable: TFP: No of Fulltime Employees and NBV of Machinery (Log Value)	
Variables	Coefficients
Overdraft	-0.174*** (0.048)
Credit Line/Loan	-0.079* (0.047)
Checking Account	0.032 (0.061)
Moderate Obstacle	0.018 (0.055)
Major Obstacle	-0.063 (0.053)
Very Severe Obstacle	-0.222*** (0.057)
Small Firm	-0.429*** (0.062)
Medium Firm	-0.179*** (0.060)
Age of Firm (Log)	-0.054 (0.045)
Managerial Experience (Log)	-0.063 (0.053)
GDP Per Capita (Log)	0.015 (0.029)
Domestic Credit	0.001** (0.001)
Observations	3401
R-Squared	0.038

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

Table 5 present results using alternative measures and the results obtained still shows that the lack of access to finance negatively affects firms' productivity. Overdraft and credit line/loan are negatively significant at 1% and 10% respectively. This means that a 1% increase in firms with no overdraft facility would decrease productivity by approximately 17% and a 10% increase in firms with no credit line/loan would decrease productivity by 8%.

Further estimation is carried out to show how the effect of access to finance on firms' total factor productivity would differ based on the size and ownership of the firm (tables 6 and 7). Results showing only the coefficients of measures of access to finance and ranking of financial constraint is reported below.

Table 5: Base Regression Results (OLS): Size of the Firms

	Small	Medium	Large
Dependent Variable: Total Factor Productivity: Labour Cost and Material Cost (Log Value)			
Overdraft	-0.138* (0.075)	-0.178*** (0.065)	-0.168* (0.088)
Credit Line/Loan	-0.129* (0.073)	0.054 (0.067)	0.080 (0.086)
Checking Account	-0.071** (0.064)	-0.096 (0.120)	-0.307 (0.198)
Moderate Obstacle	0.146** (0.073)	-0.084 (0.078)	-0.032 (0.108)
Major Obstacle	-0.034 (0.064)	-0.070 (0.078)	-0.068 (0.123)
Very Severe Obstacle	-0.133** (0.067)	-0.257*** (0.092)	-0.387*** (0.143)
Observations	2775	1380	681
R-Squared	0.023	0.089	0.204

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

Table 6 shows that the productivity of all sizes of firms is negatively affected by the lack of access to overdraft facilities. However, the lack of access to credit line/loan and checking account significantly and negatively affects the productivity of only small firms. Also all sizes of firms who rank finance as a very severe obstacle experience a decrease in their productivity.

Table 6: Base Regression Results (OLS): Ownership of the Firms

	Traded Shares	Non-Traded Shares	Sole Proprietor	Partnership	Limited Partnership
Dependent Variable: Total Factor Productivity: Labour Cost and Material Cost (Log Value)					
Overdraft	-0.054 (0.392)	-0.121** (0.050)	-0.150* (0.086)	-0.247* (0.144)	0.024 (0.130)
Credit Line/Loan	0.235 (0.408)	-0.030 (0.052)	-0.077 (0.087)	-0.074 (0.157)	-0.015 (0.137)
Checking Account	0.803 (0.673)	0.192** (0.097)	-0.113* (0.065)	0.193 (0.151)	-0.242 (0.244)
Moderate Obstacle	0.703 (0.464)	0.201*** (0.064)	0.163* (0.085)	0.092 (0.163)	-0.107 (0.160)
Major Obstacle	1.237** (0.534)	0.076 (0.064)	0.043 (0.074)	-0.219 (0.149)	0.172 (0.181)
Very Severe Obstacle	-0.512 (0.817)	0.059 (0.074)	-0.095 (0.076)	-0.113 (0.148)	-0.343 (0.219)
Observations	81	1525	2276	466	414
R-Squared	0.018	0.013	0.008	0.022	0.013

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

Table 7 shows that lack of access to finance has an insignificant effect on incorporations with traded shares and limited partnerships. However, the productivity of sole proprietorships is negatively affected by the lack of access to overdraft facilities and checking/saving accounts. Although, the lack of access to credit line/loan facilities has a negative effect it is insignificant. Also, the productivity of incorporations with non-traded shares and partnerships are negatively affected by the lack of access to overdraft facilities.

5.3: OLS Estimates: Labour Productivity Model

In table 8 labour productivity is used as a measure of firms' productivity. Labour productivity is derived by dividing the total annual sales by the number of permanent, full-time employees. The results show that lack of access to finance increases labour productivity. This is because small and informal firms often have very low labour productivity and increasing debt or leverage tends to negatively affect labour productivity in firms with relatively low labour productivity. This is similar to the results obtained by Nunes et al (2007) and Nucci et al.

(2005), access to debt financing would decrease the productivity of low and medium-productivity firms, but would increase the productivity of high-productivity firms.

Table 7: Base Regression Results (OLS): Whole Sample

	(1)	(2)	(3)	(4)
Dependent Variable: Labour Productivity = Total Sales / Number of Employees (Log Value)				
Overdraft	0.683*** (0.023)	0.644*** (0.023)	0.177*** (0.018)	0.169*** (0.019)
Credit Line/Loan	0.372*** (0.024)	0.374*** (0.025)	0.168*** (0.019)	0.167*** (0.019)
Checking Account	0.209*** (0.026)	0.211*** (0.026)	-0.018 (0.020)	-0.021 (0.020)
Moderate Obstacle		0.139*** (0.027)	0.065*** (0.020)	0.056*** (0.021)
Major Obstacle		0.256*** (0.025)	0.093*** (0.019)	0.082*** (0.020)
Very Severe Obstacle		0.359*** (0.027)	0.118*** (0.021)	0.105*** (0.021)
Small Firm			2.046*** (0.025)	2.045*** (0.026)
Medium Firm			1.101*** (0.026)	1.101*** (0.027)
Age of Firm (Log)			-0.247*** (0.016)	-0.243*** (0.017)
Managerial Experience (Log)			-0.024** (0.010)	-0.027** (0.011)
GDP Per Capita (Log)				-0.015 (0.010)
Domestic Credit				-0.0002 (0.00022)
Observations	11,387	10,886	9824	9824
R-Squared	0.1411	0.1590	0.5477	0.548

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

5.4 IV-GMM: Instrumental Variable Model

This study uses a two-stage efficient GMM estimator and the results without (column1) and with (column 2) country dummies are presented in table 9.

Table 8: IV-GMM: Instrumental Variable Model

Dependent Variable: Total Factor Productivity: Labour Cost and Material Cost (Log Value)		
Variables	1	2
Access	-2.57*** (0.734)	-4.66*** (1.110)
Moderate Obstacle	-0.049 (0.066)	-0.109 (0.081)
Major Obstacle	-0.038 (0.060)	-0.052 (0.075)
Very Severe Obstacle	-0.203*** (0.065)	-0.246*** (0.082)
Small Firm	-0.324** (0.173)	-0.001 (0.228)
Medium Firm	-0.203** (0.114)	-0.003 (0.148)
Age of Firm (Log)	0.101** (0.051)	0.172** (0.065)
Managerial Experience (Log)	-0.105*** (0.039)	-0.191*** (0.052)
GDP Per Capita (Log)	-0.052 (0.035)	0.178 (0.181)
Domestic Credit	-0.005*** (0.0006)	0.045*** (0.009)
Country Dummy	NO	YES
Observations	5161	5161
R-Squared	-0.2303	-0.8699
Endogeneity	15.37	34.79
P-value	0.0001	0.0000
Hansen-Sargan	0.478	0.335
P-value	0.4892	0.5626

Note: Endogeneity tests of the endogenous variable are implemented under the null hypothesis that the specified variable can be treated as exogenous. Endogenous explanatory variable (access to credit) is instrumented using the type of ownership and the gender of owner(s). The Hansen-Sargan's statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. Standard errors are reported in parenthesis, ***, **, * denotes significance levels at 1%, 5% and 10% respectively.

To test and control for potential endogeneity bias, following Gatti and Love (2006), we construct a variable (ACCESS) which takes a value of one if the firm does not have either a credit line, overdraft, or a checking account and zero otherwise. ACCESS is constructed by combining credit line, overdraft, and checking account as the three variables represent firm's access to short and long term finance. ACCESS is instrumented using the type of ownership and the gender of owner(s). The Hansen-Sargan's over identification test shows that the instruments are valid.

The results show that the lack of access to finance reduces the level of firms' productivity with and without country dummy. Also, firms who view finance as a very severe obstacle experience a reduction in their level of productivity by 20% and 19% respectively. The productivity of small and medium sized firms is negatively affected in the regression without country dummies. The test for endogeneity shows that ACCESS is endogenous and we cannot reject the null hypothesis. Therefore, although the results obtained for the main explanatory variables are robust with the OLS method, the IV-GMM method gives a more reliable and consistent results.

5.5: Stochastic Frontier Model

To contribute to existing literature, firms' productivity is also measured using stochastic frontier Cobb-Douglas and translog production functions. The result of the log likelihood ratio test shows that the translog production function is the best specification to measure firms' productivity:

Log Likelihood-ratio test	LR chi2 (3) = 2285.99
(Assumption: Cobb-Douglas nested in translog)	Probability > chi2 = 0.000

Tables 10⁴ below shows results for the trans-logarithmic production functions. The results show that both log of labour cost and material cost are statistically significant at the conventional significance level of 1%, implying the suitability of the translog function for the firms studied. The results obtained for the measures of lack of access to finance on firms' productivity are robust to those for the OLS and IV-GMM estimates. The lack of access to overdraft and credit line/loan facilities negatively affects firms' productivity and reduces firms' productivity by 19% and 36% respectively. Also, firms who rank finance as a moderate and major experience a decrease in their productivity levels. Small and medium sized firms also experience decreasing levels of productivity by approximately 39% and 27% respectively.

⁴ Appendix 3: Cobb-Douglas results.

Table 9: Stochastic Frontier Normal/Half Normal Model Regression

Dependent Variable: Translog Production Function	
Variables	Coefficients
Material Cost (β_1) (Log)	0.435*** (0.034)
Labour Cost (β_2) (Log)	0.798*** (0.036)
Material Cost2 ($(1/2) \beta_1 \beta_1$)	0.194*** (0.011)
Labour Cost2 ($(1/2) \beta_2 \beta_2$)	0.176*** (0.014)
Output = $\beta_1 * \beta_2$	-0.194*** (0.012)
Overdraft	-0.193** (0.096)
Credit Line/Loan	-0.356*** (0.091)
Checking Account	0.278 (0.215)
Moderate Obstacle	-0.279* (0.150)
Major Obstacle	-0.367** (0.168)
Very Severe Obstacle	0.050 (0.157)
Small Firm	-0.386*** (0.145)
Medium Firm	-0.271* (0.141)
Age of Firm (Log)	-0.208** (0.104)
Managerial Experience (Log)	0.068 (0.068)
Observations	4682
Log Likelihood	-5334.0593
Wald Chi2	1914336.84
Probability > chi2	0.0000

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

6. Conclusion and Policy Implication

Although there exists a limited literature on the relationship between finance and firms' productivity, the evidence of this relationship is almost non-existent for African countries. This study contributes to the literature by providing empirical evidence of the link between finance and firms' productivity. To do this, cross-sectional firm level data from World Bank Enterprise Survey data for seventeen (17) African countries are used. Empirical analysis is conducted on the effect of lack of access to internal and external finance on firms' productivity. Three constructed dummy variables measure access to finance: the absence of overdraft facilities, credit line/loan facilities, and checking/savings account. We capture firms' productivity using three measures: labour productivity, total factor productivity (TFP), and stochastic frontier translog functions.

For the whole sample, the results obtained are robust for TFP models and stochastic frontier translog functions. The lack of access to finance, especially overdraft facilities negatively affects the productivity of firms in Africa. Also, smaller firms and sole-proprietorships are mostly affected because they have less access to finance. In addition, firm characteristics such as size and age of firm affect its productivity. The level of economic growth and development of the financial system a firm operates in affects its productivity and ability to access finance. However, labour productivity (output per unit of labour) is negatively affected by access to finance because small and medium firms (92% of firms in this study) have low labour productivity which is negatively affected by increasing access to debt financing.

The results obtained have important policy implications. First, they are consistent with the idea or hypothesis that total factor productivity (which attempts to capture the relative efficiency of the usage of capital and labour inputs) is negatively affected by firms' inability to access finance in Africa. Second, firm characteristics such as size, age, and managerial experience can influence firms' ability to access finance and its effect on productivity. These points imply that the sensitivities of firm-level productivity to finance suggest that access to external finance is still not sufficiently wide-spread in Africa. Further development of a balanced financial system is required. To reduce the pressure on banks, stock and bond markets in particular should be equally developed. This would ensure that more finance is channelled towards those firms whose productivity is highly dependent on the availability of finance irrespective of their characteristics. If this were to happen, these firms would be able to increase their investments in productivity-enhancing activities, which would benefit long-term economic growth.

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APPENDIX

Appendix 1: Descriptive Statistics: The summary statistics of the variables

Variable	Mean	Std. Dev.	Minimum	Maximum	Obs
<i>A. TFP calculation</i>					
Net Book Value (logs)	12.7418	3.796	-6.77	28.36	4206
Sales (logs)	12.1949	3.0511	-4-19	27.58	23989
Material cost (logs)	11.6186	4.1770	-5.44	26.91	6275
Labour cost (logs)	10.7085	3.8540	-5.44	26.30	12321
<i>B. Firm-level characteristics</i>					
Age of Firm (logs)	2.6665	0.6404	0	4.897	8742
Managerial Experience (logs)	2.3030	0.7490	0	5.707	25072
Dummy = 1 if firm has no overdraft	0.7883	0.4085	0	1	23253
Dummy =1 if firm has no loan	0.8325	0.3734	0	1	24900
Dummy = 1 if firm has no account	0.1525	0.3595	0	1	14978
Dummy = 1 if firm size is small	0.6553	0.4752	0	1	23470
Dummy = 1 if firm size is medium	0.2631	0.4403	0	1	23470
Dummy = 1 if firm size is large	0.0814	0.2735	0	1	23470
Dummy = 1 if Manufacturing sector	0.4979	0.5000	0	1	16607
Dummy = 1 if Retail Sector	0.2303	0.4210	0	1	16607
Dummy = 1 if Other services	0.2716	0.4448	0	1	16607
Dummy = 1 if finance is no obstacle	0.2080	0.4059	0	1	24730
Dummy = 1 if finance is Minor obstacle	0.1569	0.3637	0	1	24730
Dummy = 1 if finance is Moderate obstacle	0.1794	0.3837	0	1	24730
Dummy = 1 if finance is Major obstacle	0.2486	0.4322	0	1	24730
Dummy =1 if finance is Very Severe obstacle	0.2068	0.4050	0	1	24730
<i>C. Country-level characteristics</i>					
GDP per capital (log)	7.470	0.9214	5.5314	8.7393	25946
Private Credit (% GDP)	30.053	30.6356	3.9223	160.125	25946

Appendix 2: Base Regression Results (OLS): Whole Sample with Country Dummy

	(1)	(2)	(3)	(4)
Dependent Variable: Total Factor Productivity: Labour Cost and Net Book Value of Machines. Land and Buildings (Log Value)				
Overdraft	-0.060*** (0.056)	-0.053*** (0.051)	-0.078** (0.053)	-0.152*** (0.053)
Credit Line/Loan	-0.012** (0.053)	-0.006* (0.054)	-0.012 (0.054)	-0.001 (0.053)
Checking Account	-0.070*** (0.057)	-0.167** (0.059)	-0.131*** (0.058)	-0.139*** (0.058)
Moderate Obstacle		0.213*** (0.063)	0.176*** (0.062)	0.131** (0.062)
Major Obstacle		0.084 (0.059)	0.061 (0.058)	-0.040* (0.058)
Very Severe Obstacle		-0.162* (0.063)	-0.181*** (0.063)	-0.275*** (0.063)
Small Firm			-0.012** (0.071)	-0.033** (0.069)
Medium Firm			0.028 (0.069)	-0.010 (0.067)
Age of Firm (Log)			-0.269*** (0.051)	-0.265*** (0.050)
Managerial Experience (Log)			0.104*** (0.031)	0.079*** (0.031)
GDP Per Capita (Log)				0.373*** (0.032)
Domestic Credit				0.002*** (0.0005)
Observations	2665	2,430	2401	2401
R-Squared	0.0089	0.0156	0.0238	0.0696

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively

Appendix 3: Stochastic Frontier Normal/Half Normal Model Regression

Dependent Variable: Cobb-Douglas Production Function

Variables	Coefficients
Material Cost (β_1) (Log)	0.569*** (0.015)
Labour Cost (β_2) (Log)	0.556*** (0.017)
Overdraft	-0.464*** (0.113)
Credit Line/Loan	-0.433*** (0.103)
Checking Account	-0.002 (0.302)
Moderate Obstacle	-0.795*** (0.198)
Major Obstacle	-0.902*** (0.218)
Very Severe Obstacle	-0.326 (0.206)
Small Firm	-0.467*** (0.117)
Medium Firm	-0.323*** (0.119)
Age of Firm (Log)	-0.111 (0.093)
Managerial Experience (Log)	0.073 (0.061)
Observations	4682
Log Likelihood	-6477.0563
Wald Chi2	513362.44
Probability > chi2	0.0000

Note: Standard errors in brackets. ***, **, * denotes significance levels at 1%, 5% and 10% respectively