

The impact of financial integration on financing innovative development in Sub-Saharan Africa

Alhassan Tijani Forgor

Peoples' Friendship University of Russia (RUDN University)

Moscow, Russia

atijaniforgor@yahoo.com

Abstract — This article reviews and analyzes the role of access to finance on financing innovation development in developing countries, for that matter Sub-Saharan region. The data collected from the World Development Indicators database of the World Bank cover the period of the 'New Economy', and were adequately tested to ensure it satisfies the research objective. Thus, the data compiled was examined, prior to the application of exploratory factor and regression analyses, in order to ensure that they were amenable to the use of these techniques and relevance to this study.

XLSTAT software was used to perform correlation and regression analyses on independent variables used as proxy variables for innovation development (indigenous promotion of innovation growth through funds for R&D and human capital development) such as total domestic credit, domestic credit to private sector; domestic credit to bank credit to private sector; expenditure on education as percentage of GDP; and FDI, whilst GDP per capita growth was used in this study the dependent variable. The research results show that overall domestic credit, domestic credit to private sector, bank credit to private sector and FDI all show a positive influence economic growth, with domestic credit to private sector being the most influential. However, a negative correlation was found between economic growth and the expenditure on education, a special proxy variable for innovation (human capital development and R&D). This explains, surprisingly, that a higher spending on this variable will lead a decrease in growth in Sub-Saharan Africa, which seems unrealistic. It was anticipated that all these variables especially overall domestic credit, credit to private sector including bank credits must have significant positive coefficients. Although, the results of this study seem a bit worrying, however, the overall of goodness-of-fit measures: R-value (0.57) and lower P-value (0.047) prove the reliability of the model, hence must be accepted as such. The results indicate that the growth effect of financial development is sensitive to the choice of proxy used. Like either using the private sector credit to GDP ratio or the private sector credit as a ratio to total credit, we found positive and significant effect of financial development on innovation induced growth.

This study provides a guideline in future research for policymakers, economists and business people for better assessment of how a broader financial inclusion could facilitate innovation growth and economic development of Sub-Saharan African countries.

Keywords — *Financial integration, financial inequality, innovation development, economic growth, Sub-Saharan Africa, individuals, firms, SMEs*

I. INTRODUCTION

Finance serves as the lifeblood to innovative process and strategies process, hence economic development. This is supported by solid theoretical and empirical evidence, policymakers are becoming increasingly convinced on the vital role that the efficient, well-functioning financial systems play in the channeling of funds to the most productive use and the allocation of risks to the right hands, hence boosting innovative activities, improving opportunities and income distribution and poverty reduction. However, extent at which access to finance and its range of services are limited, which supersedes the benefits of financial development by eluding many individuals and enterprises, thus leaving many a large size of the population in abject poverty. This article focuses on the access dimension and the relationship between access to finance and the funding of innovative development.

An improvement in access and building of inclusive financial systems is a relevant objective of many countries, especially, developing economies of which Sub-Saharan Africa is included. But, the challenge of improved access implies making financial services readily available to all, thus creating a leveled playing ground, equality of opportunity and tapping the full potential and resources in an economy. The hurdle is not about ensuring that a lot or majority of people have access to basic financial services, but rather how to enhance the quality and reach of savings, payments, insurance, credits as well as other risk management product so as to bring about sustained growth and productivity, especially for the small and medium scale firms. Although the formal financial sector in a few countries has achieved a well-functioning and efficient universal coverage of the population, at least for basic services, however, some level of financial exclusion still persists even in many high-income countries. This is a result of difficulty in participating in such sophisticated economies, thus financial exclusion can be more serious hindrance to those affected as in Sub-Saharan region.

Financial market frictions can be the critical mechanism in creating persistent income inequality or poverty traps. A lack of inclusive financial systems cause poor individuals and small firms rely on their limited personal wealth and internal resources to invest in their education, take up entrepreneurial roles, and/or seize the promising growth opportunities. Nevertheless, financial market imperfections, including transactional costs and information asymmetries, are the likely hurdles facing talented poor and micro-firms that lack credit histories, collateral and connections, hence limiting their innovation and growth opportunities leading to persistent inequality and slower development. However, the access

dimension of financial development, most often, is overlooked as result of the serious gaps in the data on who has access to which financial services and the barriers in broader access.

Despite the attention and emphasis access to financial services (financial integration) has gained in theory, there is very limited empirical evidence linking broader financial inclusion to growth and development outcomes, thus bringing forth at best tentative public policy measure in this scope. Broad access to finance means an absence of both price and non-price barriers in using financial services; access to finance is difficult to be defined and measured owing to the numerous dimensions. Financial services must be available at any desired time and place, whilst products are required to be tailored to certain needs. Finance related services must be affordable, and very cognizant of the indirect costs borne by the user which may include traveling to distant places to a bank branch. All efforts aimed at improving financial inclusion need to make a business sense and translate into profits for service providers to ensure a lasting effect. However, certain pertinent questions about broader financial access, which gradually getting answers include: what is the extent of financial exclusion around the world and the link between financial access and growth and/or poverty elimination? What major hurdles and policy snags are encountered in ensuring a broader financial access? Which aspect of access to finance matters most: at the household or firm level? And lastly, is direct access by household and firms different (and to what extent) from nationwide spillover effects of financial sector development as a result of efficient production and robust labor market? The development of mechanisms and indicator of broader access would help leapfrog by providing answers to these questions.

II. LITERATURE REVIEW

In the impact of finance on growth discourse, conceptually, it is crucial to distinguish two effects (Mankin, Romer, & Weil, 1992), on the one hand, the role of finance on raising income levels of developing economies and on helping economies merge in income towards advanced countries, and on the other hand, the impact on steady economic growth rate. The second effect (see Aghion, Hwitt, & Mayer-Foulkes, 2005) could emanate from the impact of financial development in facilitating innovation and accelerating the frontier movement outwards. Governments and Central Banks of different countries and developmental institutions like the United Nations have worked out and developed different initiatives at regular intervals to tackle obstacles of access to finance or financial inclusion. For instance, in the United States, the Community Reinvestment Act (1977) requires Banks to offer credit throughout their area of operation, whilst in India, government implemented Pradhan Mantri Jan-Dhan Yojana (PMJDY) to cover strategies to outreach the weaker section of the population. PMJDY is a core financial plan aimed at covering all households in the country with banking facilities including inbuilt insurance coverage. In Germany, the Bankers' Association introduced current account for 'everyman'. A low cost bank account termed as 'Mzansi' or 'no-frill' bank account was launched for people with no or less access to financial services 2004 in South Africa [4]. In Brazil, a branchless Banking system using banking correspondents (BCs) strategy is used to spread access to banking through agents. In Kenya banking without a Bank (mobile banking) system is used as a strategy to broaden financial inclusion and

to promote the utilization and best use of Technology for broadening financial inclusion [5].

Modern development theory concentrates on studies such as evolution of growth, relative income inequalities and persistence in unified models. Financial market imperfections play a central role in many of such models, influencing major decisions towards human and physical accumulation and job choices. Financial market imperfections, in theories centered on capital accumulation, determine the level borrowing by the poor to invest in education or physical capital for household development. Whilst financial imperfections theories stressing on entrepreneurship, determine the level to which talented but with limited personal wealth or internal resources, can raise external funds to initiate business or innovative projects through research and development or adaptation of new technologies. Hence, it is evident that the evolution of financial development, innovative growth and intergenerational income dynamics are closely related. Finance does not only influence the efficiency of resource allocation in an economy, but also on comparative economic opportunities of individuals/ households or firms of different income levels.

This deep focus on the financial sector in economic modeling has been stems from historical development of mirage of views on the link between economic growth including innovative development approaches and income inequality. The early believe was that the initial stages of economic development would, naturally, lead to the concentrations of wealth by few individuals or households, hence causing inequality among the larger section of the population. Inasmuch there is a higher marginal propensity to save by the rich minority than the poor majority, researchers argue that the quest to finance large indivisible investment projects of development implies that rapid growth would require wealth concentration, thus leading to a fundamental trade-off between growth and social justice. To this end, Kuznets (1955, 1963) noted that this trade-off could mean that inequality would persist in the initial phases of development until the benefits and opportunities accruing from it spread across the economy. Although, some earlier empirical evidence from the some developed economies including the United States support the Kuznets hypothesis, however similar evidence from developing economies proves otherwise. Furthermore, the return to uprising inequality in developed countries in a couple of decades outlines further the drawbacks of Kuznets' model.

Despite the fact that the provision of incentives to reward the innovation (productive efficiency) of firms and investment seem to mean that growth and inequality must be positively related, but empirical studies indicate that it is not always so. More so, while extremely low inequality is indeed empirically associated, particularly, with rapid subsequent growth, however the highest growth rates are associated with moderate inequality. But, very high inequality tend to reduce subsequent growth (see Alesina & Rodrik, 1994; Perotti, 1992, 1993 & 1996; Persson & Tabellini, 1994). Studies which support these findings, in helping to them better, explored concrete approaches and mechanisms where inequality might adversely affect growth and firms' innovation activities. Financial market imperfections are mostly at the major line of thought since these inequalities occur as a result of such defects. The other possible ways through which higher inequality could slow or reduce growth include systems in states with less accountability and respect for civic and social life [13]. In

Galor and Zeira's model (1993), for instance, poor individuals are unable to invest in their education despite their high marginal productivity as a result of financial market frictions. While in the model of Banerjee and Newman (1993), it is argued that individuals' career choices are limited by their early endowments [15]. The structure of occupational choices determines whether people can become entrepreneurs or remain wage earners, and in turn predetermines how much they can save and what risks can be borne by them, hence coming with long-run effects on growth and income distribution [16].

Thus, these models reveal how lack of access to finance can be a critical mechanism in causing persistent income inequality or poverty and slow growth. One major implication or conclusion that can be drawn from these modern development theories and models is that redistribution of wealth can facilitate and boost growth factors such as innovation of firms as well as adoption of external technologies for growth. This school of thought rationalizes a focus on redistributive public policies in areas such as education and land reforms. This prompts an argument, however, that if it the cause of capital market imperfections that lead to this relationships and calls for redistribution, what is the essence of neglecting the policies that could eliminate financial market imperfections? Notwithstanding, credit constraints or other frictions are taken as exogenous in some theories. Whilst in others, information asymmetry and transaction costs endogenously lead to adverse selection and moral hazard frictions, which affects the transactions on financial markets. In both cases, financial market imperfections are taken and different redistributive mechanisms to promote growth are suggested, with emphasis on education, saving, or changes in fertility. This is true, although, the literature notes as well that the continuous existence of financial market frictions, the absence of virtuous circle as in Kuznets's model may also require permanent redistributive measures (see Aghion & Bolton, 1997; Aghion, Caroli & Garcia-Penalosa, 1999).

Aghion and Bolton (1997) noted that the economic magnitudes of disincentive effects, caused by most of the redistributive measures [17], are a subject of intense discourse. Thus, a better effective and sustainable development mechanism should directly tackle financial market frictions in a way that may not lead to adverse incentive effects. As argued by Demirgüç-Kunt and Levine (2001), such tensions disappear when attention is paid on financial sector reforms. The reduction of financial market frictions in order to expand opportunities for individuals and firms bring about positive, not negative, incentive effects. These arguments, thus, are in support of the modern development theories whilst stressing on promoting financial inclusion, at the core of the development agenda, through financial sector reforms. It is, therefore, worth noting that the financial depth, generally, may have direct and indirect effects on small and medium enterprises (SMEs) as well as the poor households. A greater financial depth, consequently, can lead to greater access for both individuals and firms, thus placing them in a better position at household level to improve their consumption and insurance, while at the firm level to help take advantage of investment opportunities and innovation projects for development. All the same, if improvement in financial development does not directly improve direct access for SMEs or household, however, the indirect effects are equally necessary. This is because the deprived individuals may

benefit from it via getting higher wages, and as well-functioning financial systems progressively develop efficient products and labor market may promote growth. In the same vein, SMEs may witness an expansion, even if the financial sector is inclined to serving mostly the larger firms, in their business opportunities by helping them undertake innovation development or adapt new and better productive methods.

III. DATA AND METHODOLOGY

Secondary data was primarily used for this research study. For data analysis and interpretation, XLSTAT software was used. Pearson's correlation and covariation coefficient was employed to interpret the linear relationship between variables. As broad as our topic is, we use the following proxies for our analysis: Domestic credit to private sector; Domestic credit; Domestic banks' credit to private sector; FDI; Expenditure on education and using GDP per capita as dependent variables. However, the lack of data on the level of funding innovation using Gross Expenditure on Research and Development caused us to drop this important variable. The data collected for the period of 1999 - 2017 from the database of World Development Indicators of the World Bank. This period was chosen since it covers 'New Economy' from an economic point of view, which DeLong and Summers (2001) have noted the "essence of the New Economy" to be, generally, the intensive use of technology including information technology [19]. Furthermore the "New Economy" has been defined by the Canadian government (2002) as "an Economy that is producing or intensively using innovative or new technologies." With these definitions posit the importance of innovation in economic growth of a country. The data collected for the was analyzed presented in tables and graphs and statistical tools such as mean, simple percentage, standard deviation and correlation have been used to achieve the research objective. A detailed description of the variables by World Development Indicators is presented in Table 1 below.

TABLE 1. VARIABLES USED IN THE MODEL

GDP per capita growth (annual %)	Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
Domestic credit provided by financial sector	Domestic credit provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The financial sector includes monetary authorities, deposit money banks and other financial corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits.
Domestic credit to private sector	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment.
Domestic banks' credit to private sector	Domestic credit to private sector by banks refers to financial resources provided to the private sector by other depository corporations except central banks), such as through loans, purchases of non-equity securities, and trade credits.
Expenditure on education (% of GDP)	Education expenditure refers to the current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment.
Foreign Direct Investment	Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.

Source: World Development Indicators of the World Bank Data 2019

In the finance – innovation development analysis in one model, the relationship between economic growth rate per capita, which we deem as an indicator of real economic development and financial access for innovation development projects (for instance, the availability of funds to the private

sector). The model relating the economic growth and finance-induced innovation is represented as:

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \beta_4x_4 + \beta_5x_5 + \dots + \beta_3x_{ii} + \epsilon_i \quad (1)$$

Table 2 shows the descriptive statistics of the variables used to analyze the relationship between economic growth and the financing of innovation development in the above model. GDP Per Capita Growth: the measurement of an economies standard of living. A positive correlation is highly expected between GDP growth rate and GDP per capita growth rate but as in Sub-Saharan population is growing rapidly it is necessary to consider both to measure actual economic growth of this region. Education expenditure (% of GDP): is used a proxy variable for innovation in the economy, it is expected that as spending on education increases, bringing about an increase in education level in the economy leads more innovation. Also, we use the expenditure on education and FDI as proxy variables for innovation since the former could serve a measure of institutional quality and technical knowledge, whilst it is also expected that spillovers from foreign investments could improve innovation.

TABLE 2. DESCRIPTIVE STATISTICS OF VARIABLES

Statistic	Dom. credit	Bank credit to PS	Dom. credit PS	Expend. on Edu	FDI	GDP per capita
Minimum	-1.871	-2.226	-1.917	-1.622	-1.731	-2.277
Maximum	1.508	1.923	1.464	2.175	2.662	1.346
Range	3.380	4.149	3.381	3.797	4.394	3.624
Median	0.035	0.086	-0.113	-0.204	-0.035	-0.031
Sum	0.000	0.000	0.000	0.000	0.000	0.000
Mean	0.000	0.000	0.000	0.000	0.000	0.000
Variance (n)	1.000	1.000	1.000	1.000	1.000	1.000
Standard deviation (n)	1.000	1.000	1.000	1.000	1.000	1.000
Standard deviation (n-1)	1.029	1.029	1.029	1.029	1.029	1.029

Source: Author's computation using data from World Bank database: World Development Indicators 2019.

The focus on capital availability to private sector was arrived based on the vital role the sector plays in innovation development of countries. Table 3 shows the definitions (indicators) to the variables used in the model.

TABLE 3. DESCRIPTIVE STATISTICS

Variable	Indicator
GDP per capita (annual %)	GDP.p.c
Domestic credit provided by financial sector	Dom.c
Domestic credit to private sector	Dom.c.ps
Domestic credit to private sector by banks	Bank.c.ps
Expenditure on education (% of GDP)	Exp.edu
Foreign Direct Investment	FDI

The model for this study is therefore presented as follows:
 $GDP\ growth = \beta_0 + \beta_1 (Dom.c)_i + \beta_2 (Dom.c.ps)_i + \beta_3 (Bank.c.ps)_i + \beta_4 (Exp.edu)_i + \beta_5 (FDI)_i + \epsilon_i \quad (2)$

A multi-collinearity test has been carried out using correlation in order to understand the relationship among the variables in the model. Table 4 below presents the model parameters.

TABLE 4. CORRELATION ANALYSIS

	Dom.c	Bank.c.ps	Dom.c.ps	Exp.edu	FDI	GDP.p.c
Dom.c	1	0.476	0.772	-0.540	0.080	0.313
Bank.c.ps	0.476	1	0.815	-0.307	0.399	0.058
Dom.c.ps	0.772	0.815	1	-0.408	0.060	0.348
Expend.edu	-0.540	-0.307	-0.408	1	-0.363	-0.465
FDI	0.080	0.399	0.060	-0.363	1	0.096
GDP.p.c	0.313	0.058	0.348	-0.465	0.096	1

Source: Author's computation using data World Development Indicators 2019

The above table is a correlation matrix which tests the multicollinearity among independent variables including the dependent variable. The matrix shows significant positive correlations (below 0.30) between GDP per capita used as the control variable in this study and domestic credits to private sector and domestic credit, whilst the control variable has insignificant positive relationships with bank credits provided to private sector and foreign direct investment show an relationship. A positive relationship between growth and private sector credit supports several other studies (e.g., Levine, 2005; Akinlo & Olufisayo, 2009), however the weak correlation is not surprising as it could be as result of the limited data accessibility associated with the region. The F-statistic of 3.18 demonstrates the overall significance of this model.

IV. RESULTS AND DISCUSSION

The model outlined in the data and methodology section was used to test the hypothesis of this study. Multi linear regression contained in Table 5 shows the results of the model where economic growth rate was used as a dependent, while all the other were treated independent and proxy variables through which improved financial access can serve as a conduit to capital accumulated for innovation development, thus economic growth.

TABLE 5. REGRESSION ANALYSIS

Regression Statistics	
Sum of weights	18.000
DF	12.000
R ²	0.570
Adjusted R ²	0.391
MSE	1.363
RMSE	1.167
MAPE	91.250
DW	1.613
Cp	6.000
AIC	10.273
SBC	15.616
PC	0.860
Press	51.819

Source: Author's computation using data World Development Indicators

The multiple linear models presented in the Table 6, 7, and 8 below demonstrate the general measures of goodness-of-fit, which makes the model possible to be used after satisfying the assumptions, and hence is found adequate. This model has been adequately evaluated using regression statistical analysis. The multiple R and R squared determine the correlation and coefficient of determination respectively, and thus, the R value 0.57 is a proof of significant relationship between economic growth and the other independent finance-induced innovation proxy variables used in this study.

TABLE 6. ANALYSIS OF VARIATION

Source	DF	Sum of squares	Mean squares	F	Pr > F
Model	5	21.675	4.335	3.181	0.047
Error	12	16.354	1.363		
Corrected Total	17	38.029			

Source: Author’s computation using data World Development Indicators

TABLE 7. MULTICOLLINEARITY STATISTICS

	Domestic credit	Bank credit to PS	Domestic credit PS	Expend. on Edu	FDI
Tolerance	0.257	0.139	0.088	0.582	0.433
VIF	3.889	7.211	11.352	1.719	2.307

Source: Author’s computation using data World Development Indicators

Using the values contained in the model parameters from Table 8 below the relationship between economic growth and the independent innovation proxy variables is represented as follows:

$$GDP\ growth = 13.78 - 0.18 * Dom.c - 0.97 * Bank.c.ps + 0.60 * Dom.c.pc - 1.24 * Exp.edu + 1.23 * FDI \quad (3)$$

TABLE 8. COEFFICIENTS OF VARIABLES IN THE MODEL

Source	Value	Standard error	T	Pr > t	Lower bound (95%)	Upper bound (95%)
Intercept	13.779	7.470	1.845	0.090	-2.496	30.054
Domestic credit	-0.185	0.102	-1.823	0.093	-0.407	0.036
Bank credit to PS	-0.970	0.328	-2.959	0.012	-1.685	-0.256
Domestic credit PS	0.605	0.199	3.044	0.010	0.172	1.037
Expend. on Edu	-1.240	0.987	-1.257	0.233	-3.390	0.910
FDI	1.233	0.681	1.811	0.095	-0.251	2.717

Source: Author’s computation using data World Development Indicators 2019

The lower P-value of 0.047 indicated the reliability and the significance of the model. However negative coefficient between GDP per capita and expenditure on education used as proxy variables for economic growth and innovation respectively is surprising. Since it seems to explain that a high spending on education will lead a slow economic growth in Sub-Saharan economic region, which is unrealistic. Although, this study raises a number of questions based on its results, however, the R value and lower P-value proves the reliability of the model and must be accepted.

V. CONCLUSION

The importance of access to finance cannot be overemphasized in any economy since a broader access to financial services could serve a medium through which resource can be accumulated from the population and channel into more efficient and productive sectors. This promotes innovation, and hence facilitates rapid growth in the Sub-Saharan Africa. Generally, Africa can be a leader continent in

innovative growth rather than a follower if the appropriate mechanisms are developed and put in place to allocate funds to areas where they are most needed for better productive projects of development, hence increasing innovation. The results indicate that as spending on education increases, economic growth will slow in Sub-Saharan economies. This, therefore, poses the question if this type growth will be for a short-term phenomenon or a sustainable one. Although, the results explain that domestic bank credit to private sectors does not significantly influences growth as it is the case of many developed countries, where the private sector actually serves as the backbone of their economies by using available resources to undertake technological innovative projects for growth. However, this is not very surprising as even among the followers of Schumpeter the role of the financial sector has never drawn much attention. In Schumpeter’s vision (Perez, 2004) the financial world itself is not entrepreneurial, and Schumpeter defining the entrepreneur as the dynamic force driving innovations and hails him as “the real hero of development”. The banker is merely a ‘bridge’, “a facilitator, the one that provides the means for the entrepreneur to exercise his creative will.” The dominant neoclassical school of economics saw the role of financial development in growth strictly in quantitative terms, by supporting a higher level of investment and so accumulating physical and human capital. The importance of finance was not denied, but the general view was one of perfect markets in which finance would readily be available if profitable opportunities would present themselves. The negative correlation also raises the questions to the business society and policymakers if we would be allocating our resources efficiently by following or adopting the growth models of developed economies especially the nature and impact of spending on education for human capital development. These questions also open the topic for future research in this field.

The results indicate that the growth effect of financial development is sensitive to the choice of proxy used. For instance, using either the private sector credit to GDP ratio or the private sector credit as a ratio to total credit, we found positive and significant effect of financial development on innovation induced growth. However, same cannot be said when one uses spending on education to GDP ratio to proxy for finance induced innovation as the coefficient on this variable was found to be significantly negative. The indexes created from principal component analysis confirmed the sensitivity of the effect to the choice of proxy. This finding helps in understanding the conflicting results in the literature as many studies rely on single indicators hence unable to identify which financial sector variables have positive growth enhancing effects and which does not.

This study concludes with the call for broader and efficient financial access, and the channeling of the pool of resources to more productive to promote innovation and rapid sustainable growth.

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