FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH: THE CASE OF RWANDA

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ABSTRACT

The link between financial development and economic growth has been assessed by many studies on either groups of countries or individual countries which have come up with conclusions reflecting mainly four schools of thought linking the two: the supply-leading phenomenon; the demand-following phenomenon; bidirectional causation between the two; or no/negative association between the two. This study explores this literature and tries to analyze where Rwanda falls in these theories. It uses a recently constructed financial development measure (FD index) that combines many dimensions of financial system development; access, depth and efficiency of both financial intermediaries and financial markets, which is extensively broader than traditional indicators used in the majority of previous studies. The study has employed the augmented Granger non-causality test suggested by Toda and Yamamoto to assess the link between finance and growth, if any, for the years 1980 to 2018. The results suggest that, for Rwanda, the link is described by the demand-following theory, particularly driven by financial institutions. On the other hand, the financial markets and traditional indicators have a bi-directional relationship with economic growth. These findings are important for further research on financial institutions and highlight the importance of nurturing the financial markets so as to drive growth.

Key Words: Economic Growth, Financial Development, Rwanda

JEL Classification: E44, G10, G20, 016

1. INTRODUCTION

Policy makers and economists worldwide have been and are still seeking dynamic areas, which can foster economic growth and sustain it. This search will go on as new ideas are needed to fit the changing world context. Financial development has been one of these ideas that has been highly debated and studied, especially on its contribution to economic growth.

The financial system's functions, as outlined by several studies such as those of Levine (1997), Ang (2008) and Haan et. al (2015), are pooling resources from economic agents with surplus and distributing them in a selective process to those who need them but will leverage on them, facilitating trading and diversifying risk portfolios and enabling corporate control for better performance of firms. In delivering its functions, the financial system reduces information and transaction costs that would otherwise limit how resources would be distributed among different agents. Financial development is therefore described by the World Bank (2020) as the increased efficiency that reflects reduced costs of a country's financial system in delivering these functions and can be classified into increased access, depth, efficiency and stability of the financial system.

The debate has been on whether the progress of the financial system drives/accelerates economic growth as it conducts its primary role of resource allocation. The mostly discussed channel is through its effect on capital accumulation and increased innovation, which are the factors of production for long-term growth according to the Solow model growth theory (Levine, 1997; Ang, 2008; Haan et al, 2015).

Several schools of thought have come up in empirical assessments of the relationship between financial development and economic growth. One school of thought, which is the most popular, is that financial development drives economic growth (supply leading hypothesis), for example Levine (1997), Khan and Senhadji (2000) and Apergis et al (2007). The second school of thought is that economic growth drives the need for a more developed financial system i.e. the demand-following hypothesis (Hossain et al, 2017; Noor et al, 2017). The third school of thought is that they both cause each other (Calderon and Liu, 1999; Okello et al, 2015). The fourth school of thought is that there is no significant relationship between finance and growth or that its growth is detrimental to economic growth (Acarvi et al, 2009; Hashim, 2011;

Effiong, 2015). Many studies have focused on analyzing this theory on groups of countries, whose results and conclusions have many important policy implications for similar countries. However, it is paramount to conduct country level studies considering countries' economic, political, institutional and geographic uniqueness; as these and other characteristics may steer a country's reaction to a certain policy in a different direction from the expected/norm.

In a similar vein, this study extends this analysis to Rwanda's context, considering the high average GDP growth it has recorded in the last 2 decades of about 8%. Rwanda has also made strides in financial system development where, for most of the past, it was bank-based, but more recently, other financial institutions and financial markets have been growing and supplementing the banks' role of intermediating between economic agents with excess resources to those with a resource gap. Do these two analogous developments have anything to do with each other?

This study first conducts an extensive review of literature on the finance and growth relationship both on country-level and on groups of countries and then conducts an empirical case study on Rwanda. It uses the financial development index as the main decision variable as it represents the multifaceted nature of financial development i.e. access, depth and efficiency of either financial institutions or financial markets, using 20 variables that have been aggregated into one (Svirydzenka, 2016). It also analyses which dimension drives the overall relationship between the index and growth. The results are then compared with traditional indicators. It is the first study that uses the financial development index and its subcomponents for a country-level study to the best of our knowledge and it analyses a longer period than previous studies on Rwanda. Existing studies, including those on Rwanda by Kigabo et al (2015), Okello et al (2015) Karangwa and Gichondo (2016), Gisanabagabo and Ngalawa (2016), Nyalihama and Kamanzi (2019) have used indicators that represent mostly one dimension of finance and in most cases, financial depth of financial institutions. A more common finding in these studies is that the finance-growth nexus in Rwanda is defined by the bi-directional theory.

In order to decipher which school of thought/direction of causality between finance and growth in the Rwandan context, the study adopts the Toda-Yamamoto Granger Causality Test. The results point to the demand-following theory i.e. economic growth precedes financial development and this is driven mostly by financial institution

depth. The financial institution efficiency, financial market depth and the traditional indicators have a bidirectional relationship with growth, which offset a little the growth to finance relationship but not enough to reverse the causal direction of the aggregate index.

The rest of the paper is organized as follows: Section 2 surveys the literature on financial system's role and the link of its development to economic growth, Section 3 analyses financial development in Rwanda, Section 4 describes the variables and model specification in Rwanda's analysis, Section 5 presents the results and Section 6 concludes and discusses some policy implications.

2. LITERATURE REVIEW

2.1. The role of the financial system

Many authors including Levine (1997), Ang (2008) and Haan et al (2015), detail the theoretical background on how financial development and economic growth are related by analyzing how efficiency in conducting each financial system's function plays a role in an economy's growth.

Regarding risk amelioration, the financial system reduces liquidity risk by making it easy to transfer and sell off or get back savings from assets such as equity, bonds and demand deposits through reduced information and trading costs. High-return projects, which are more beneficial for the economy's growth, more often need long-term commitment of funds. When savers are assured that they can easily recover their savings from long-term commitments when needed, they are more likely to make long-term investments. In this sense, the function of reducing risk enables an economy to shift to long-term, normally illiquid, investments. Higher returns would lead to more capital accumulation and if the long-term commitment is in research and development, they would promote technological innovation.

The authors also show that the financial system's role of reallocation of resources reduces transaction costs that savers would face e.g. in terms of searching for the best investment opportunities/projects. They may not have the time nor the skills to correctly assess this. Financial institutions' task of acquiring information from borrowers usually reduces this information gap for savers on the aggregate level by finding the higher potential production technologies and entrepreneurs, therefore

enabling savers to invest in projects with little information but high returns in addition to making them feel safe to let go of their money into the intermediaries. Economic agents in need of money for investment will then benefit from the reduced cost and time to pool funds from different savers. Through selection of entrepreneurs with the highest potential as well as production capacities, capital accumulation and innovation will be promoted.

The other financial system function, exerting corporate control, as described by Levine (1997), Ang (2008) and Haan et al(2015), is achieved by collateral, financial contracts and other arrangements enforced by the financial system that ensure that managers run the firm in ways that will bring maximum benefit to the owners or outside creditors. These arrangements encourage investment by reducing the uncertainty of how the funded projects/firms are being run. Another way is through separating ownership from management of the firm which will reduce the monitoring cost for savers. How this works is that instead of many savers monitoring projects, financial intermediaries take over this role and savers are assured of always earning interest from their deposits. This function also leads to reduced information asymmetry as by default, a long-term relationship is developed between the firms and the financial institutions. In terms of long-run growth, financial arrangements that improve corporate control tend to promote faster capital accumulation and growth by improving the allocation of capital.

2.2. The link between financial development and economic growth

Empirical studies on the relationship between financial development and economic growth have led to divergent conclusions, especially because of the use of different sample periods and countries, methodologies and measures of financial sector development.

Levine (1997) presents his findings in his earlier papers with King (1993 b &c), where they assess the relationship between financial sector development and economic growth using averaged cross-sectional data from 1960-1989 on 80 countries from all income levels. They use four variables representing financial development i.e. liquid assets/GDP, size of commercial bank credit vis a vis the total credit allocated by the banks and central bank because it is expected that commercial banks are better at providing the functions of the financial system, credit to private enterprises divided by the total credit and credit to private sector/GDP. They use three growth indicators

variables as the dependent variables i.e. GDP per capita, productivity growth and capital growth. They find that all financial developments indicators predict all growth indicators at both statistically and economically significant levels.

To further elaborate on the effect of the financial development and growth, Levine presents the findings from studies that tried to come up with measures of some financial functions and assesses their effect on growth. First, a study by Levine and Sara Zervos (1996) that uses total value of shares on the stock exchange on the GDP and turnover ratio of stock to assess the relationship between stock market liquidity and the three growth variables mentioned in the Levine and King (1993) study. The relationship is found to be positive and significant. A key control variable is the credit to the private sector used in order to separate the effect of stock market liquidity and other financial development aspects.

Second, Levine describes several studies that use firm level data to show that firms that suffer asymmetric information, whereby outside investors have difficulty monitoring them, are more sensitive to their cash flow. In addition, evidence from Japan, Italy and the U.S.A. shows that firms that have longer relationships with banks have less external finance constraints, pay less interest and are less likely to pledge collateral. Evidence also shows equity price rises of firms with records of bank loans. Hence, countries that effectively reduce liquidity constraints and information asymmetry promote faster growth.

Many other studies prove a positive and significant causal relationship from financial development to growth. Calderon and Liu (2002) use pooled data for 109 countries for the years between 1960 and 1994. They find a statistically bigger causal relationship for developing countries compared to developed countries meaning there is more room for financial development-driven growth for the former. The effect on developing countries is said to be channeled through mostly capital accumulation rather than productivity channel while the inverse is true for developed countries. The results are also stronger when longer term data is used, showing the graduality of the effect of financial development on the real sector.

Apergis et al (2007) find that financial development causally affects growth when they use panel data analysis methods on 65 OECD and non-OECD countries between 1975-2000 after confirming for heterogeneity across time and countries. Petrakos et al (2007) also imply the theory of heterogeneity in their findings from a survey

conducted among academia, private sector and public sector experts from all over the globe on their views about factors underlying economic dynamism. Different factors affect growth in different countries and to varying degrees hence, the difference in policy solutions adopted for each country. However, a lot of these policies are similar.

A study by Khan and Senhadji (2000) also finds a strong positive relationship between four financial development variables and growth when they use a cross section analysis of 159 countries between 1960-1999. The four indicators cover both banking system and market securities and are credit to private sector/GDP (fd1), fd1+ stock market capitalization/GDP (fd2), fd2+public and private bond market capitalization/GDP (fd3) and stock market capitalization. When the data is broken into a pooled time series cross-section form, the relationship becomes insignificant for fd2 and fd3. They explain that the weakened relationship might be because the three financial development indicators are not capturing the change in structures in a given period that would affect growth.

A country specific study on Rwanda by Kigabo et al (2015) using Johnsen co-integration test similarly finds that financial sector development, as measured by credit to private sector boosts economic growth. Likewise, Gisanabagabo and Ngalawa (2016) find that finance precedes growth in Rwanda and a shock particularly to credit to the private sector rather than liquidity creates more fluctuations in growth. Both of these studies use quarterly data from 2000 to 2014 and 1996 to 2010 respectively. Okello et al. (2015) also find that banking development positively affects Rwanda's economic growth. They use broad money/GDP, credit to the private sector/GDP and bank deposit liability/GDP for the banking sector development. However, the results differ for different variables when different tests are used i.e. the Johansen test proves a positive and significant effect when using credit to private sector and bank deposits while the money supply effect is significantly negative but the Granger test gives positive results for bank deposits and money supply. The Johansen test results by Okello et. al are similar to those of a study on Ghana by Adu et al (2013) that finds that financial development boosted growth between 1961-2010 in a statically and economically significant level, using the Autoregressive Distributed Lag (ARDL) model; but this applies when private sector credit share of total credit or as a share of GDP are used as proxies for financial development. When broad money is used instead, the relationship is significantly negative. Pautwoe & Piabuo (2017)'s

also conduct a country-specific study on Cameroun for the years 1980-2014 using an ARDL estimation and conclude that there is a positive long-run relationship between financial development and economic growth. Measures for financial development are the same as those used in the Okello et al. study.

The second theory of the nexus between financial development and economic growth is that economic growth drives financial development which has mixed views. The idea is that as the economy grows, there will be more demand for financial services by investors and savers hence the financial sector infrastructure services will be supplied in response to the new demand (Patrick, 1966). Levine (1997) tests to see if economic growth drives finance but concludes the opposite after finding that initial finance significantly predicts GDP per capita, productivity and capital growth. The results remain the same even when instrumental variables of the legal treatment of creditors are used as a representation of exogenous financial development in other studies. Both cross sectional and pooled cross section time series data also give similar results. A study by Hossain et al (2017) on Bangladesh however, has findings that contradict that of Levine, at least for the particular country. Hossain et al use a diverse set of financial indicators covering financial depth, access, efficiency and stability but compress them into two factors using the Factor Analysis technique and test their causality on economic growth using the Granger Causality test using data from 1988-2013. One of their findings is that economic growth actually drove financial development when measured by depth and stability. The validity of a growth to finance argument in Malaysia was not rejected by Noor et al. (2017) in their assessment of the relationship using an ARDL bounds test using data between 1960 and 2010 and credit to the private sector as their financial development measure.

The third school of thought is that there is a bidirectional relationship between finance and growth. Calderon and Liu (1999) find bidirectional causality but use "Gaweke decomposition test' to test which dependence is stronger. They find the dominating direction to be from financial development to growth as it explains at least 81% of the linear dependence between the two, using the sample of all countries. However, when the sample is broken into different country income levels, the linear dependence of economic growth on finance is stronger for developing countries but for developed countries, the dependence of finance on growth is stronger. Okello et al (2015) also find bidirectional causality in their Granger test when using Rwanda's credit to the private sector as a banking sector development indicator. Other studies

on Rwanda also find bidirectional causality e.g. Karangwa and Gichondo (2016) and Nyalihama and Kamanzi (2019) which both use Granger causality and Johansen cointegration in their analyses. However, Karangwa and Gichondo find a stronger relationship from growth to finance and this relationship is applicable to all sectors of the economy (agriculture, industry and services). They use quarterly credit and real GDP data from 2006 to 2015. On the other hand, Nyalihama and Kamanzi used a geometric mean of banking sector deposits of the current and previous quarters as a share of nominal GDP as the financial development measure and real GDP for economic growth, and assess the years 2006 and 2018 using quarterly data and find a stronger finance to growth link in the industry and services sectors.

Different authors have found a parabolic relationship between financial development and economic growth meaning finance has a positive effect on growth when financial development is low but its effect becomes negligible or negative at very high levels. When Khan and Senhadji (2000) test for non-linearity in their work, they find that indeed the second order term has a negative relationship on growth but they argue that it may have been caused by conditional convergence that was not captured by initial GDP per capita, which was one of their control variables. Arcand et al (2012) also find a non-linear relationship in their cross section and panel analyses when the financial sector exceeds 100% of GDP. It is argued that the cost of financial stability for such high levels of financial sector development exceeds the benefits and that there could be a reallocation of resources to sectors that either have lower returns which are less risky or sectors that feed speculative bubbles such as the housing sector which eventually have negative effects on economic growth. Cecchetti & Kharroubi (2012) find an inverted U-shaped relationship between finance and growth when they analyse 50 emerging and advanced countries. They use credit to private sector/GDP and the share of the financial sector employment over total employment (a financial sector input measure-but only for advanced countries due to data constraints) to measure the financial sector development and find positive effects on growth which becomes negative once the financial sector size exceeds the GDP. A study on finance-growth nexus for emerging economies by Sahay et al (2015), also concludes on a bell-shaped relationship when they use an aggregate financial development index that incorporates financial access, depth and efficiency; arguing that the negative effects from finance mostly come from too much depth rather than efficiency or access.

A number of studies have brought out evidence on the fourth school of thought; the aspect of no relationship or even a negative relationship between finance and economic growth. For instance, Acaravci et al (2009) found no long-run relationship between the two in their panel study that focused on Sub-Saharan Africa using a sample of 24 countries for the years 1975 to 2005. Effiong (2015) finds the same results for a panel of 21 Sub-saharan countries in the years 1986-2010. A study by Hashim (2011) using Spearman rank correlation on Nigeria also proves that there is no relationship between financial development, as proxied by eleven indicators that cover both financial intermediaries and financial stock markets, and economic growth from 2002-2006.

In their subsequent study, Cecchetti and Kharroubi (2015) suggest that the discussion should move from financial development level and economic growth to financial sector growth. They find that financial sector growth negatively affects real economic growth due to a crowding out effect on productivity using manufacturing industry data from 15 advanced OECD countries. Fast financial sector growth is argued to be detrimental to sectors that compete with the financial sector for skilled labour, which is assumed to be inelastically supplied. Since the finance sector is skill-intensive, and skill-intensive sectors are R&D intensive, growth of the financial sector harms R&D intensive industries, sectors that are said to be engines for growth. Therefore, financial sector growth favors low R&D industries. In addition, based on the assumption that "entrepreneurs with high productivity projects are less able to pledge future returns as collateral", exogenous financial sector growth (which is represented by lower transaction cost) is normally followed by strong developments in sectors such as construction where you can easily pledge collateral but whose productivity is low. This reduces the total productivity growth. Samargandi et al (2014) also find a negative long-run relationship between financial deepening and growth for 52 middle income countries. They test for nonlinearity as well and find that finance is detrimental to growth for upper middle-income countries beyond a certain threshold in the long-run and has no effect in the short run. They suggest that the financial sector size is beyond the socially optimal level for upper middle-income countries due to the marginal negative effects.

Along the same thinking, Griffith-Jones et. al (2016) say that the negative relationship between financial development levels and growth is not as relevant for African low-Income countries (LICs), as their financial sectors are still small. However, they raise

the concern that rapid financial sector growth that has been noted in African LICs can be detrimental to the economies if not accompanied by improvement in regulatory capacity or reduced exposure to external shocks, both of which are lacking in most African LICs. Some countries had credit to GDP growths of between 150% and 1550% between 2000-2010, on the back of the aforementioned features that increase their vulnerability to shocks. Nigeria is an example of a country which had a crisis despite its low financial development due to fast credit growth that was used to mostly purchase shares, especially in bank stocks, which led to price bubbles and a financial burst that was made worse by the North-Atlantic crisis. The authors warn that countries, which were not affected by the crisis, should be wary of complacency based on small financial sectors.

Other debates surrounding the relationship between financial development and economic growth are based on e.g. the differences between financial system structures and economic growth. Some argue that bank-based systems have bigger effects on growth and some defend market-based systems. Some say that they are complements. These arguments lie in how effective each structure is in providing the functions of the financial system (Haan et al, 2015). In their review of numerous studies, Valickova et al (2015) find that measures of financial development based on stock markets have a bigger growth effect hence imply a structural efficiency in market-based systems. Another discussion is on how institutional quality affects the relationship between financial development and economic growth. See studies by Effiong (2015) and Haan et al (2015).

Some authors have conducted surveys of studies on the effect of financial development and economic growth. To this end, Nor (2015) concludes that a positive causal relationship exists between financial development and economic growth. Valickova et al (2015) also conduct an empirical analysis on 1334 estimates for 67 studies and find that a strong positive relationship of financial development on growth. They also find varying results between regions due to heterogeneity and hence question the use of similar measures of financial development. The authors also find that their sample literature has no publication bias for particular results but heterogeneity in reported effects is driven by differences in research design. Ang (2008) suggests that despite more studies supporting a causal relationship between finance and economic growth, a generalization should be discouraged and more

country specific studies should be conducted due to the distinctive characteristics and policy environments of each country.

3. FINANCIAL DEVELOPMENTS IN RWANDA

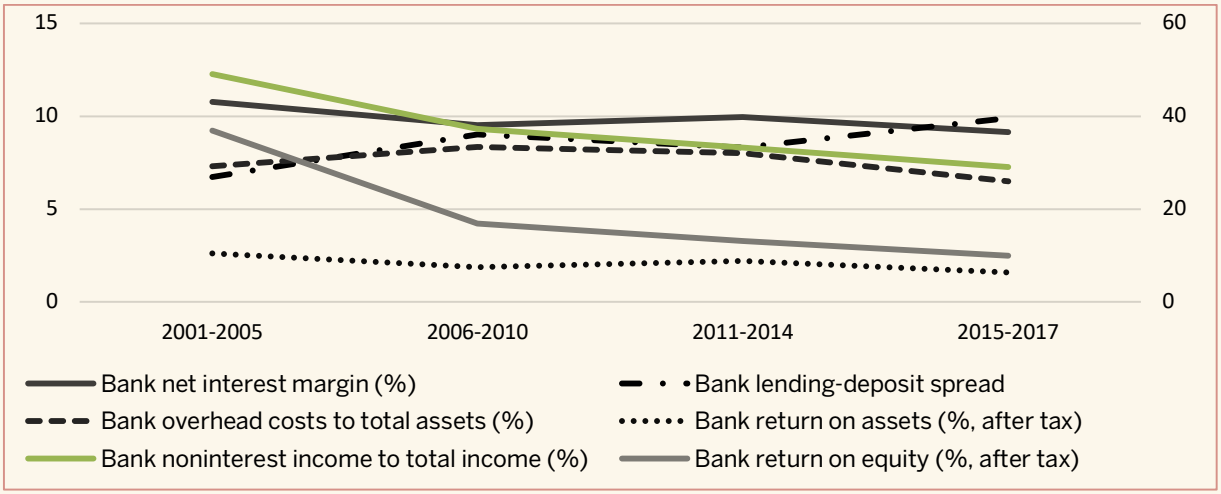
The financial system of Rwanda has evolved over time from being almost purely financial intermediary-based to more recently having a growing and relatively active financial market. Among the financial institutions/ intermediaries, as per June 2020, the banks had the largest assets of about 66%, followed by pensions schemes (17.2%), insurers, microfinance institutions (9.5%) and Non-Deposit Financial Institutions (0.5%). The share of the banking sector has however been gradually declining as the other sectors expand as it was much more in previous years. For instance, it had a share of 71% in 2010. These other sectors have supplemented the financial services by banks and even increased the dynamism of the credit to private sector portfolios, for instance, to the agricultural sector or the small and medium firms that had difficulties obtaining the same due to issues such as collateral (Kigabo, 2021).

The financial sector has also deepened over time as proven by several financial depth indicators. Credit to private sector ratio to GDP has increased from 4.0% in 1980 to 20.1% in 2019 while the ratios of aggregate money supply(M3) and financial system deposit liabilities have increased from to 12.4% to 26.3% and 6.6% to 23.9% respectively (World Bank, 2020 ; Kigabo 2021). Life and non-life insurance premium to GDP also grew from 0.42% in 2000 to 1.67% in 2014. (World Bank, 2020).

In terms of access to financial institutions, bank branches per 100,000 adults has increased from 0.4 in 2004 to 6.1 in 2017 while ATMS per 100,000 adults have increased from 0.04 to 5.6 in the same period (World Bank, 2020). Mobile money, which is used by 60% of adults, has played a key role in financial inclusion in Rwanda. It enables users to access some financial services such as sending/transferring and receiving money, paying bills, buying airtime and even borrowing. Only 23% of adults use it for non-transferring purposes. However, it is the most accessible of the financial system infrastructure because 87% of adults have access to a mobile phone and it takes the shortest time (18.78 minutes) to access a mobile money agent compared to agents to infrastructures of other institutions (SACCOs: 38.86 min, MFIs:41.16min, ATMs:41.21min, Bank branc:42.85min) (Finscope, 2020).

Regarding financial institution efficiency in terms of 'intermediating savings to investments', particularly the banking sector, the net interest margin rate, which is revenues on interest bearing assets divided by interest bearing assets, seems to be falling over time which indicates more efficiency while that of the lending deposit spread is fluctuating upwards which indicates less efficiency in intermediation (Figure 1). Operational efficiency as shown by the overhead costs to total assets and non-interest income to total income also seem to be falling which indicate more efficiency. Return on assets and return on equity, which are measures of profitability, have been respectively stable and declining, which does not show improvement in efficiency. Overall, different indicators point to different efficiency performances.

Figure 1: Financial institution efficiency indicators



Source: Global Financial Development Database

The Financial Market of Rwanda comprises the money market and capital markets which were established in 1997 and 2005 respectively. Instruments traded on the money market are open market operation instruments from the National Bank of Rwanda (NBR) and Treasury Bills that the government uses to borrow. The capital market comprises the stock and bond markets.

The bond market is composed only of government bonds, as the corporate bond market is not yet developed. Outstanding government bonds sold to the domestic market were about 8% of GDP in 2019 from 2.4% in 2017. This amount increased significantly in 2020 by 73% (Own calculation using NBR Statistics). Outstanding

international debt securities in 2017 was 4.5% of GDP from a European bond that was issued by the government in 2013.

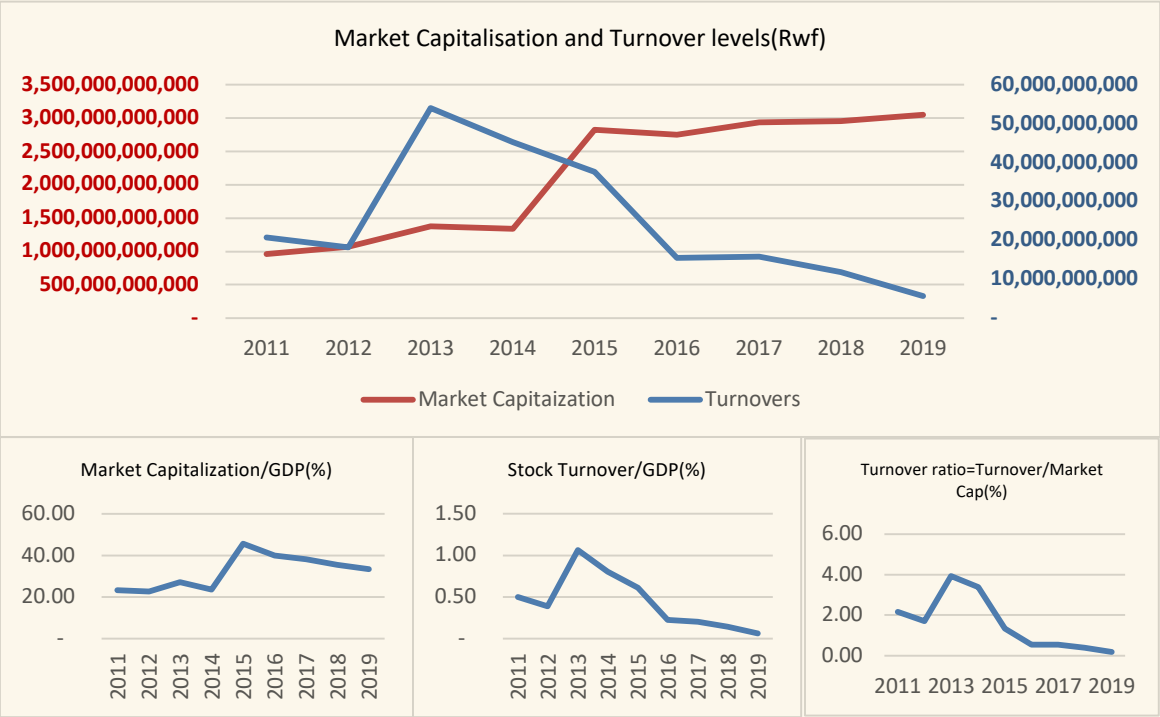
The stock market in Rwanda is still quite young, hardly 10 years old and small in absolute level when compared to other countries (Table 1). Rwanda stock exchange was officially launched in 2011 where it started with 3 listed or cross listed companies which have grown to a total of 10 companies in 2020. Therefore, in terms of access, only 10 companies can be financed through this market so far. Market capitalization, which is an indicator of financial market depth, has had an upward trend and has had an average of 32.16% of GDP between 2011 and 2019, which is not so low. However, the average sales of stock has been 0.44% of GDP and the stock turnover ratio, which indicates the financial market efficiency, was 1.58% in the same period and both have been declining over time. These are very low when compared to South Korea and the U.S. in the same period (see table 1 and figure 2). Rwanda's 2019 values on the stocks traded to GDP and turnover ratios are also lower than those of more comparable countries in terms of income level such as Kenya and Bangladesh.

Table 1: Stock market depth and access indicators

	Rwanda (2011-2019)	Korea (2011-2018)	U.S. (2011-2018)	Rwanda (2019)	Kenya (2019)	Bangladesh (2019)
Market capitalization of listed domestic companies (% of GDP)-right scale	32.2	87.8	138.2	33.48	26.2	28.2(2018)
Stocks traded, total value (% of GDP)	0.4	120.1	212.6	0.1	0.5	4.3
Stocks traded, turnover ratio of domestic shares (%)	1.6	138.0	150.8	0.2	1.9	20.4

Source: Own calculations using NBR statistics and World Bank Indicators

Figure 2: Stock market trends: Depth and efficiency



Source: Authors' own calculations using NBR statistics

4. MODEL AND VARIABLE SPECIFICATION

4.1. Model specification

With reference to the empirical studies mentioned above and other relevant literature, the relationship between financial development and economic growth can be summarized in the regression model below;

$$Y_t = \beta_0 + \beta_1 FD + \beta_2 FD^2 + \beta_3 X_t + e_t$$

Where Y_t represents the growth variable, which in most cases is GDP per capita, GDP per capita growth or their logs. β_0 represents the constant and e_t the error term. FD represents a financial development indicator, whose relationship with economic growth will be indicated by β_1 and β_2 while X_t, stands for control variables.

FD^2 has been introduced in more recent literature where it is argued that the relationship between financial development and economic growth is better represented with a quadratic function since it is non-linear. β_1 & β_2 then answer our main question of whether the relationship is causal, whether it is parabolic and whether it is positive.

4.2. Financial development variables

Many authors in earlier studies primarily used bank credit to the private sector and monetary aggregates (M2, M3) as indicators of Financial Development because of data availability; see Calderon & Liu (2002), Apergis et al (2007) and Arcand et al (2012), among others. M3 is described as a better measure than M2 because it includes a broader range of institutions (Apergis et al). Caldreon & Liu, Arcand et al, Khan, and Senhadji (2000) argue that credit to the private sector is a better measure of financial depth than monetary aggregates because it presents the actual funds that go into the private sector which are more efficiently used for investment. Monetary aggregates really just show the ability of the financial system to facilitate transactions rather than channel funds from savers to borrowers and that an economy can have low financial development but have high liquid liabilities to GDP.

Another indicator that has been used in literature for financial development depth is financial system value added which apparently has stronger results that support the hypothesis of financial development positively affecting growth (Levine, 1997). Deposit money bank assets divided by deposit money bank assets plus central bank assets (Moral-Benito & Allison, 2018) and deposit bank liabilities divided by GDP have also been used to represent financial development (Okello et al, 2015).

However, most of the above indicators only measure one aspect of financial development; depth and only that of financial intermediaries. Other authors have used measures that include the financial markets' development because of their great importance for the developed economies' financial systems and their rising importance in emerging and developing countries. Measures of other forms of financial development, i.e financial access and financial efficiency, have also been used in more recent studies.

Financial market measures for depth commonly used include stock market capitalization to GDP ratio or stock market value traded to GDP (Levine, 1997; Khan

and Senhadji, 2000; Levine and Zervos, 1996). This data is mostly available for advanced economies because of the uncommonness of the stock markets in developing countries.

Some studies have used measures that have combined both financial intermediary and financial market indicators and/or combined indicators representing financial system access, depth, efficiency and development. For instance, Khan and Senhadji (2000) have added stock capitalization, credit to private sector and public market bond capitalization to GDP ratio to cover both financial intermediaries and financial markets in one of their indicators. Hossain et al (2017), in an attempt to use all the dimensions of financial development, condensed six indicators into two factors using factor analysis, one for the efficiency/Accessibility dimension and the other for depth/stability. The original indicators were credit to the private sector (depth), market capitalization (depth), listed companies per million (access), interest rate spread (efficiency), stock market turnover ratio (efficiency), and Bank non-performing loans (stability).

Svirydzenka (2016) recently introduced a financial development measure that incorporates financial access, depth and efficiency for both financial markets and financial intermediaries in one index. The main reason is that the traditional indicators do not represent the vastness and dynamics of financial development. She uses an exhaustive set of 20 variables which she standardizes and aggregates into a few subindices by weighting them using principal component analysis and then finally aggregating them into one index, the financial development index. For financial institution depth, some indicators that she has used that are not common to literature are sizes of the pension fund, mutual fund and Insurance premiums. Arcand et al (2012) also incorporated the credit by non-bank institutions in their credit to private sector measures due to their general increasing importance in financial systems. For financial institution access, whose data was limited to banking access, Svirydzenka used a bank branch and ATM per 100,000 adults. Financial institution efficiency was represented by six indicators that covered operating, profitability and efficiency in intermediating savings to investment.

For financial market measures, five indicators for stock and debt securities sizes were used for depth while percentage of market capitalization out of the top 10 companies

and number of debt issuers were used for market access whereas the stock turnover ratio was used for efficiency.[15]

4.3. Control variables.

In order to avoid omitted variable bias, other explanatory variables that have been proven to have relationship with economic growth and financial development are included in the finance growth analysis model. For instance, the majority of studies have used initial GDP per capita to control for catch-up growth which means that lower income countries will have faster growths than higher income countries, according to the conditional convergence theory (Khan & Senhadji, 2000; Apergis et al, 2007). Another common control is the openness to trade which is believed to facilitate growth through quality imports, wider markets for exports, transfer of technology and know-how, among others (Billmeier & Nannicini, 2007; Apergis et al, 2007).

Government expenditure is also used as a control variable. It is argued that government spending's effect on growth depends on the type of spending. It however, causes a crowding-out effect on the economy's resources and it will use the resources less efficiently than the private sector and hence slow growth (Apergis et al, 2007). Diamond (1989) contends that government spending, on the aggregate, does not have an effect in the long run for developing countries including that of capital infrastructure expenditure which he even finds to be negative. He however finds social capital expenditure on health, housing and welfare and current expenditure on directly productive sectors to be positively linked to growth.

Most studies have also included proxy measures for capital stock and labor levels as they are fundamental drivers of growth according to the Solow growth model. The quality of labor i.e., human capital, has been measured using indicators such as average years of schooling, initial levels of human capital, average years of secondary schooling el ac. Indicators used for capital stock include initial physical capital, gross capital formation, output share of investment etc. (Moral-Benito and Allison, 2018; Beck, 2008; Apergis et al, 2007; Adu et al, 2013).

[15] See Annex 1 for more detailed explanation of the FD index construction

4.4. Data and variable specification

In this study, we use time series annual data from 1980 to 2018 for all variables.

To measure financial development, we use the financial development index (FD index-fd), extracted from the IMF database, as the main indicator as it represents many dimensions of financial development. We then analyze which particular dimension drives the relationship with economic growth in Rwanda's case using the FD index's subindices: financial institution index (fi), financial markets index (fm), financial institution depth (fid), financial institution access (fia) and financial institution efficiency (fie). We finally then compare the results with traditional indicators used in previous studies in Rwanda, particularly those used by Kigabo et al (2015) and Okello et al (2015) i.e. banking system deposit liability to GDP ratio(systdeposit), and credit to private sector to GDP ratio(priv_cred) and M3 to GDP ratio(M3). We extract data of the traditional indicators from the Global Financial Development Database in the World Bank Group.

To measure economic growth, we use log real GDP per capita growth (gdpna_gr). We chose per capita growth over real GDP due to its better indication of the citizen's welfare development than the overall GDP. Based on availability of data, we use the following controls; log population growth to represent labor (pop_gr), capital formation to GDP ratio to represent capital stock (capital), trade openness to GDP ratio (trade) and government consumption to GDP (gov_cons). Both economic growth and control variables' data are extracted from the Penn World Tables which uses 2011 constant values (Feenstra et al, 2015).

We do not include any quadratic functions as part of the explanatory variables for the financial development as Rwanda's financial development is still quite far from the levels suggested by studies that start becoming harmful to growth e.g. those previously mentioned in this study. For instance, Rwanda's credit to private sector ratio to GDP in the last five years in the data was about 20 percent while the turning point for this indicator has been said to be about 80 to 100 percent. The FD index indicator in the same period was 0.10, yet the study by Sahay et al (2015) finds the turning point to be between 0.4 and 0.7, across countries from all income-levels.

4.5. Methodology

This study has adopted the modified Granger causality test suggested by Toda and Yamamoto (TY) (1995) that uses an augmented Vector Autoregression model. This causality test is applied on the variable levels which reduces bias that would come with wrongly identifying their respective levels of integration and can be used on analyses of data which have different orders of integration, which is not the case for the Granger causality test. Another advantage over the Granger causality test is that it does not depend on pre-testing for cointegration which can be tedious and a cause for another bias when a wrong cointegrating relationships are identified. Finally, the F-statistic used in testing granger causality is not appropriate when the series are integrated or cointegrated as the test will not have standard distribution.(Muhammed et al, 2014; Umar and Bakar, 2015; Dristsaki, 2017).

The first step of our procedure is to assess whether the variables are stationary i.e., their variances and means are not dependent on time. This is assessed using graphs for visual analysis and the Augmented Dicky Fuller test where the null hypothesis is the presence of a unit root i.e. it is non-stationary. From this step, we shall note the maximum order of integration among the variables (i^{max}), which will be used in feeding the augmented VAR model.

The next step will be to estimate a VAR and select its optimal lag length (l). The selection will be aided by the Akaike Selection Criterion (AIC) and judgment of the lag that maintains the model's stability. We then estimate a ($l + i^{max}$)th order(k) VAR model, which is the augmented version, with the last lagged vectors being introduced as exogenous variables. The Wald procedure is then used to test the augmented VAR for causality. This Wald statistic will be valid as long as the order of the integration will not exceed the lag length of the VAR model. This will be applied to all financial development indicators.

The augmented VAR model for which the TY Granger test will be applied on is denoted as follows;

$$\left(gdpna_{gr}\ FD\ indicator\ capital\ \ pop_{gr}\ trade\ \ gov_{cons}\ \ \right) = (a_1\ a_2\ a_3\ \ a_4\ a_5\ \ a_6\ ) +$$

$$\left(\delta_{11,1..l}, \delta_{12,1..l}, \delta_{13,1..l}, \delta_{14,1..l}, \delta_{15,1..l}\delta_{16,1..l}\ \ \delta_{21,1..l}, \delta_{22,1..l}, \delta_{23,1..l}, \delta_{24,1..l}, \delta_{25,1..l}\delta_{26,1..l}\ \ \delta_{31,1..l}, \delta_{32,1..l}, \delta_{33,1..l}, \delta_{34,1..l}, \delta\right.$$

$$\left(\delta_{11,k}, \delta_{12,k}, \delta_{13,k}, \delta_{14,k}\delta_{15,k}\delta_{16,k}\ \ \delta_{21,k}, \delta_{22,k}, \delta_{23,k}, \delta_{24,k}\delta_{25,k}\delta_{26,k}\ \ \delta_{31,k}, \delta_{32,k}, \delta_{33,k}, \delta_{34,k}\delta_{35,k}\delta_{36,k}\ \ \delta_{41,k}, \delta_{42,k}, \delta_{4}\right.$$

$$+(e_1\ e_2\ e_3\ \ e_4\ e_5\ \ e_6\ )$$

An example of the results we would be interested for one of the financial development indicators, the fd index series, is as follows.

$$gdpna_{gr_t} = a_0 + \sum_{n=3}^{l} \delta_{1\ldots3} gdpna_{gr_{t-1\ldots t-3}} + \sum_{n=3}^{l} \phi_{1\ldots3} fd_{t-1\ldots t-3} + \sum_{n=3}^{l} \alpha_{1\ldots3} X_{t-1\ldots t-3} + \sum_{k=l+1=4}^{l+i^{max}} \delta_4 gdpna_{gr_{t-4}} + \sum_{k=l+1=4}^{l+i^{max}} \phi_4 fd_{t-4} + \sum_{k=l+1=4}^{l+i^{max}} \alpha_4 X_{t-4} + e_t$$

where $gdpna_{gr_t}$,fd_t,X_t, are the gdp per capita growth, financial development index and control variables respectively while the coefficients δ , ϕ and α denote the relationship of their lags with the dependent variable. The Granger Causality test is then run to determine the direction of causality, if any.

4. EMPIRICAL RESULTS

5.1 Unit root test results

The first step's results of assessing the stationarity in levels are presented in figures 3 &4. Graphically, the gdpna_gr which is our main dependent variable and pop_gr seem to be stationary. The other variables seem to have drifts or trends and therefore are potentially non-stationary.

Figure 3: Graphical rep. of variables

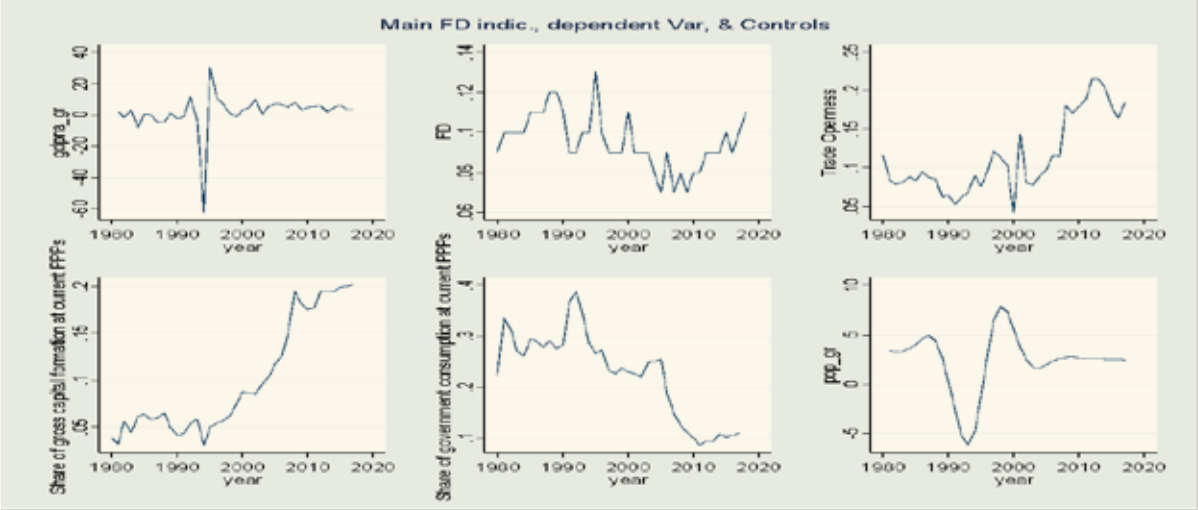
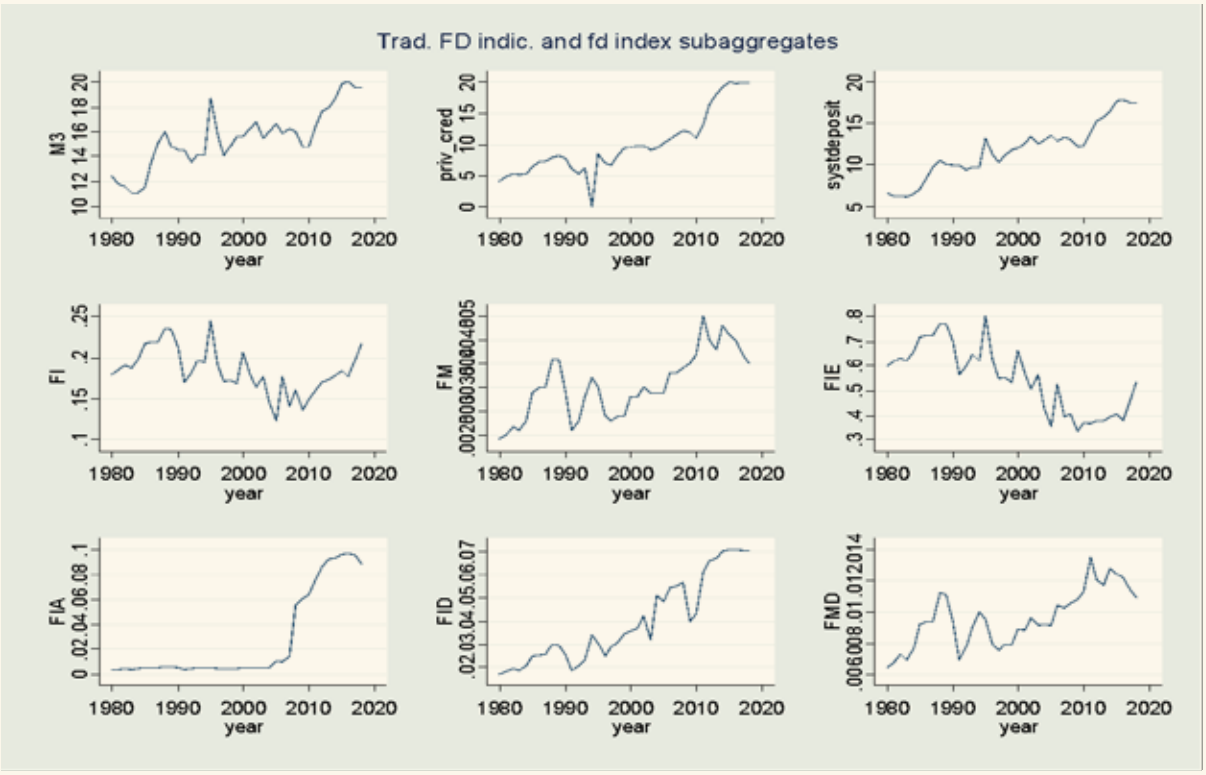


Figure 4: Graphical rep of variables



Source: Author's Calculations

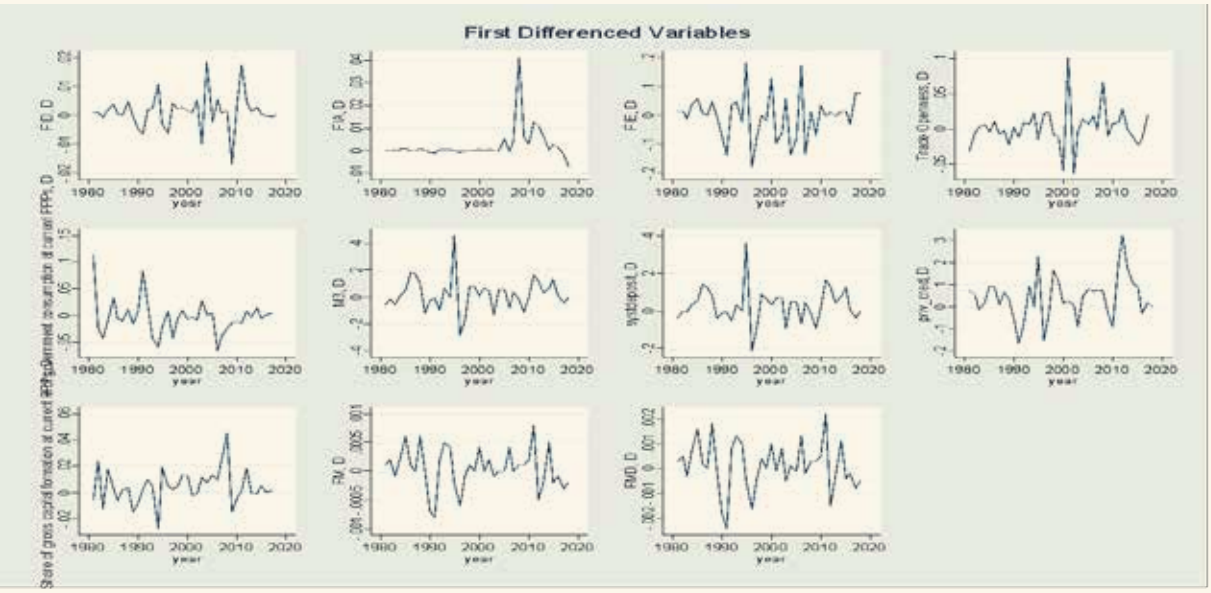
Using the Augmented Dicky Fuller Test, the unit root tests prove indeed that the gdpna_gr and pop-gr are stationary at levels i.e I(0) in addition to the fd index and fi subindex levels. The rest of the variables become stationary after the first differencing of the levels i.e I(1). This is then the highest order of integration,i^{max}(Table 1). The graphs of the differenced variables also reflect the same (figure 5)

Table 2: Unit root test results

ADF			
Variable	Level	First Difference	Order of Integration
	Test_Statistic		
FD	-1.984**	-	I(0)
fi	-1.913**	-	I(0)
fm	-3.139	-5.347***	I(1)
pop_gr	-8.526***	-	I(0)
gdpna_gr	-5.297***	-	I(0)
fmd	-3.099	-5.135***	I(1)
fid	-3.005	-5.776***	I(1)
fia	-1.395	-3.655***	I(1)
fie	-2.658	-5.654***	I(1)
trade	-2.227	-5.294***	I(1)
gov-cons	-1.226	-4.972***	I(1)
capital	0.069	-4.568***	I(1)
M3	-3.270	-5.315***	I(1)
systdeposit	-3.000	-5.106***	I(1)
priv_cred	-1.829	-4.460***	I(1)
*/**/*** indicates rejecting null hypothesis of unit root at 10%/5%/1% sig. levels respectively			

Source: Author's Calculations

Figure 5: Graphical view of differenced variables

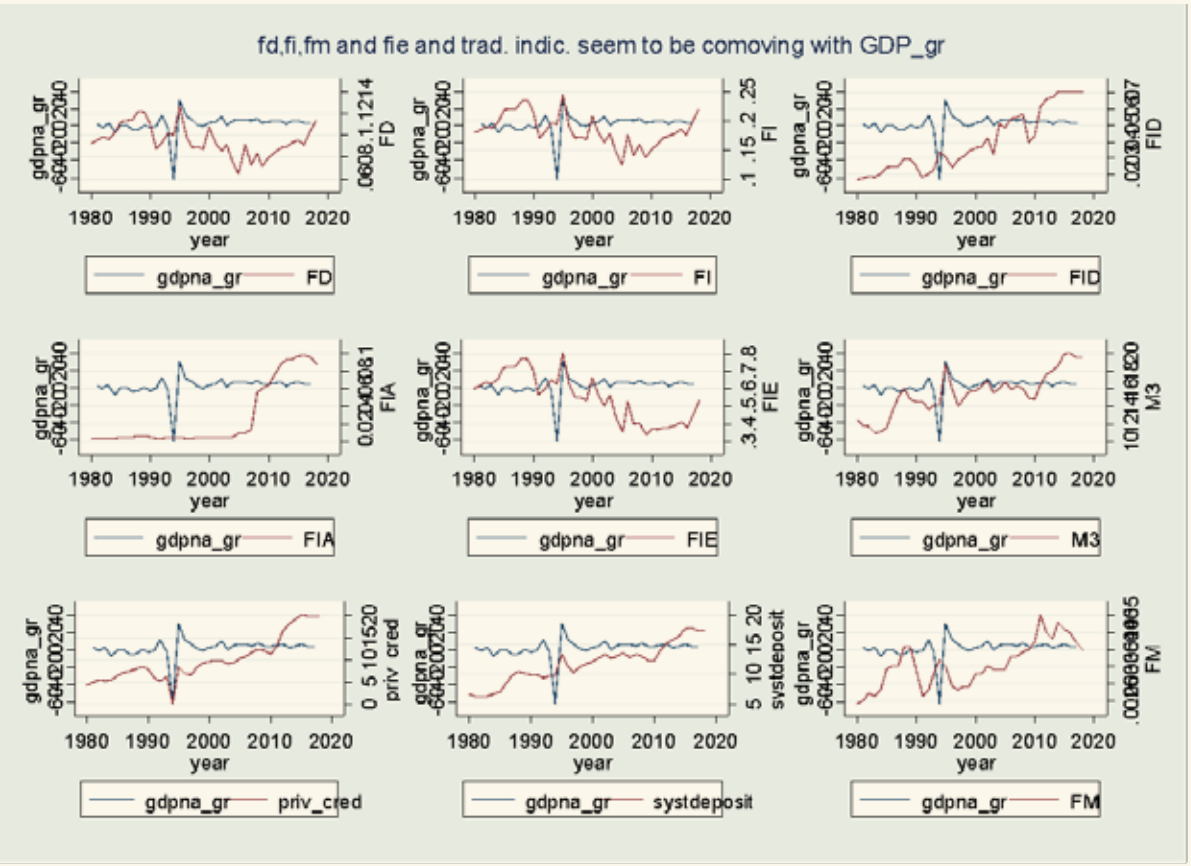


Source: Author's Calculations

5.2 Granger causality test results.

The relationship between the financial development indicators and economic growth can also be visually assessed using graphs. From figure 1, there is some degree of co-movement between the GDP per capita growth and the FD, FI, FM and FIE indices as well as the traditional financial development indicators.

Figure 6: Visual analysis of finance-growth correlation



Source: Author's Calculations

We then compare our graphical analysis with the TY Granger causality results. When using the fd index as the financial development indicator, table 3 shows that the null hypothesis that fd index does not granger-cause growth cannot be rejected meaning financial development does not granger-cause growth. The null hypothesis for non-causality of capital and trade openness on growth cannot be rejected as well[16].

On the other hand, the null of non-causality from economic growth to financial development is rejected at the 1% significance level. This proves a unidirectional causal relationship between finance and growth following the demand following theory.

[16] The results show that GDP growth instead causes capital growth at 1% sig. level. As for trade, the null hypothesis of non-causality in either direction cannot be rejected.

We go on and further analyze which part of Rwanda's financial system drives this growth to finance relationships. Table 4 (a) shows the results from granger causality tests where the financial development indicator is either the financial institution sub-index or the financial market sub-index. We find that the financial institutions(fi) mostly drive the growth to finance relationship as the non-causation from growth to finance cannot be rejected but that from finance to growth is rejected. As for the financial markets(fi) and growth, they have a bi-directional relationship with each other.

We then investigate which of the three subindices of the fi and fm index drive their relationships (Table 4 b). For the fi, fie, fid and fia are used in the same VAR model because of their high correlation (see Annex 2). We find that fie has a two-way causality relationship with growth. Fia on the other hand granger causes GDP while GDP granger causes fid.

For the fm subindex, the trend is identical to the fmd subindex because both the fma, fme have values of 0 for all years therefore its results are really driven by the performance of the fmd. From this, it can be concluded that the relationship of the aggregate fd index and gdpna_gr direction is mostly driven by fid and partly by fie and fmd.

Table 3: TY granger causality results for the FD index (Chi square statistics)

Y var \ X var	gdp_gr	fd	capital	trade	gov_cons	pop_gr	All
gdpna_gr	_	**2.179**	**4.565**	**7.257**	**13.041***	**18.556***	**113.04***
	_	**[0.536]**	**[0.207]**	**[0.064]**	**[0.005]**	**[0.000]**	**[0.000]**
fd	**8.648***	_	6.472	51.613*	52.889*	23.307*	142.15*
	[0.034]	_	[0.091]	[0.000]	[0.000]	[0.000]	[0.000]
capital	**11.835***	29.654*	_	7.700*	9.348*	9.534*	64.479*
	[0.008]	[0.000]	_	[0.053]	[0.025]	[0.023]	[0.000]
trade	**3.526**	7.363	11.265*	_	54.936*	31.786*	140.8*
	[0.317]	[0.061]	[0.010]	_	[0.000]	[0.000]	[0.000]
gov_cons	**11.157***	15.181*	38.694*	8.561	_	36.141*	107.76*
	[0.011]	[0.002]	[0.000]	[0.036]	_	[0.000]	[0.000]
pop_gr	**47.777***	41.578*	21.223*	48.057*	28.872*	_	276.84*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	_	[0.000]

Ho=X does not granger cause Y, P-values are in brackets

** indicates rejecting null hypothesis of granger non-causality at 5%/1% sig. levels*

Optimal Lag=3 lags

Table 4: TY Granger causality results for the FD sub aggregates (Chi-square statistics)

a) Y var \ X var	gdp_na	fi	fm
gdp_na	-	**2.003**	**58.227***
	-	**[0.572]**	**[0.000]**
fi	**8.703***	-	-
	[0.0134]	-	-
fm	**24.973***	-	-
	[0.000]	-	-

Ho=X does not granger cause Y, P-values are in brackets

** indicates rejecting null hypothesis of granger non-causality at 5%/1% sig. levels*

Optimal Lag=3 lags

b) Y var \ X var	gdp_na	fid	fia	fie	fmd
gdp_na	-	**3.386**	**19.689***	**36.478***	**53.593***
	-	**[0.184]**	**[0.000]**	**[0.000]**	**[0.000]**
fid	**10.474***	-	24.257*	1.270	-
	[0.005]	-	[0.000]	[0.530)	-
fia	**4.632**	5.201	-	54.216*	-
	[0.099]	[0.074]	-	[0.000]	-
fie	**58.399***	11.469*	6.7276*	-	-
	[0.000]	[0.003]	[0.035]	-	-
fmd	**32.906***	-	-	-	-
	[0.000]	-	-	-	-

Ho=X does not granger cause Y, P-values are in brackets
** indicates rejecting null hypothesis of granger non-causality at 5%/1% sig. levels*

Optimal Lag(FI indices)=2 lags, Fmd=3lags

Source: Author's Calculations

Finally, as can be seen in table 5, the TY Granger test results of the traditional indicators are pointing to a two-way causality between financial development and growth. This is partly in line with the previous studies in Rwanda by Kigabo et al (2015), Okello et al (2015), Karangwa and Gichondo (2016) and Nyalihama and Kamanzi (2019).

Table 5: TY Granger causality results, Trad. indicators (Chi-square statistics)

Ho \ Var	priv_cred	M3	Systdeposit
Fin. dev does not granger cause GDP gr.	**42.154*** [0.000]	**23.483*** [0.000]	**16.611*** [0.001]
GDP_gr does not granger cause Fin. Dev	**17.298*** [0.001]	**58.905*** [0.000]	**67.999*** [0.000]

** indicates rejecting null hypothesis of granger non-causality at 5%/1% sig. Levels*
Optimal Lag= 3 lags, , P-values are in brackets

Source: Author's Calculations

5. CONCLUSION AND POLICY RECOMMENDATIONS.

This study reviews different literature with differing schools of thought regarding the finance and growth link; the supply leading hypothesis, the demand-following hypothesis, the bidirectional- causation hypothesis or the hypothesis that there is no link between the two. An empirical analysis is then made on Rwanda to find out which finance-growth nexus hypothesis is applicable to Rwanda using the Toda and Yamamoto Granger causality test for the years between 1980-2018. It uses the financial development index as the main measure for financial development. Due to the fd index encompassing different dimensions of financial development such as access, depth and efficiency for both financial institutions and financial markets using 20 different indicators. It is a better measure than traditional indicators that have been used in previous studies that would mostly only represent the depth dimension such as bank credit and money aggregates (M2/M3). Results show that Rwanda's finance-growth association is explained by the demand-following theory whereby financial sector services and infrastructure expand or get innovated as the economy grows due to more demand for financial services.

Further analysis shows that this relationship is mostly driven by the financial institutions' relationship with growth, which also supports the demand-following theory. Finding out why the financial institution index particularly that of depth, does not follow the supply-leading hypothesis is an area for further analysis. The policy implication for this is that more efforts should be directed in finding non-finance factors that boost economic growth and finding out ways to make the financial institutions become more beneficial to the overall growth process, since they make a bigger part of Rwanda's financial system as the usage financial markets to finance the private sector is relatively still in its infantry levels.

Another result from the study is a bidirectional relationship between financial markets and growth. This implies the growth of the economy will lead to more demand for the financial markets' services and the financial markets growth will lead to even further growth. Since Rwanda's financial market is still small and has a big room of growth, the government should continue in its efforts to facilitate firms to list their shares in the Rwanda Stock Exchange and establish financing by debt securities such as corporate bonds. The government so far has already set some incentives to encourage participation in the financial markets such as zero tax for venture capital firms that are registered with the Capital market Authority (CMA) for the first 5 years, exemption from capital gains for secondary market transactions for listed companies. There is also a plan to establish a corporate bond market, among others (Kigabo, 2021).

Among the control variables, we found a bi-directional causal relationship between growth and government consumptions and population growth. These are therefore some of the non-financial factors that can be leveraged on to boost Rwanda's economic growth. For example, government consumption could be boosted by its borrowing through bonds in the financial markets. The government bonds still have room for growth, because according to Kigabo(2021), the demand for bonds is very high. The oversubscription to listed bonds was 180.3% between 2014 and 2019.

Kigabo (2021) highlights the challenges that are limiting the participation in the financial market to include lack of knowledge of these non-intermediary channels of financing or fear of losing control of their companies(in the case of selling shares). Therefore, for this market to grow, more awareness should be spread among the population on the same. The result of this would be further growth of the economy

which in turn would lead to development of the financial institutions which depend on it and financial markets which have a chicken-egg relationship with growth.

Results from the traditional indicators (M3, credit to private sector and system deposit liabilities) display a bi-directional relationship between finance and growth. This means that policies that boost both growth and these indicators should be adopted concurrently in order for both to grow.

REFERENCES

Acaravci, S. K., Ozturk, I. & Acaravci, A., 2009. Financial Development and Economic Growth: Literature survey and Empricial Evidence from Subsaharan African countries.

Adu, G., Marbuah, G. & Mensah, J. T., 2013. Financial development and economic growth in Ghana: Does the measure of financial development matter? *Review of Development Finance,* pp. 192-203.

Ang, J. B., 2008. A survey of Recent Developments in the Literature of Finance and Growth. *A journal of economic surveys, Volume 22,* p. 536-576.

Apergis, N., Fillipidis, I. & Economidou, C., 2007. Financial Deepening and Economic Growth Linkages: A Panel Data Analysis. *Review of World Economics: Volume 143,* p. 179-198.

Arcand, J.-L., Berkes, E. & Panizza, U., 2012. Too much finance?. *IMF Working Paper.*

Beck, T., 2008. *The Econometrics of Finance and Growth,* s.l.: The World Bank.

Billmeier, A. & Nannicini, T., 2007. *Trade Openness and Growth: Pursuing Empirical Glasnost,* s.l.: IMF.

Calderon, C. & Liu, L., 2002. The direction of causality between financial development and economic growth. *Journal of Development Economics,* pp. 321-334.

Ceccheti, S. G. & Kharroubi, E., 2015. *Why does financial sector growth crowd out real economic growth*?. BIS Working Papers.

Cecchetti, S. G. & Kharroubi, E., 2012. *Reassessing the impact of finance on growth*. Bank for International Settlements.

Dritsaki, C., 2017. Toda-Yamamoto Causality Test between Infaltion and Nominal Interest Rates: Evidence from Three Countries of Europe. *International Journal of Economics and Financial Issues,* Issue 2146-4138, pp. 120-129.

Effiong, E., 2015. Financial Development, Institutions and Economic Growth: Evidence from Sub-Saharan Africa. *MPRA.*

Feenstra, R. C., Inklaar, R. & Timmer, M. P., 2015. *The Next Generation of the Penn World Table,* s.l.: Groningen Growth and Development Centre.

Finscope, 2020. *Finscope: Financial Inclusion ,* Kigali: Access to Finance Rwanda.

Gisanabagabo, S. & Ngalawa, H., 2017. Financail Intermediation and Economic Growth in Rwanda.. *Journal of Economic and Financial Services,* pp. 253-273.

Griffith-Jones, S., Karwowski, E. & Dafe, F., 2016. A financial sector to support development in low-income countries. In: *Achieving Financial Stability and Growth in Africa.* London: Routledge.

Haan, J. d., Oosterloo, S. & Schoenmaker, D., 2015. *Financial Markets and Institutions.* Cambridge: Cambridge University Press.

Hashim, Y. A., 2011. Financial Development and Economic Growth in Nigeria. *International Journal of Management Science,* pp. 47-55.

Hossain, A., Biswas, S., Hossain, N. & Poddar, A., 2016. Financial Sector Development and Economic Growth in Bangladesh: A Factor Analysis Based Causality Approach. *International Journal of Economics and Finance,* pp. 229-238.

Karangwa, M. & Gichondo, A., 2016. An assessment of the sectoral distribution of commercial bank credit on economic growth in Rwanda. *National Bank of Rwanda Economic Review,* Volume 8, pp. 55-87.

Khan, M. S. & Senhadji, A. S., 2000. Financial Development and Economic Growth: An overview. *IMF Working Paper.*

Kigabo, T., Okello, J. & Mutuyimana, J., 2015. Financial development, monetary policy and economic growth in Rwanda. *BNR Economic Review,* pp. 79-100.

Kigabo, T. R., 2021. *Monetary Policy in Rwanda.* s.l.:Springer Singapore.

Levine, R., 1997. Financial Development and Economic Growth: Views and Agenda. *Journal of Economic Literature,* pp. 688-726.

Levine, R. & Zervos, S., 1996. Stock Markets, Banks and Economic Growth. *Policy Research Working Paper, Word Bank.*

Mohammed, M. B. H., Safi, S. & Farhat, A., 2014. Testing the causal relationship between Exports and Imports using a Toda-Yomamoto approach: Evidence from Tunisia. *Economics &Strategic Management of Business Process(ESMB),* Volume 2, pp. 75-80.

Moral-Benito, E. & Allison, P. D., 2018. *Dynamic Panel Data Modeling using Maximum Likelihood: An alternative to Arellano-Bond*.* s.l.:University of Notre Dame.

NBR, 2020. *Monetary Policy and Financial Stability Report,* Kigali: NBR.

Noor, S. I. M., Rambeli, N. & Ramli, 2017. Financial Growth and Economic Development: Evidence from Malaysia. *International Journal of Academic Research in Business and Social Sciences.*

Nor, N. H. H., 2015. *Financial Development and Economic Growth: A survey of Literature.* s.l., e-ISBN.

Annex 1: The FD Index construction

As explained by Svirydzenka (2016) The FD index was constructed using a set of 20 indicators that were first normalized between 0 and 1, aggregated into subindices that captured financial institutions' and markets' depth, access and efficiency and then aggregated into the final financial development index. The variables were selected based on their availability in the majority of the countries across a long time period. Data from a total of 189 countries is used. The indicators are listed in the table below.

FINANCIAL INSTITUTIONS	
• Depth	Private sector credit to GDP, Pension fund assets to GDP, Mutual Fund Assets to GDP, Insurance Premiums, life and non-life to GDP.
• Access	Bank Branches per 100,000 adults, ATMs per 100,000 adults.
• Efficiency	Net interest margin, Lending-deposit spread, Non-interest income to total income, Overhead costs to total assets, return on assets, Return on equity
FINANCIAL MARKETS	
• Depth	Stock market capitalization to GDP, Stocks traded to GDP, International debt securities to GDP, Total debt securities of financial corporations to GDP, Total debt securities of non-financial corporations to GDP.
• Access	Percent of market capitalization outside of top 10 largest companies, Total number of issuers of debt (domestic and external, nonfinancial and financial corporations)
• Efficiency	Stock market turnover ratio (stocks traded to capitalization)

Source: Svirydzenka (2016)

These indicators were not free of limitations such as missing data especially for low income developing countries. For example, 32 percent of the sample had missing markets. The main approach used to deal with the data was splicing which solved for changes in the indices caused by introduction of new series in later periods.

The indicators were then winsorized at the 5th and 95th percentiles which helped avoid a scenario where extreme values of the indicator would cause other values to concentrate around 0 or 1 once normalized.

After winsorizing, the indicators are then normalized to values between 0 and 1 using the formulas below. $I_x = \frac{x - x_{min}}{x_{max} - x_{min}}$ where x is the raw data, and I_x the normalized data series. x_{min} is the global minimum across countries and time and x_{max} is the global maximum. The value 1 is therefore equal to the highest value of data across time and countries while 0 is given to the lowest.

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• Efficiency	Stock market turnover ratio (stocks traded to capitalization)

Source: Svirydzenka (2016)

These indicators were not free of limitations such as missing data especially for low income developing countries. For example, 32 percent of the sample had missing markets. The main approach used to deal with the data was splicing which solved for changes in the indices caused by introduction of new series in later periods.

The indicators were then winsorized at the 5th and 95th percentiles which helped avoid a scenario where extreme values of the indicator would cause other values to concentrate around 0 or 1 once normalized.

After winsorizing, the indicators are then normalized to values between 0 and 1 using the formulas below. $I_x = \frac{x - x_{min}}{x_{max} - x_{min}}$ where x is the raw data, and I_x the normalized data series. x_{min} is the global minimum across countries and time and x_{max} is the global maximum. The value 1 is therefore equal to the highest value of data across time and countries while 0 is given to the lowest.

For indicators where a higher value points to worse performance, such as 'net interest margin, lending-deposits spread, noninterest income to total income, and overhead costs to total assets', this formula is applied; $I_x = 1 - \frac{x - x_{min}}{x_{max} - x_{min}}$ so that a higher value would indicate better performance.

The 20 now normalized indicators were aggregated into 6 subindices; financial institution depth (FID), financial institution access (FIA), financial institution efficiency (FIE), financial market depth (FMD), financial market access (FMA) and financial market efficiency (FME). They are aggregated through a weighted linear average where the weights are attained through principal component analysis.

The 6 subindices are then normalized to values between 0 and 1 using the first normalization formula and aggregated further into the Financial Institution Index (FI) and Financial Market Index (FM). These two indices then undergo the same procedure of normalization and aggregation to obtain the final Financial Development Index (FD).

Annex 2: The fie, fia and fid correlation

```
. pwcorr fie fid fia, star(0.05) sig
```

	fie	fid	fia
fie	1.0000		
fid	-0.7397*	1.0000	
	0.0000		
fia	-0.6825*	0.8611*	1.0000
	0.0000	0.0000	