Financial Intermediation and Economic Growth: Evidence from Rwanda

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Abstract

The relationship between financial intermediation and economic growth has been under investigation for decades. Some studies have been conducted using panels of countries with or without similar characteristics while others have been carried out on individual countries. In less-developed countries, the evidence about the link between financial intermediation and economic growth is particularly deficient. This study attempts to empirically investigate the possible cointegration and causal link between financial intermediation and economic growth in Rwanda, using quarterly data spanning from 1996Q1 to 2010Q4. A Structural Vector Autoregressive model is used to analyse the short-run dynamics between variables of interest. Findings of the study show evidence of a cointegrating relationship between financial intermediation and economic growth in the country. It is further observed that a shock to domestic private sector credit accounts for the largest proportion of fluctuations in real output growth, while the shock to potential liquidity comes second. This supports the supply-leading hypothesis in the intermediation link between financial sector development and economic growth in Rwanda, which suggests that the country can achieve significant economic growth if it reinforces incentives to attract businesses that can easily make use of the present financial services.

Keywords

Financial intermediation, Economic growth, Cointegration, Structural VAR, Rwanda.

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1. INTRODUCTION

The interaction between financial sector development and economic growth has attracted considerable attention in the economic growth literature. An extensive body of studies has reported a significant role of financial sector development on economic growth (King and Levine, 1993; Levine, 1997; Levine, Loayza et al., 2000). In a recent survey of 67 empirical studies on this relationship, Havránek et al. (2013) find that 48% of the surveyed studies found a positive and statistically significant relationship between financial sector development and economic growth, while 33% show that the relationship is positive but not significant. It is generally argued that financial sector development leads to economic growth by easing the funding concerns of investors (Schumpeter, 1934; Benhabib and Spiegel, 2000).

However, there is no agreement on whether or not investors increase borrowing in response to financial sector development. Some studies argue that financial sector development improves the availability of funds through a well-functioning financial system, which leads to an increase in borrowing (Khan and Semlali, 2000; Levine et al., 2000; Almeida and Wolfenzon, 2005; Apergis et al., 2007). Others maintain that investors' decision to borrow is a function of the health of the economy, and not necessarily financial sector development (Gurley and Shaw, 1955; De Gregorio and Guidotti, 1995; Odhiambo, 2008). The secondary views, referred to as the interdependent approach, suggest that the relationship between financial sector development and borrowing may be bi-directional (Arestis and Demetriades, 1997; Odhiambo, 2005), unimportant or absent (Demetriades and Andrianova ,2004; Dufrénot, Mignon et al., 2008; Muchai, 2013). There is, however, no study that we are aware of that has investigated the directional influence in borrowing and its links to economic growth in Rwanda. This study sets out to address this gap.

Rwanda is one of the low-income countries that have been putting in place measures to develop the financial sector, with the ultimate objective of achieving sustainable economic growth via private sector development. In its Economic Development and Poverty Reduction Strategy, second generation (EDPRS2), the government of Rwanda announced a targeted annual economic growth rate of 11.5%, in order to reach the Vision 2020 of making Rwanda a middle-income country, with an average per capita GDP of US$1,240 by the year 2020. This would involve a reduction of the poverty rate by at least 24%, the creation of 1.8 million new off-farm jobs, an increase in urbanisation by 35%, and an increase in export growth by 28%, with the private sector taking a dominant share of investment between 2012 and 2020 (Ministry of Finance and Economic Planning, 2013). As Rwanda considers the private sector to be a driver of its economic growth, several questions with profound policy implications ought to be asked. Will efforts to develop the financial sector lead to sustainable economic growth? What is the mechanism that relates financial sector development to economic growth? Is it the availability of finance that attracts investors or simply the anticipated future economic growth that creates demand for financial services? Put differently, what kind of finance-growth relationship exists in the Rwandan context? This study will attempt to answer these and other questions. It concentrates on indirect finance, as the financial capital market in Rwanda is underdeveloped and individual non-bank lenders do not have adequate financial resources for the envisaged investment.

Existing empirical studies have used a range of variables for financial development, ranging from monetary aggregates (M1, M2, and M3 as percentages of GDP) to domestic credit as a percentage of GDP and credit to the private sector as a percentage of GDP, along with some control variables such as human capital, geography and population. Some of these studies were conducted using panels of countries with the same or different characteristics, while others have been conducted

on individual countries. As highlighted earlier, the existing evidence suggests that there is no consensus on the nature of the relationship between financial sector development and economic growth. As few studies have been conducted in less-developed countries (LDCs), the evidence about the nature of the relationship is even more deficient, particularly at a country level. Examples include the studies on Sierra Leone (Kargboll and Adamu, 2009), Uganda (Kilimani, 2007), and Tanzania (Odhiambo, 2005), among others. This calls for empirical research at country level, given the policy implication benefits that LDCs would derive from these findings. Rwanda is a case in point with regard to the paucity of the evidence about the relationship in LDCs. A review of the literature to date shows that no published research on the relationship between finance and economic growth has been conducted in Rwanda. This study is expected to pioneer such research in this area.

The study employs a structural vector autoregressive model to investigate links between the financial sector and economic growth in Rwanda for the period 1996 to 2010. The main argument is that a thorough understanding of the cause-and-effect relationship between financial intermediaries and economic growth in Rwanda is essential, especially against the generally held view that the financial sector is a catalyst for private sector development and hence economic growth in the country. The findings of the study will contribute to investment decisions and policy making, in addition to making a contribution to the body of knowledge.

The study findings suggest that domestic private sector credit shocks contribute the most to variations in the rate of economic growth, while the shock to potential liquidity comes second. This supports the supply-leading hypothesis in the intermediation link between the financial sector and economic growth in Rwanda.

The rest of the paper is organised as follows: section 2 reviews the literature on links between finance and economic growth; section 3 presents the methodology; and section 4 discusses the study results, while section 5 concludes the paper.

2. INTERACTION BETWEEN FINANCIAL INTERMEDIATION AND ECONOMIC GROWTH

Financial intermediaries offer a wide range of financial services, namely: payment services, deposit and lending services, investments, pensions and insurance services, E-banking, financial advisory services, safe-keeping facilities and foreign exchange services (Casu, Girardone et al., 2006). They help in mobilising short- and long-term savings and transforming them into long- or short-term loans with the aim of making profits on the interest differential as well as fees. These institutions are specialised in mobilising savings, evaluating projects and their risks, and monitoring borrowers-cum-investors, so that by containing asymmetric information, transaction costs can be reduced, leading to efficient investments that yield a positive return to the economy (Becsi and Wang, 1997). Accordingly, they reduce credit constraints on investors by directing funds to individuals with better investment opportunities, which in turn promotes economic growth. By doing this, they allow for affordable exchanges between borrowers and lenders in a world of imperfect information (Khan and Semlali, 2000). In attempting to find a way that economic growth can be achieved, Schumpeter (1934) argued that financial intermediaries are able to contribute to economic growth by identifying and directing funds to more innovative projects, which otherwise would not have access to capital. However, due to imperfect information in the lending–borrowing process, savers do not know who is a trustworthy investor to

whom they can lend their funds. To overcome this barrier, financial intermediaries with their specialisation in scrutiny and monitoring capacities bring together the lenders and borrowers-cum-investors, and the process eventually benefits all parties involved, with spillover effects to the economy. The lender is to some extent confident that the funds will be directed to the right borrower, while the borrower gets funds for the project undertaken. Financial intermediaries get paid for their services and the whole economy benefits from the availability of goods and/or services produced by the investor, creation of employment, and purchases of inputs. The question remains, how do investors access funds?

Many profitable investments necessitate long-term commitment of capital, whereas savers are sometimes reluctant to keep their savings for long periods. Furthermore, many less-developed countries have underdeveloped capital markets. Accordingly, most borrowers, like small-scale firms and consumers who do not have access to equity or debt markets, as is the case in Rwanda, are served by banks and other deposit-taking institutions.

Concerning the directional link between financial expansion and economic growth, several empirical studies have tested the relationship between financial intermediation and economic growth and have found, as highlighted earlier, several conclusions. Some have observed that finance may influence growth (supply-leading hypothesis). Others have found that growth drives finance (demand-following hypothesis). In addition, there is a possibility of bidirectional causality, unimportant influence or simply independence between finance and economic growth.

2.1 Supply-leading hypothesis

This approach postulates that development of the financial sector leads to economic growth. Findings of Goldsmith (1969), King and Levine (1993), Neusser and Kugler (1998), Khan and Semlali (2000), Levine et al., (2000), Almeida and Wolfenzon (2005), Jean-Claude (2006) and Apergis et al., (2007) on pooled countries' time series provide support for this view, that financial sector development and economic growth go hand-in-hand. Countries with better-developed financial systems tend to enjoy a sustained period of growth, and studies confirm the causal link between the two, where the financial sector is considered a driver for economic growth. The same conclusion was reached in studies applied to developing countries, either using countries pooled together, such as in Odedokun (1996), Ndikumana (2000), Christopoulos and Tsionas (2004) and Ndebbio (2004), or considered individually, such as in Kilimani (2007) and Kargboll and Adamu (2009), conducted on Uganda and Sierra Leone respectively.

2.2 Demand-following hypothesis: Growth creates demand for financial services

This relationship stems from the understanding that when an economy experiences real economic growth, private businesses are most likely to plan investments that increase their demand for financial services (see Robinson, 1952; Gurley and Shaw, 1955; Ghirmay, 2004; Zang and Kim, 2007). Improved performance of the firms implies an increase in the need for financial capital for greater expansion, meaning financial sector development responds positively to higher rates of economic growth. Private investors are interested in exploiting available opportunities, and borrow more from financial intermediaries to make their investments. Examining the link between financial development and economic growth in Kenya, Odhiambo (2008) found a causal relationship flowing from economic growth to financial sector development.

2.3 Reciprocal causality between finance and growth

Patrick (1966) argued that the directional causality between financial sector development and economic growth changes with the stage of development. At an early stage of development, the economy needs a real impulse from the financial sector, providing funds for innovations and investment. Later, when the economy reaches a level of self-sustainability, many investors see opportunities and increase their borrowing, in order to further invest in new projects. Akinboade (1998) and Odhiambo (2005) found a bi-directional causality between financial development and economic growth in Botswana and Tanzania, respectively. Financial sector development and economic growth were observed to be complementary to one another. The same findings were reached by Luintel and Khan (1999) in a study of the finance-economic growth relationship for ten less-developed countries.

2.4 Independent causality between finance and growth

Muchai (2013) and Cevik and Rahmati (2013) found that the relationship between finance and economic growth is non-existent in Kenya and Libya, respectively. In an empirical study of the finance-growth channel in Kenya, using a VAR analysis for the period 1972 to 2008, Muchai (2013) found no relationship because savings mobilised by financial institutions did not influence capital formation, hence not leading to economic growth. The study by Cevik and Rahmati (2013) on Libya for the period 1970 to 2010 observed an absence of a long-run relationship between financial intermediation and non-hydrocarbon output growth. A plausible explanation for this absence of relationship between financial sector development and economic growth, which Demetriades and Andrianova (2004) underscored, is the possibility of funds being diverted to non-productive activities, due to microeconomic inefficiencies in the banking sector.

3. METHODOLOGY

3.1 Introduction

Economic theory postulates interaction between financial sector development and economic growth via investments (Benhabib and Spiegel, 2000; Mishkin, 2007; Kargboll and Adamu, 2009). In this study, this relationship is investigated using five variables, namely: potential liquidity available *(PLA)* (proxied by the ratio of M2 to GDP, as a measure of financial development), real interest rates *(INT)*, domestic credit to the private sector as a ratio of GDP *(DCP)*, gross fixed capital formation as a ratio of GDP *(GFCF)*, and the rate of economic growth *(Y)*.

Financial sector development expresses the degree of supply of financial assets within an economy and increases with its monetisation (Muchai, 2013). The higher the available liquidity with financial intermediaries, the greater their capacity to grant credit to more borrowers, and hence a potential increase in output. Ngalawa and Viegi (2011) argue that a decline in available bank credit adversely affects investment and output. Real interest rate *(INT)* reflects the real cost of funds to investors and a real return to savers. When it is low, investors-cum-borrowers take advantage and increase their applications for loans with financial intermediaries, which once granted are usually allocated to productive uses, which leads to increases in the level of output. Domestic credit to the private sector *(DCP)* expresses more accurately the role of financial intermediaries in channelling funds to private businesses (Khan and Semlali 2000; Demetriades and Law, 2004). Khan and Semlali (2000) and Demetriades and Law (2004) consider the amount

of bank credit to the private sector to be a good indicator of the general level of development of interaction between the banking sector and the productive economic sector. The stock of capital represented by gross fixed capital formation *(GFCF)* constitutes a basis for the undertaking of economic activities. The standard prediction of the neoclassical growth model is that growth rates will be higher through enhanced capital accumulation (Papaioannou, 2007).

3.2 Unit root test

A unit root test is conducted using the Augmented Dickey Fuller (ADF) procedure to verify if variables are stationary or not. Critical values are from MacKinnon (1991).

3.3. Cointegration test

The purpose of cointegration is to confirm the existence of any long-run relationship(s) between a set of non-stationary time series (Johansen, 1988; Phillips and Perron, 1988; Johansen and Juselius, 1990). In this study, the test consists of assessing the existence of potential long-run relationship(s) between financial development and economic growth in the reduced form of an SVAR model in equation (5). The test for cointegration is performed using the Johansen and Juselius (1990) maximum likelihood approach: the trace statistic ($\lambda\, trace(r)$) and the maximal-eigenvalue statistic ($\lambda\, max(r, r+1)$) given by:

$$\lambda\, trace(r) = -T \sum_{i=r+1}^{n} ln\left(1 - \hat{\lambda}_i\right) \quad \textbf{(1)}$$

$$\lambda\, max(r, r+1) = -Tln\left(1 - \hat{\lambda}_{r+1}\right) \quad \textbf{(2)}$$

where $\hat{\lambda}_i$ is the estimated value of the i^{th} ordered eigenvalue of matrix A and r denotes the number of independent equilibrium relationships. The test concludes that there is a long-run relationship if the trace statistic ($\lambda\, trace(r)$) and the maximal-eigenvalue statistic $\lambda\, max(r, r+1)$ are greater than the critical values from Johansen and Juselius (1990).

Prior to estimating the VAR, selection of an appropriate lag length is made. The appropriate lag length is of great importance, as inference on the VAR model is dependent on this choice (Canova, 2007). An appropriate lag length assumes that residuals are Gaussian, meaning they do not suffer from autocorrelation, non-normality and heteroscedasticity. One of the methods of selecting the VAR lag length is based on a likelihood ratio (LR) test (Hatemi-J and S. Hacker, 2009). The number of lagged values to be included in each equation is determined by using Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan and Quinn Criteria (HQC). Gujarati (2003) argues that the lower the value of criteria statistics, the better the model.

3.4 Structural VAR

According to Stock and Watson (2001), a VAR is an econometric model in which each variable is explained by its own lagged variables, current and past values of other endogenous variables and some exogenous variables. Hatemi-J and Hacker (2009) have argued that even though the VAR model is atheoretical, it is dynamic and is in accord with economic theory. Stock and Watson (2001) and Lütkepohl (2011) consider VAR models to be powerful tools for describing the dynamic

behaviour of economic and financial data and to generate reliable multivariate benchmark forecasts, in their different variants in applied economics.

On the use of a structural VAR, the recent economic literature justifies it as a superior alternative to the earlier variants of VAR models, because it makes use of economic theory to identify the contemporaneous relationships between variables (Canova, 2007). In the same vein Phillips and Perron (1988) stress that impulse response analysis, based on the unrestricted VAR containing unit roots, is inconsistent, hence resulting in a misleading policy analysis, as the estimated impulse responses can be expected to be inherently uncertain, especially in large samples associated with horizon increases. So, the structural VAR fits in as an alternative improvement to this approach.

To illustrate the SVAR, assume that the structural form of the VAR is given by equation (3) below:

$$Ay_t = C_0 + D_1 y_{t-1} + D_2 y_{t-2} + \cdots + D_p y_{t-p} + Bu_t \quad \textbf{(3)}$$

where A is an invertible matrix(kxk) of coefficients. This matrix describes contemporaneous relations among variables. C_0 is a $(k \times 1)$ vector of constants or intercepts, y_t is a $(k \times 1)$ vector of endogenous variables, D_i (for all $i = 1,2, \dots, p$) is a vector of coefficients; B is a $(k \times k)$ matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and u_t is a $(k \times 1)$ vector of error terms that may be contemporaneously correlated, but are uncorrelated with their own lagged values.

The system of equations (3) cannot be easily estimated, due to the fact that the variables have contemporaneous effects on each other. This problem is solved by rewriting the VAR in a reduced form, which is obtained by pre-multiplying equation (3) by the inverse of A (Greene, 2003; Gujarati, 2003; Enders, 2004; Ngalawa and Viegi, 2011):

$$y_t = A^{-1}C_0 + A^{-1}D_1 y_{t-1} + A^{-1}D_2 y_{t-1} + \cdots + A^{-1}D_p y_{t-p} + A^{-1}Bu_t \quad \textbf{(4)}$$

where $A^{-1}C_0 = \gamma_0$, $A^{-1}D_1 = \gamma_1$, $A^{-1}D_2 = \gamma_2$ and $A^{-1}D_p = \gamma_i$ for all $i = 1,2, \dots, p$ and $A^{-1}B\, u_t = e_t$. The result is equation (5), which can be easily estimated because no variable has a direct contemporaneous effect on other variables in the VAR (Greene, 2003; Ngalawa and Viegi, 2011).

$$y_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i\, y_{t-i} + e_t \quad \textbf{(5)}$$

In this reduced form, the occurrence of one structural shock on one variable can potentially be transmitted to other variables, due to the fact that the error terms in the VAR are composites given by $e_t = A^{-1}Bu_t$. The vector e_t holds the following property:

$$\varepsilon(e_t, \acute{e}_t) = \Sigma \quad \textbf{(6)}$$

where $A\Sigma A' = BB'$

The structural economic shocks are separated from the estimated reduced form residuals by imposing restrictions on the parameters of matrices A and B as presented in equation (6) based on economic theory (Giannini, 1991; Berkelmans, 2005). The model requires at least $2n^2 - \left(\frac{n(n+1)}{2}\right)$ restrictions on the matrices A and B for the model to be identified (Giannini, Lanzarotti et al., 1995). To impose these restrictions, this study makes use of structural factorisation, an approach common in the recent literature (Sims, 1986; Amisano and Giannini, 1997; Ngalawa and

Viegi ,2011). The structural shocks are identified according to the following system of equations (7):

$$\begin{bmatrix} e_t^{PLA} \\ e_t^{INT} \\ e_t^{DCP} \\ e_t^{GFCF} \\ e_t^{Y} \end{bmatrix} = \begin{bmatrix} 1 & a_{12} & a_{13} & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} \\ 0 & a_{42} & a_{43} & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}^{-1} \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} u_t^{PLA} \\ u_t^{INT} \\ u_t^{DCP} \\ u_t^{GFCF} \\ u_t^{Y} \end{bmatrix} \quad \textbf{(7)}$$

Prior to analysing the transmission of shocks on the VAR system, a stability test is carried out. A VAR is stable if all the eigenvalues of matrix A of coefficients of the lagged variables have modulus less than one (Hatemi-J, 2004). That means none of the inverse roots of the characteristic autoregressive polynomial lies outside the complex unit circle.

The study employs impulse responses and variance decomposition to analyse the results. Introduced in VAR modelling by Sims (1980), impulse response functions provide an answer to the question of how a change in one variable affects the system in the future. They trace out the time path response of current and future values of each variable to a one unit increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero (Amisano and Giannini, 1997; Stock and Watson, 2001; Enders, 2004); and provides a quantitative measure of the reaction of each variable to shocks in the different equations of the system (Bernanke and Mihov, 1997). Variance decomposition, on the other hand, indicates to what extent the forecast error variance of each variable can be explained by shocks to the remaining variables. It provides information about the proportion of the movements in a sequence, due to the variable's own shock and other identified shocks (Enders, 2004), separating the variation in endogenous variables into the component shocks of the VAR.

3.5 Data and variables

The VAR used in this study contains five variables, namely: financial development, proxied by *PLA* (potential liquidity available is measured by the ratio of M2 to GDP), real interest rates (*INT*), domestic credit to the private sector (*DCP*), gross fixed capital formation (*GFCF*), and the rate of economic growth (*Y*). These variables are quarterly time series from World Development Indicators and span the period 1996:1 – 2010:4. The variables are initially available in annual frequency, but are converted to quarterly series using the quadratic-match average approach. With the exceptions of real interest rate and GDP growth rate, each series is used in natural logarithm form. While data interpolation has the advantage of increasing degrees of freedom, it has some shortfalls related to 'seasonal factors' that may arise in quarterly data. However, according to Marwah (1997), this problem of seasonal movements is not as serious in quarterly data as it might be in case of higher-frequency levels of monthly, weekly or daily data that may require an adjustment to remove the seasonality aspect.

4. EMPIRICAL RESULTS

The long-run relationship between financial sector development and economic growth is estimated using the cointegration technique of Johansen and Juselius (1990). However, prior to undertaking the estimation, the data is tested for stationarity, in order to understand its

properties (Harris, 1995). Furthermore, a selection of an appropriate lag length and test for stability of the system is performed.

4.1 Stationarity tests

Stationary series have to display a reverting mean and a constant variance (Gujarati, 2003).The Augmented Dickey-Fuller test is used to determine the order of integration of the variables in the model (see TABLE 1 for results). The test results show that all variables in the model are integrated of order 1.

TABLE 1: ADF unit root test results for stationarity of variables

Variable	*Levels (ADF Test Statistic)*	*First Difference (ADF Test Statistic)*	*Order of integration*
Potential liquidity available (PLA)	0.201789	- 2.198665**	I(1)
Real interest rates (INT)	- 0.604608	- 2.499218**	I(1)
Domestic credit to private sector (DCP)	0.975554	- 2.378643**	I(1)
Gross fixed capital formation (GFCF)	0.788542	- 4.140875***	I(1)
GDP growth (Y)	- 0.795077	- 3.050678***	I(1)

Source: Authors' calculations

Note: (***), (**), and (*) signify rejection of the unit root hypothesis at the 1%, 5% and 10% levels, respectively.

4.2 Lag length selection

The Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan and Quinn Criteria (HQC) all agree that the appropriate lag length in each equation is two (see TABLE 2).

TABLE 2: Lag length selection

Lag	*LogL*	*Likelihood Ratio test*	*Final Prediction Error*	*Akaike Information Criteria*	*Schwarz Information Criteria*	*Hannan and Quinn Criteria*
0	-188.3027	NA	0.000607	6.782552	6.961767	6.852201
1	194.4109	684.8559	2.16e-09	-5.768802	-4.693512	-5.350908
2	255.2483	98.19374*	6.26e-10*	-7.026256*	-5.054890*	-6.260116*
3	268.0201	18.37352	1.01e-09	-6.597197	-3.729757	-5.482812

Source: Authors' calculations

* indicates lag order selected by the criterion

4.3 Cointegration tests

Once the unit root tests are performed and all variables are identified as $I(1)$, the next step is to carry out cointegration tests using the Johansen and Juselius (1990) procedure. Cointegration of the variables in our model, if established, suggests that there is a long-run relationship between the variables (Gujarati, 2003). The Johansen and Juselius (1990) cointegration test has two variants: the Trace test ($\lambda\, trace(r)$) and the Maximum Eigenvalues test ($\lambda\, max(r, r+1)$). The procedure starts with the selection of the correct lag length. The number of lagged values to include in each equation is identified as two, confirmed by all information criteria (see TABLE 2). An analysis of the SVAR's stability is carried out to establish stability of the model and assurance of meaningful impulse response and variance decomposition outcomes. Given the conclusiveness of the above tests, a formal test of cointegration is performed and the results are presented in TABLE 3.

TABLE 3: Cointegration test results

No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None *	0.422972	83.56607	69.81889	0.0027
At most 1 *	0.363729	52.22381	47.85613	0.0184
At most 2	0.247481	26.45240	29.79707	0.1158
At most 3	0.156853	10.24563	15.49471	0.2623
At most 4	0.009092	0.520626	3.841466	0.4706

Source: Authors' calculations

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) *p*-values

The Trace test indicates the existence of two cointegrating relationships and the maximum eigenvalue test suggests no cointegrating relationship. This study adopts results of the trace test, as it has been established that the test is superior, since it appears to be more robust to skewness and excess kurtosis in the residuals than the maximum eigenvalue test (Sjö, 2008).

Following the confirmation of the existence of cointegrating relationships, an analysis of short-run dynamics through impulse response functions and variance decomposition can be carried out among the variables considered in this study.

For the stability of the VAR, all the inverse roots of the characteristic polynomial are less than one (see TABLE 4), meaning that they are all inside the unit circle. Once this necessary and sufficient condition for stability of the system is satisfied, this leads to impulse response functions and forecast-error variances having meaningful interpretations.

TABLE 4: Roots of characteristic polynomial

Endogenous variables: Potential Liquidity Available, Real Interest Rates, Domestic Credit to the Private Sector, Gross Fixed Capital Formation, and GDP growth	
Lag specification: 1 2	
Root	*Modulus*
0.948477	0.948477
0.854568	0.854568
0.809860 - 0.242636i	0.845426
0.809860 + 0.242636i	0.845426
0.696161 - 0.401135i	0.803461
0.696161 + 0.401135i	0.803461
0.747230	0.747230
0.472239 - 0.413446i	0.627652
0.472239 + 0.413446i	0.627652
0.402696	0.402696
No root lies outside the unit circle.	
VAR satisfies the stability condition.	

Source: Authors' calculations

4.4 Impulse response and variance decomposition analysis

4.4.1 Impulse response analysis

An unexpected increase of potential liquidity available by 1% leads to significant instantaneous increases in real interest rates by 0.9% and output by 0.4%, and a decrease in gross fixed capital formation of about 0.8% below the baseline (see FIGURE 1). All three responses quickly become insignificant by the second quarter. Domestic credit to the private sector, however, does not respond significantly to the potential liquidity available shock. Thus potential liquidity available appears to have little impact on real output. This finding is not surprising due to the imperfect structure of the financial sector in Rwanda, which may place limits on the extent of the shock to the real economy. The significant output response to a potential liquidity shock, nonetheless, supports the supply-leading hypothesis on the relationship between financial sector development and GDP growth.

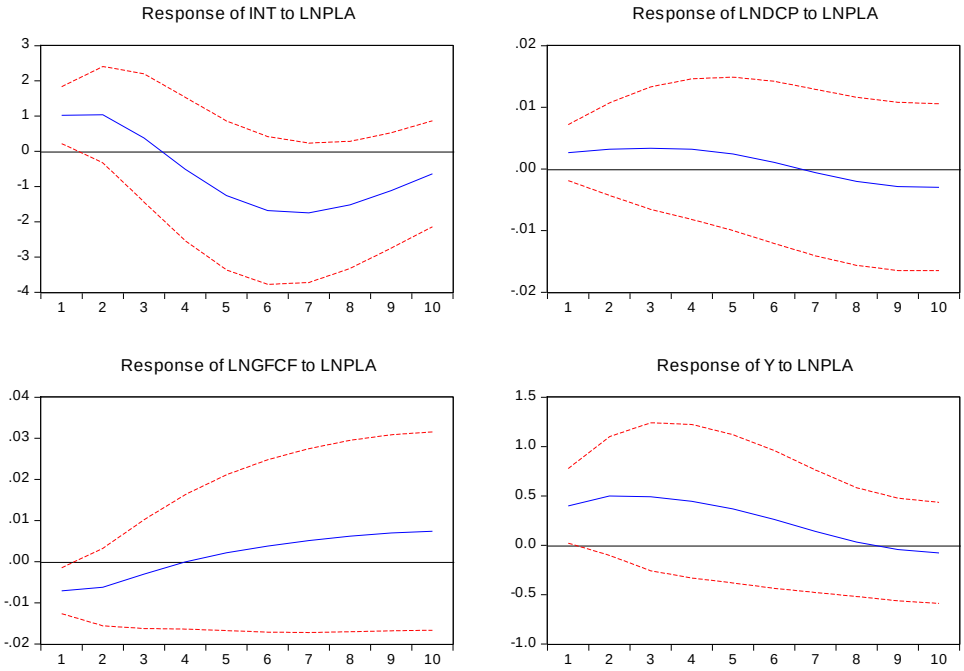

FIGURE 1: Impulse responses to a potential liquidity available (PLA) Shock

PLA: Potential Liquidity Available; INT: Real Interest Rate; DCP: Domestic Credit to Private Sector; GFCF: Gross Fixed Capital Formation; Y: GDP growth

FIGURE 2 presents impulse responses of the selected variables to an interest rate shock. The figure shows that following the shock, domestic credit to the private sector increases to a maximum of 1.1% above the baseline in the second quarter before returning to equilibrium by the end of the third quarter. Real GDP growth increases to a maximum of 12% above the baseline in the second quarter. This response becomes insignificant by the fourth quarter. The increase in domestic credit to the private sector following a positive interest rate shock may appear inconsistent with the conventional theory. However, it reveals that in Rwanda, domestic private borrowers may not be constrained primarily by how high the interest rates are, but rather by the availability of domestic credit. An increase in interest rates makes lending more profitable to financial intermediaries. Thus, financial intermediaries may reshuffle their asset portfolio in the wake of increasing interest rates, in the process increasing the share of loans and advances in total assets.

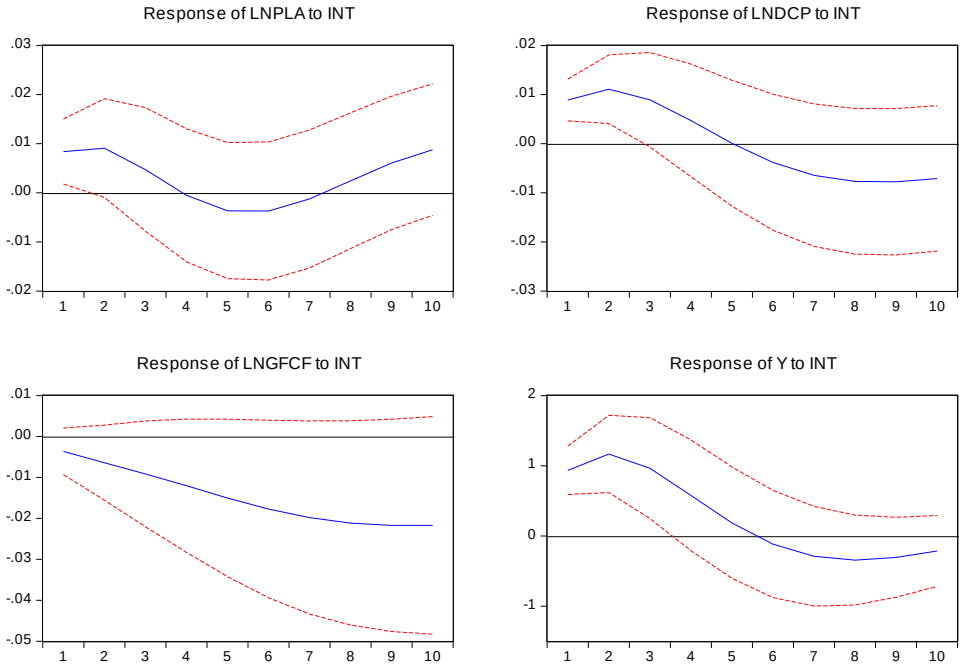

FIGURE 2: Impulse responses to an interest rate shock

PLA: Potential Liquidity Available; INT: Real Interest Rate; DCP: Domestic Credit to Private Sector; GFCF: Gross Fixed Capital Formation; Y: GDP growth

Impulse responses of the selected variables to a shock on domestic credit to the private sector are presented in FIGURE 3. The figure shows that following the shock, real output growth increases significantly to a maximum of 15% above the baseline in the second quarter, and thereafter declines to equilibrium in the fourth quarter. Interest rates also respond to the shock with an increase of 1.5% initially and 2% above the baseline in the second quarter before declining to equilibrium. This shows that an increase in domestic credit to the private sector raises interest rates probably due to a declining ability of the financial intermediaries to convert other assets into loans and advances.

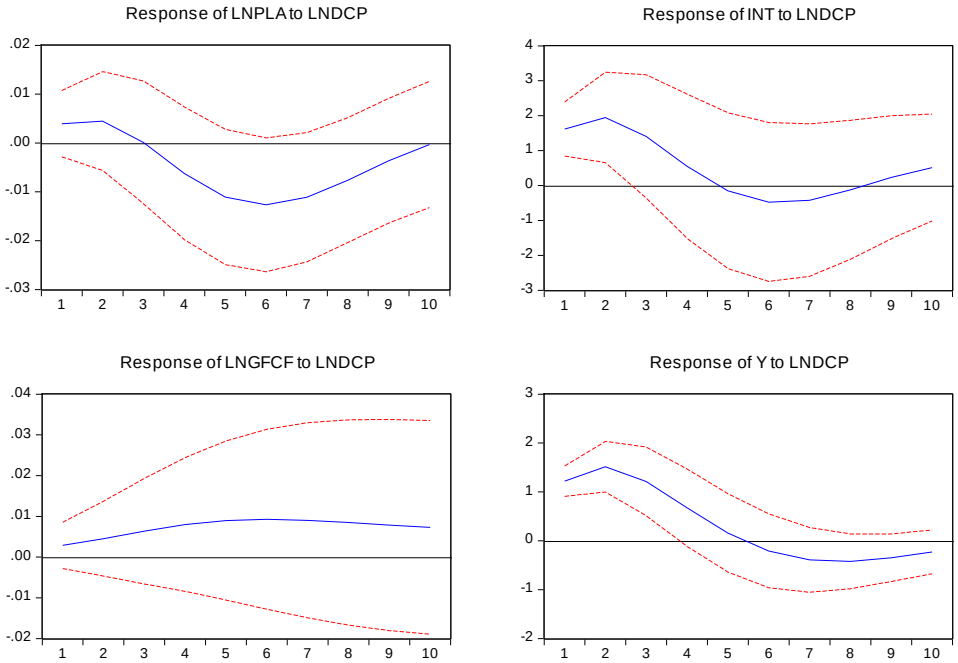

FIGURE 3: Impulse responses to a domestic credit to the private sector shock

PLA: Potential Liquidity Available, INT: Real Interest Rate, DCP: Domestic Credit to Private Sector, GFCF: Gross Fixed Capital Formation, Y: GDP growth

Impulse responses of a real output growth shock are presented in FIGURE 4. Potential liquidity available increases instantaneously following the output growth shock, probably to accommodate the increase in economic activity arising from the shock. The increase in potential liquidity, however, is marginally significant and it becomes clearly insignificant by the beginning of the second quarter. Interest rates respond to the shock by increasing initially, peaking at about 2.5% above the baseline after two quarters before taking a downturn and reverting to equilibrium. Domestic credit to the private sector also records an immediate increase following the shock, peaking after about two quarters. The instantaneous rise in domestic credit and interest rates in the first period is a direct consequence of the real output growth shock. The higher output growth in the first period requires an increase in investment and hence financial resources, consequently putting upward pressure on domestic credit to the private sector and interest rates.

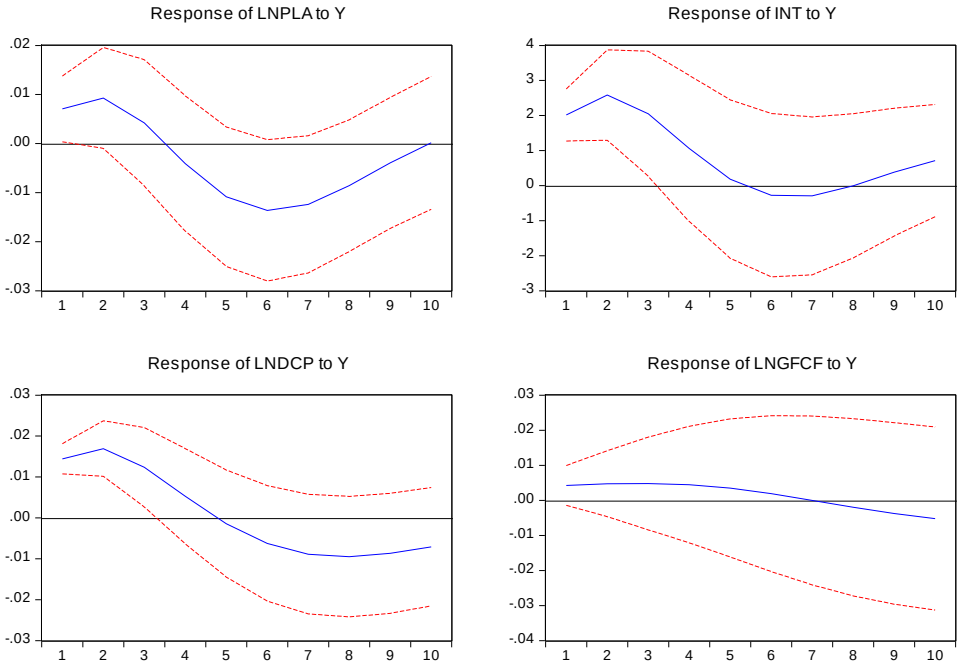

FIGURE 4: Impulse response to output growth shock

PLA: Potential Liquidity Available; INT: Real Interest Rate; DCP: Domestic Credit to Private Sector; GFCF: Gross Fixed Capital Formation; Y: GDP growth

While FIGURE 1 provides evidence that the relationship between financial development and economic growth in Rwanda is consistent with the supply-leading hypothesis, FIGURE 4 indicates that the evidence is inadequate to suggest that economic growth leads financial sector development (demand-following hypothesis).

4.4.2 Variance decomposition

The forecast variance decomposition of our SVAR is estimated over a 60-quarter period and TABLE 5 provides details of the first 20 quarters.

TABLE 5: Variance decomposition

Variance decomposition of potential liquidity available

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Fixed Capital Formation	GDP growth
1	0.102904	98.16707	0.811298	1.001603	0.010016	0.010016
4	0.208081	86.75151	0.426327	10.80246	1.894881	0.124819
8	0.241641	70.42638	0.922944	13.13260	15.38921	0.128870
12	0.278422	65.70520	1.389530	12.40430	20.37316	0.127814

16	0.300620	59.78121	1.575537	18.94573	19.47881	0.218716
20	0.321929	52.50907	1.595011	28.13855	17.41929	0.338078

Variance decomposition of real interest rates

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Fixed Capital Formation	GDP growth
1	0.101446	1.010097	98.97939	0.010306	0.000103	0.000103
4	11.06761	36.77586	2.028087	58.20867	2.417382	0.570005
8	22.47933	58.91776	2.099122	37.86261	0.750057	0.370450
12	24.09669	59.35421	2.051549	37.27811	0.915345	0.400787
16	25.51548	57.16956	1.843743	38.29669	2.258709	0.431300
20	26.16567	56.23184	1.756277	39.02292	2.549611	0.439347

Variance decomposition of domestic credit to private sector

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Fixed Capital Formation	GDP growth
1	0.103725	0.816358	0.630925	96.62031	0.966203	0.966203
4	0.358962	0.204617	0.885275	97.60482	0.192745	1.112545
8	0.559954	0.225447	1.041497	97.34989	0.188986	1.194181
12	0.686182	0.152823	1.029952	97.47244	0.137686	1.207097
16	0.761438	0.176633	1.056490	97.41222	0.148837	1.205818
20	0.803503	0.262408	1.085794	97.26335	0.183203	1.205240

Variance decomposition of gross fixed capital formation

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Fixed Capital Formation	GDP growth
1	0.101999	0.036802	0.825754	1.019449	98.10780	0.010194
4	0.305433	5.416843	2.068113	13.82021	78.52100	0.173843
8	0.556188	9.058138	2.494076	44.48185	43.42561	0.540329
12	0.782913	9.014226	2.403478	61.02456	26.80723	0.750507
16	0.958580	7.608585	2.234900	70.01186	19.27519	0.869462
20	1.088503	6.325636	2.086295	75.26516	15.38466	0.938253

Variance decomposition of GDP growth

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Fixed Capital Formation	GDP growth
1	0.100000	0.000000	0.000000	0.000000	0.000000	100.0000
4	2.275768	33.45622	0.252584	36.27915	28.29763	1.714417
8	6.139682	27.72303	0.082826	54.46856	16.95636	0.769218
12	6.548727	24.99927	0.130086	58.72731	15.35340	0.789938
16	6.567449	24.95289	0.135523	58.80016	15.31874	0.792693
20	6.583714	24.88875	0.134865	58.82772	15.35624	0.792421

TABLE 5 shows that fluctuations in potential liquidity available are mostly explained by variations in domestic credit to the private sector and gross fixed capital formation. The contribution of domestic credit to the private sector to variations in potential liquidity available increases from 10.80% after four quarters to 12.40% after 12 quarters and 28.14% after 20 quarters. The contribution of gross fixed capital formation to fluctuations in potential liquidity available also increases from 1.89% after four quarters to 20.37% after 12 quarters and drops to 17.42% after 20 quarters. The contribution of real output growth to fluctuations of potential liquidity available is very small, and remains less than 0.5% each quarter over 20 quarters. This suggests that the relationship between financial intermediation and economic growth in Rwanda may not be demand-following.

It is further observed in TABLE 5 that domestic credit to the private sector accounts for the largest proportion of fluctuations in real output growth, followed by potential liquidity available, indicating that the relationship between financial intermediation and economic growth in Rwanda may be supply-leading. Domestic credit to the private sector accounts for 36.28% of the fluctuations in real output growth in the first four quarters, which increases to 54.47% after eight

quarters and 58.83% after 20 quarters. The contribution of potential liquidity available to variations in real output growth is somewhat smaller albeit still large relative to other variables. Potential liquidity available accounts for 33.46% of the variations in real output growth after four quarters, which drops to 27.72% after eight quarters and 24.89% after 20 quarters. This corroborates the earlier observation from the impulse response functions connoting that financial sector development leads economic growth (supply-leading hypothesis).

Gross fixed capital formation also accounts for a relatively large proportion of the fluctuations in GDP growth. TABLE 5 shows that 28.29% of the fluctuations in GDP growth is explained by gross fixed capital formation after four quarters. The contribution of gross fixed capital formation in GDP growth variations declines to 15.35% after 12 quarters and remains more or less the same at 15.36% after 20 quarters.

The largest proportion of the fluctuations in domestic credit to the private sector is explained by domestic credit to the private sector itself (96.62% in the first quarter, 97.47% after 12 quarters and 97.26% after 20 quarters). This may probably be explained by imitating behaviour, in Rwanda, in conducting business with limited entrepreneurial spirit and less diversification. In addition, this reconfirms that domestic credit to the private sector is not necessarily driven by interest rates in Rwanda. Rather, as more credit is provided, additional productive capacity is created through increased gross fixed capital formation and GDP growth, which requires more domestic credit to the private sector. This explains why besides its own contribution, GDP growth contributes the most to fluctuations in domestic credit to the private sector. GDP growth accounts for 1% of the variations in domestic credit to the private sector after the first quarter, which increases to 1.2% after 12 quarters and remains unchanged until after 20 quarters.

5. SUMMARY AND CONCLUSION

This study set out to investigate the link between financial intermediation and economic growth in Rwanda for the period 1996:1 to 2010:4. Using a structural VAR, the study finds that GDP growth makes a very small contribution to fluctuations in potential liquidity available, which is used as a measure of financial development. It is observed, however, that potential liquidity available accounts for a third of the fluctuations in GDP at the end of two years and a quarter of the GDP fluctuations at the end of five years. This provides evidence that the relationship between financial sector development and economic growth in Rwanda is in line with the supply-leading hypothesis, indicating that development of the financial sector leads economic growth in the country and not vice versa. A further investigation of impulse response functions confirms this finding. It is observed that GDP growth increases instantaneously and significantly following a shock to potential liquidity available. A GDP growth shock, however, leads to a very small increase in potential liquidity available, which is marginally significant. Thus, the financial sector may be considered a driver of economic growth in Rwanda. This finding is in agreement with similar studies on developing countries such as those by Odedokun (1996), Ndikumana (2000), Christopoulos and Tsionas (2004), Ndebbio (2004), Kilimani (2007) and Kargboll and Adamu (2009).

LIST OF REFERENCES

Akinboade, O.A. (1998). Financial development and economic growth in Botswana: A test for causality/Développement financier et croissance économique au Botswana: Un test de causalité. *Savings and Development,* pp.331-348.

Almeida, H. & Wolfenzon, D. (2005). The effect of external finance on the equilibrium allocation of capital. *Journal of Financial Economics,* 75(1), pp.133-164.

Amisano, G. & Giannini, C. (1997). *Topics in structural VAR econometrics*. Springer Berlin Heidelberg.

Apergis, N., Filippidis, I. & Economidou, C. (2007). Financial deepening and economic growth linkages: a panel data analysis. *Review of World Economics*, 143(1), pp. 179-198.

Arestis, P. &. Demetriades, P (1997). Financial development and economic growth: Assessing the evidence*. *The Economic Journal*, 107(442), pp. 783-799.

Becsi, Z. & Wang, P. (1997). Financial development and growth. *Economic Review*, (Q4), pp. 46-62.

Benhabib, J. & Spiegel, M.M. (2000). The role of financial development in growth and investment. *Journal of economic growth*, 5(4), pp. 341-360.

Berkelmans, L. (2005). *Credit and monetary policy: An Australian SVAR*. Reserve Bank of Australia.

Bernanke, B.S. & Mihov, I. (1997). What does the Bundesbank target? *European economic review*, 41(6), pp. 1025-1053.

Canova, F. (2007). *Methods for applied macroeconomic research*. Princeton University Press.

Casu, B., Girardone C.& Molyneux, P. (2006). *Introduction to banking*. Pearson Education.

Cevik, M.S. & Rahmati, M.M. (2013). *Searching for the Finance-growth Nexus in Libya*. International Monetary Fund.

Christopoulos, D.K. & Tsionas, E.G. (2004). Financial development and economic growth: evidence from panel unit root and cointegration tests. *Journal of Development Economics*, 73(1), pp. 55-74.

De Gregorio, J. & Guidotti, P.E. (1995). Financial development and economic growth. *World development*, 23(3), pp. 433-448.

Demetriades, P. & Andrianova, S. (2004). Finance and growth: what we know and what we need to know. *Financial Development and Economic Growth: Explaining the Links,* pp. 38-65.

Demetriades, P. & Law, S.H. (2004). *Finance, institutions and economic growth*. University of Leicester Discussion Paper in Economics (04/5).

Dufrénot, G., Mignon, V. & Peguin-Feissolle, A. (2008). *Testing the finance-growth link: is there a difference between developed and developing countries*? Available: https://hal.archives-ouvertes.fr/halshs-00348350/.pdf. (Accessed 16 December 2015).

Enders, W. (2004). *Applied time series econometrics*. Hoboken: John Wiley and Sons.

Ghirmay, T. (2004). Financial Development and Economic Growth in Sub-Saharan African Countries: Evidence from Time Series Analysis. *African Development Review*, 16(3), pp. 415-432.

Giannini, C. (1991). *Topics in structural VAR econometrics*. Universita degli Studi di Ancono, Dipartimento di Economia.

Giannini, C., Lanzarotti, A.& Seghelini, M. (1995). A traditional interpretation of macroeconomic fluctuations: The case of Italy. *European Journal of Political Economy*, 11(1), pp. 131-155.

Goldsmith, R.W. (1969). *Financial structure and development*. Yale University Press New Haven.

Greene, W.H. (2003). *Econometric analysis*. Pearson Education India.

Gujarati, N. (2003). *Basic Econometrics*, *4th edition.*/Irwin: McGraw-Hill Inc.

Gurley, J.G. & Shaw, E.S. (1955). Financial aspects of economic development. *The American Economic Review,* pp. 515-538.

Harris, R.I. (1995). *Using cointegration analysis in econometric modelling*. Prentice Hall London.

Hatemi, -J,A. (2004). Multivariate tests for autocorrelation in the stable and unstable VAR models. *Economic Modelling*, 21(4), pp. 661-683.

Hatemi, -J,A. & Hacker, R.S. (2009). Can the LR test be helpful in choosing the optimal lag order in the VAR model when information criteria suggest different lag orders? *Applied Economics*, 41(9), pp. 1121-1125.

Havránek, T., Horvath, R.& Valickova, P. (2013). *Financial development and economic growth: a meta-analysis*. Czech National Bank (Working Paper Series 5).

Jean-Claude, M. (2006). *An Empirical Investigation around the Finance-Growth Puzzle in China: With a particular focus on causality and efficiency considerations*. Working Paper (83).

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control,* 12(2), pp. 231-254.

Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration-with applications to the demand for money. O*xford Bulletin of Economics and statistics*, 52(2), pp. 169-210.

Kargboll, S.M. & Adamu, P.A. (2009). Financial development and economic growth in Sierra Leone. Available: https://www.wami-imao.org/sites/defaults/files/Journals/v9n2_unit2../.pdf. (Accessed 10 September 2014) .

Khan, M.S. & Semlali, A.S. (2000). *Financial development and economic growth: an overview*. International Monetary Fund.

Kilimani, N. (2007). Financial development and economic growth in Uganda. *The IUP Journal of Financial Economics*, (1), pp. 14-34.

King, R.G. & Levine, R. (1993). Finance, entrepreneurship and growth. J*ournal of monetary Economics,* 32(3), pp. 513-542.

Levine, R. (1997). Financial development and economic growth: views and agenda. *Journal of Economic Literature*, pp. 688-726.

Levine, R., Loayza, N. & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, 46(1), pp.31-77.

Luintel, K.B. & Khan, M. (1999). A quantitative reassessment of the finance–growth nexus: evidence from a multivariate VAR. *Journal of Development Economics*, 60(2), pp. 381-405.

Lütkepohl, H. (2011). *Vector Autoregressive Models*. Springer.

Marwah, K. (1997). *Selected Papers Of Lawrence R Klein: Theoretical Reflections And Econometric Applications*. World Scientific.

Ministry of Finance and Economic Planning (2013). *Economic development and poverty reduction strategy 2013 – 2018*. Kigali, Republic of Rwanda.

Mishkin, F. S. (2007). *The Economics of Money, Banking, and Financial markets.* Pearson Education.

Muchai, J. (2013). Assessing the finance-growth channel in Kenya: a VAR analysis. *African Finance Journal,* 15(2), pp. 66-84.

Ndebbio, J. (2004). *Financial deepening, economic growth and development: evidence from selected sub-Saharan African countries*. AERC research paper 142, Nairobi: AERC.

Ndikumana, L. (2000). Financial determinants of domestic investment in Sub-Saharan Africa: Evidence from panel data. *World development,* 28(2), pp. 381-400.

Neusser, K. & Kugler, M. (1998). Manufacturing growth and financial development: Evidence from OECD countries. *Review of economics and statistics*, 80(4), pp. 638-646.

Ngalawa, H. & Viegi, N. (2011). Dynamic effects of monetary policy shocks in Malawi. *South African Journal of Economics,* 79(3), 224-250.

Odedokun, M.O. (1996). Alternative econometric approaches for analysing the role of the financial sector in economic growth: Time-series evidence from LDCs. *Journal of Development Economics,* 50(1), pp. 119-146.

Odhiambo, N.M. (2005). Financial development and economic growth in Tanzania: A dynamic causality test. *African Finance Journal*, 7(1), pp. 1-17.

Odhiambo, N.M. (2008). Financial depth, savings and economic growth in Kenya: a dynamic causal linkage. *Economic Modelling*, 25(4), pp. 704-713.

Papaioannou, E. (2007). *Finance and growth: a macroeconomic assessment of the evidence from a European angle*. Citeseer.

Patrick, H.T. (1966). Financial development and economic growth in underdeveloped countries. *Economic development and Cultural Change,* pp. 174-189.

Phillips, P.C. & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), pp. 335-346.

Robinson, J. (1952). The Generalisation of the General Theory. *Rate of Interest and Other Essays* (London: Macmillan, 1952).

Schumpeter, J.A. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Transaction Publishers.

Sims, C.A. (1980). Macroeconomics and reality. *Econometrica: Journal of the Econometric Society*, pp. 1-48.

Sims, C.A. (1986). Are forecasting models usable for policy analysis? *Federal Reserve Bank of Minneapolis Quarterly Review,* 10(1), pp. 2-16.

Sjö, B. (2008). Testing for unit roots and cointegration. *National ekonomiska institutionen*, Lindköpings Universitet.

Stock, J.H. & Watson, M.W. (2001). Vector Autoregressions. *Journal of Economic perspectives*, pp. 101-115.

Zang, H. & Kim, Y.C. (2007). Does financial development precede growth? Robinson and Lucas might be right. *Applied Economics Letters*, 14(1), pp. 15-19.