

MODELING THE EFFECTS OF CREDIT CHANNEL OF MONETARY TRANSMISSION MECHANISM IN RWANDA

Mugisha Robinson

Head of Research and Development, Rwanda Private Sector Federation and Senior lecturer at University of Lay Adventists of Kigali

Abstract: This study investigated the impact of credit channel of monetary transmission mechanism in executing monetary policies in Rwanda, during the period 2007-2017. The study employed a VAR methodology using impulse response graphs and variance decomposition to test the relative impact of the different variables tested being repo rate, money supply (M3), consumer price index (CPI), gross domestic products (GDP) and savings and investment, the data set was quarterly collected from national bank of Rwanda. And finding out whether credit channel is more effective or ineffective. The empirical analysis found two captivating results. Firstly, all variables were stationary at level I (0) using Eviews version 8. Secondly, with exception of innovation (M3), there exists significant influence of credit channel of monetary transmission shock to GDP and CPI, despite of being weak and a strong significant influence on economic growth. The overall result reveals that R-squared is 0.83 and adjusted R-squared is 0.69 indicating that 69 percent of the variations in inflation could be explained by the combined effect of changes in all independent variables and the overall result reveals that R-squared is 0.67 and adjusted R-squared is 0.75 indicating that 75 percent of the variations in credit to private sector could be explained by the combined effect of changes in all independent variables.

Keywords: credit channels, monetary transmission, VAR.

1. INTRODUCTION

1.1 Introduction:

Monetary transmission is a systematic process through which monetary policy decisions affect the economy in general and the price level in particular. The transmission mechanism is characterized by long, variable and uncertain time lags. Thus it is difficult to predict the precise effect of monetary policy actions on the economy and price level. Monetary transmission is important to policy formulators, decision making and implementing authorities. The policies are used to enhance stability in key economic variables and promote social and political welfare in any country. In the USA, monetary policy is the responsibility of the Federal Reserve System. The policy goals are generally the same all over the world, with objectives of promoting stable prices, exchange rates, maximum employment and long term interest rates.

Most studies have been done using Vector Autoregressive framework. Notable in developed economies including the study on the Euro-zone and the USA, (Morsink, 2003) used a factor Augmented Autoregressive model on monetary transmission in the six largest European economies. Some authors in developing economies also support the same opinion on the importance of monetary transmission. For instance, Cheong and Boodoo (2008) used a VAR decomposition IRF and found weak pass through from inter- bank rate and Treasury bill rate to prime lending rate in Trinidad and Tobago. Kendall Patrick (2001) in his study on the Caribbean found that it was difficult to discern pattern of Tb rate in Barbados, Belize, Guyana and Jamaica.

Davodi et al, (2013) note that transmission channels differ in East African Countries (EAC) with exchange rate and credit channel being important to Kenya, credit channel in Rwanda and interest rate in Burundi. Morales and Raei (2015) concluded generally that there was evidence for existence of interest rate and exchange rate channels in EAC. Since the 1970s, various authors have examined the consequences of relaxing the assumptions underlying the “money view”. Most of them focused on the information asymmetries faced by lenders and borrowers. This research has produced the “credit view” that distinguishes different forms of financing and hence different financial assets. Consequently, whereas the “money view” generally only makes a distinction between noninterest bearing “money” and interest-bearing “securities”, the credit view subdivides the “securities” further (e.g. bank loans, bonds and shares). It has become usual to describe the difference between the money view and the credit view on the basis of the transmission mechanism of monetary policy and to differentiate a “money channel” and a “credit channel”.

The effects of monetary policy therefore are magnified. The credit channel illustrates a possible way in which monetary policy is able to influence the economy even if the open market interest rate barely responds. An extreme example is where the short-term interest rate controlled by the central bank is zero. In this case, the money channel is closed and monetary policy can only take effect through other channels, such as the credit channel. Aside from such extreme examples, however, most economists tend to see the credit channel as an extension of, rather than an alternative to, the money channel. However, with the deregulation of financial markets and monetary policy are more oriented towards market based operations in developing countries, especially in Sub-Saharan Africa, there has been an increased interest in understanding how economies respond to monetary shocks (see for example Smal and Jager (2001) and Mahadeva and Smidhova (2000). This article is a contribution to this growing literature. It evaluates the capacity of the monetary policy in Rwanda to impact production and price.

In this reverence, this paper tries to identify potential channels for the transmission of monetary policy based on the indirect instruments since 1995. The design and conduct of monetary policy critically depends on a proper assessment and understanding of the effects of policy changes and shocks on relevant macroeconomic variables and their timing. The analysis of different transmission channels helps to describe their specific characteristics, such as their relative dominance, importance, and their propagating policy effects. Before to assessing whether monetary policy shocks have an impact on output and price, we first provide a qualitative assessment with respect to the effectiveness of individual channels for the transmission of monetary policy in Rwanda.

1.2 Problem Statement:

The credit channel mechanism of monetary policy describes the theory that a central bank's policy changes affect the amount of credit that banks issue to firms and consumers for purchases, which in turn affects negatively or positively the real economy. In line with other Central banks or monetary authorities across the globe, the National Bank of Rwanda have used credit channel to attain sustainable economic growth through the means of monetary policy. There are large number of studies that assessed the effectiveness of credit channel of monetary transmission mechanism. Those studies used country specific data and revealed conflicting results, for example ,Cheng (2008) study found that monetary policy shock had little impact on real output and market price suggesting the reason for this was structural weaknesses in the financial sector which was likely to hamper transmission of monetary policy. The endogenous variables he used were gross domestic product, consumer price index, money stock, short term interest rate and nominal effective exchange rate. However, a lot has happened in the financial sector since 2008 including increased levels of financial innovation, deregulation of financial regulatory authorities by the government to make financial sector competitive and perform well, but still in Rwanda financial sector is monopolistic which causes the government to intervene appropriately.

Pascal and Adha (2012) results suggest that with financial innovation in Rwanda , the effectiveness of the credit channel in monetary policy is weakened but at the same time, due to intensified financial innovation this has led to efficiency in access of finances to households, private firms and institutions therefore investing more and hence increased output behavior in mind that Kigabo (2006) concluded that the interest rate shock has insignificant effect on real output which extent is subject to concern.

Gichondo and Joys (2012) used Basic VAR model suggested that an increase in the money supply increased real output from the first to the third quarter and price level from the third to the ninth quarter. They then added the real interest rate to the basic model to examine the effect of the credit channel, and found that money supply still affected output, real interest rate and price level. The real interest rate did affect real output, and the effect was very significant. The effect of the credit channel was also significant, with money supply causing credit and, credit affected output.

From literature, different authors have given mixed results, some bearing results that agree while others results that contradict each other, there is limited literature on the long run effects of credit channel effects on financial performance as the economy grows more dynamic and diversified.

Further, the authors did not consider the explicit analysis of long run behavior of the economy. Adha (2013) noted that analysis by VAR framework requires relatively long time series with consistent policy framework and so, a small sample period would be unfruitful but all the authors used short term data. There is therefore a need to find out whether credit channel has become more effective or ineffective.

1.3 Objective of the Research:

1.3.1 General Objective:

The general objective of the study is to assess the effectiveness of credit channel of monetary policy of transmission mechanism on promotion of sustainable investment, and low inflation in Rwanda.

1.3.2 Specific objectives

1. To measure the effects of credit channel on Inflation in Rwanda.
2. To evaluate the importance of credit channel on private sector credit in Rwanda.
3. To determine the influence of credit channel on investment in Rwanda.

1.4 Hypothesis of the study

The hypothesis provides a simple statement of association between Y and X. Nothing is indicated about the association that would allow the researcher to determine which variable, Y or X, would tend to cause the other variable to change in value. Hence the following hypotheses are proposed:

1. H_{01} : there is no significant relationship between credit channel and Inflation in Rwanda.
2. H_{02} : There is no significant relationship between credit channel and private sector credit in Rwanda.
3. H_{03} : There is no significant relationship between credit channel and investment in Rwanda.

1.5 Justification of the Study:

It is the desire of every nation's government to achieve economic stability and growth, Because of this, in line with vision 2020's objective to have an average annual growth of 8% per annum every year, the credit channel of monetary transmission mechanism should be thoroughly studied and understood. The study therefore sought to be great contribution to the government, international financial institutions, policy formulators, private sector, the society at large and future scholars and students. In other words, the study's result was highly relevant in the formulation and implementation of an effective credit channel that will promote growth and improve the welfare of the people. The study will be used by the government as a benchmark for comparison of past years monetary policies and review them basing on results found in the study and therefore enable them formulate and implement an interest rate considered to be optimal for economic growth and development of Rwanda. Thirdly, the study sought to serve as a contributing foundation in guiding students who wish to further their research in this topic as they will use the work as a baseline study and subsequently work on them for better results. The study will also be important to forex dealers, securities markets dealers, the government and the public as a whole, to understand the degree of responsiveness of foreign exchange, financial securities and the economy at large to interest rate changes.

1.6 Scope of the Study:

The study covered the period 2007- 2017 which published by central bank of Rwanda. Focus was establishing the impact of credit channel on exchange rate price stability, financial stability and economic growth. The study uses quarterly data on key Repo rate, Exchange rate, Consumer price Index and GDP to ensure that the model is not under specified.

1.7 Limitation of the study:

This study aimed to measure the effectiveness credit channel of monetary policy transmission mechanism in Rwanda to help assess the current monetary policy framework conducted by the National Bank of Rwanda. Different studies showed that empirical results are sensitive to data period covered by the study and the method employed. VAR approaches are asymptotic models and hence they need large data set of the variables under the study.

Additionally, most of the studies which use quarterly data, apply interpolation technique to disaggregate annual data into quarterly data. Due to availability and reliability on quarterly data on the variables that was used in the analysis, this study dictated using quarterly data spanning from 2007Q1 to 2017Q4.

1.8 Conceptual framework:

The conceptual framework will develop based on extensive review on existing literature. It specifically explained the relationship between credit channel variables representing independent variables and investment, consumer price index inflation and credit to private sector representing dependent variables using the VAR model that reflects Rwandan Economy (Kigabo et al. 2007). While the conceptual framework presented below differentiates independent variables from dependent variables, it is worth noting that this study employed vector autoregressive.

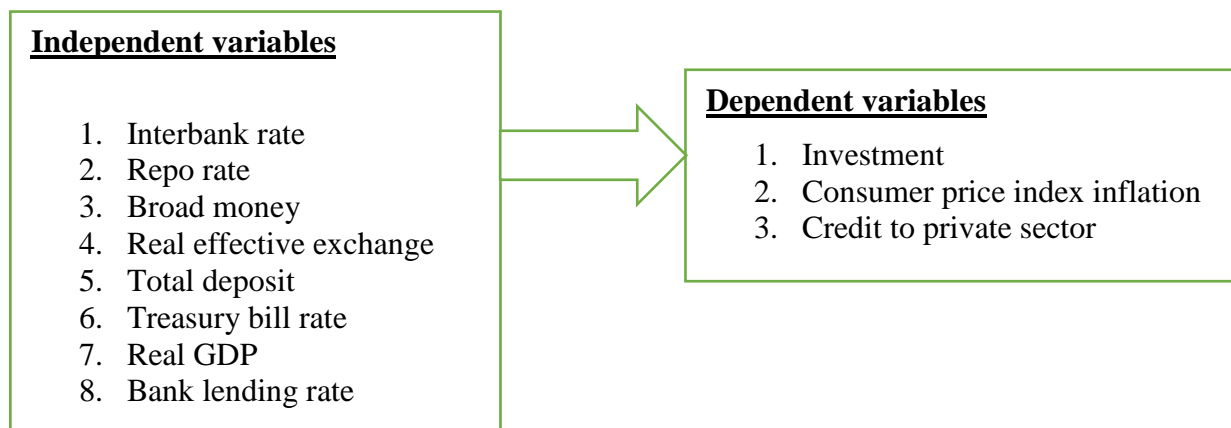


Figure 1: Conceptual framework

1.9 Dependent Variable and Independent Variables:

In this study (INVEST) investment, (CPI) Consumer price index inflation and (CPS) credit to private sector are the dependent variable. (LNR) is lending rate, (TBR) is treasury bill rate, (RR) is repo rate, (REE) real effective exchange, (TDEP) is bank total deposit, (RGDP) is real gross domestic products, (RIR) is Real interbank rate representing credit channel of monetary transmission mechanism in Rwanda are independent variables.

2. LITERATURE REVIEW

2.1 Introduction:

This chapter reviews both the theoretical literature on monetary policy transmission channels and empirical literature that focuses both on effectiveness of the monetary policy transmission channels and those that focus on credit channel in particular.

2.2 Theoretical review:

For a successful monetary policy, the monetary authorities must have an adequate understanding of the mechanisms through which monetary policy affects the economy. The transmission mechanisms discussed in the literature are Interest rate channel, Exchange rate channel, Other Asset price effects, Credit channel (Mishkin 1995).

The credit channel emphasizes the special role banks play in the financial system. Thus a contractionary monetary policy decreases bank reserves and bank deposits which leads to a fall in bank loans thereby reducing investment and hence output. There is another broad view of the credit channel which states that a contractionary monetary policy lowers equity prices which in turn lowers the net worth of the firms. Lower net worth of business firms also increases the moral hazard problem because as the owners have a lower equity stake, it gives them more incentive to engage in risky projects. This also has an adverse effect on lending which reduces investment spending and hence output. The origins of the 'credit channel' or 'lending channel' can be traced to Irving Fischer (1933) who in the first issue of *Econometrical* argued that the severity of the economic downturn of the Great Depression resulted from the poor performance of financial markets. This view was later reinforced by various economists viz, Tobin and Brainard (1963), Brunner and Meltzer (1936).

Perhaps the best known recent formulation of the lending view is a model due to Bernanke and Blinder (1988). Their model suggests that open market sales by the Central Bank which drain reserves and hence deposits from the banking system, would limit the supply of bank loans by reducing bank's access to loanable funds. This will create a shortage of credit in the economy affecting real activity.

The credit view was empirically tested by many economists. Among the earliest was the work by King (1986) who tested the correlation between bank loans and some measure of economic activity. This is a useful first step. However because it makes no effort to address issues of indigeneity, it provides little evidence concerning the nature of the transmission mechanism. Bank loans are in turn affected by economic activity. Thus correlations between bank lending and economic activity may capture the effects of output on lending rather than the other way round. An influential study on this area is Bernanke's (1983) examination of the Great Depression in the United States. According to him the depression had caused banking crises in 1930-33 which had disrupted the credit allocation process. In his words 'Fear of runs led to large withdrawals of deposits, precautionary increases in reserve deposit ratios and an increased desire by banks for very liquid and rediscount able assets. These factors plus the actual failures forced a contraction of the banking system's role in the intermediation of credit'. Bernanke and James (1991) extends this work to study the cause of depression in other countries.

2.2.1 Theories of investment:

John M. Keynes and Irving Fisher, both argued that investments are made until the present value of expected future revenues, at the margin, is Equal to the opportunity cost of capital. This means that investments are made until the net present value is equal to zero. An investment is expected to generate a stream of future cash flows, $C(t)$. Since investment, I , represents an outlay at time 0, this can be expressed as a negative cash flow, Fisher referred to the discount rate as the rate of return over costs or the internal rate of return. Keynes, on the other hand, called it the marginal efficiency of capital, (Baddeley, 2003, and Alchian, 1955). Keynes (1936) argued that investments are made until "there is no longer any class of capital assets of which the marginal efficiency exceeds the current rate of interest" (as quoted in Baddeley, 2003, p. 34). The fundamental difference between the "Keynesian view" and Fisher ("Hayekian view") lies in the perception of risk and uncertainty, and how expectations are formed. Keynes did not regard investment as an adjustment process toward equilibrium. Hayek (1941) and Fisher (1930), on the other hand, regarded investment as an optimal adjustment path towards an optimal capital stock. In the Keynesian theory investment are not! Determined by some underlying optimal capital stock.² instead genuine or radical uncertainty takes a central position. Keynes believed that humans were "animal spirited" and that this, combined with irrational and volatile expectations, made the thought of investment as an adjustment process toward equilibrium futile.

2.2.2 Monetary Theory of Inflation:

Monetarism refers to the followers of M. Friedman (1912-2006) who hold that "only money matters", and as such monetary policy is a more potent instrument than fiscal policy in economic stabilization. According to the monetarists, the money supply is the "dominate, though not exclusive" determinant of both the level of output and prices in the short run, and of the level of prices in the long run. The long-run level of output is not influenced by the money supply. The monetarists emphasized the role of money. Modern quantity theory led by Milton Friedman holds that "inflation is always and everywhere a monetary phenomenon that arises from a more rapid expansion in the quantity of money than in total output. Its earliest explanation was to be found in the simple quantity theory of money. The monetarists employed the familiar identity of exchange equation of Fisher.

2.2.3 Hahn's 1920 Economic Theory of Bank Credit: An "apotheosis of credit creation"

At the end of WW I Joseph Schumpeter established himself as a leading monetary theorist in the German language area with his long essay on "Money and the Social Product" (Schumpeter 1917- 18), in which he systematically elaborated central ideas on money and credit which were already contained in his Theory of Economic Development. There he had emphasized the financing of innovative investment activities by means of credit as the key function of the banking system. In Schumpeter's view the banker is not the trader but the producer of purchasing power. "credit is essentially the creation of purchasing power for the purpose of transferring it to the entrepreneur, but not simply the transfer of existing purchasing power" (Schumpeter 1934: 107). In contrast to the means of exchange-function of money, credit creation shows clearly the capitalistic function of money, i.e. its importance for industrial development.

2.3 Channels of Monetary Transmission Mechanism:

2.3.1 The Interest Rate Channel

According to Mishkin (2006), expansionary monetary policy (increasing money supply - M) causes the real interest rate (ir) to fall, which means that the cost of capital is lowered. The fall in real interest rate induces businesses to increase spending on investments and consumers to increase their housing and durable expenditures, which are also considered investment. This increase in investment spending (I) leads in turn to an increase in aggregate demand and a rise in output (Y). This process is illustrated in the following schematic:

$$M \uparrow \Rightarrow r_i \downarrow \Rightarrow I \uparrow \Rightarrow Y \uparrow$$

2.3.2 The Exchange Rate Channel

According to Mishkin (2006), an increase in money supply (M) causes the domestic real interest rate (ir) to fall. Therefore, assets which are denominated in domestic currency are less attractive than assets denominated in foreign currency, resulting in a depreciation of domestic currency (E). The depreciation of the domestic currency makes domestic goods relatively cheaper than foreign goods, thereby causing net export (NX) and output to rise. This is demonstrated in the following schematic: $M \uparrow \Rightarrow r_i \downarrow \Rightarrow E \downarrow \Rightarrow NX \uparrow \Rightarrow Y \uparrow$

2.3.3 Other Asset Price Channels

These channels operate mainly through two effects: Tobin's q theory of investment and wealth effects on consumption (Mishkin, 1995). According to Tobin (1969), q is defined as the market value of a firm divided by the replacement cost of capital. If q is high, the replacement cost of capital is low compared with the market value of the firm. This enables the firm to buy more plant and equipment with their now higher-value equity. Thus, investment spending increases. Conversely, if q is low, then the market value of the firm is also low in comparison with the replacement cost of capital and the firm will not purchase investment goods. Thus, investment decreases. In the monetarist view, this effect is explained by the fact that if money supply decreases, the public has less money and wants to try to decrease their spending. One way to do this is to reduce the amount of money invested in the stock market, thus depressing the demand for and the price of equities (Pe). Combining this with Tobin's q effect, this channel is expressed in the following schematic:

$$M \downarrow \Rightarrow P_e \downarrow \Rightarrow q \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$$

The wealth effect on consumption is based on the life-cycle model of Modigliani (1971). In his model, consumers determine their consumption spending by considering their lifetime resources, including human capital, real capital, and financial wealth. Common stocks are a major component of consumers' financial wealth. When stock prices decrease, consumers' wealth also decreases and they spend less on consumption. Because a contractionary monetary policy can result in lower stock price, the process is seen in the following schematic:

$$M \downarrow \Rightarrow \text{wealth} \downarrow \Rightarrow \text{consumption} \downarrow \Rightarrow P_e \downarrow \Rightarrow Y \downarrow$$

2.3.4 The Credit Channel

This channel mainly involves with the agency problems arising from asymmetric information and costly enforcement of contracts in the financial market. The credit channel operates via two main channels, that are the bank lending channel and the balance-sheet channel (Mishkin, 1995).

A decrease in money supply leads to a decrease in bank deposits, which further decreases the volume of money that banks have to loan out. This, in turn, decreases investment and, ultimately, aggregate demand. This channel allows monetary policy to operate without interest rate, meaning that decreasing interest rates may not be sufficient to increase investment. However, it is worth noting that, with financial innovation, the significance of this channel has been doubted (Mishkin, 1995). The schematic for the bank lending channel is as follows:

$$M \downarrow \Rightarrow \text{bank loans} \downarrow \Rightarrow \text{bank deposits} \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$$

The balance-sheet channel operates through the net worth of firms, with the effects of adverse selection and moral hazard. A decrease in the firm's net worth means that lenders can rely on lower collateral for their loans, which raises the problem of adverse selection and reduce lending for investment spending. Lower net worth also results in the problem of moral hazard because business owners have a lower equity stake in the firm and, therefore, have incentive to take part in risky projects. As a result, lending and investment spending decreases (Mishkin, 1995).

The ways monetary policy affect firms' balance-sheets are as follows:

$M \downarrow \Rightarrow \text{lending} \downarrow \Rightarrow \text{adverse selection \& moral hazard} \uparrow \Rightarrow P_e \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$.

A tightened monetary policy leads to a decrease in the prices of equities (P_e), raising the problems of adverse selection and moral hazard. As a result, lending for investment spending decreases.

$M \downarrow \Rightarrow \text{cashflow adverse selection \& moral hazard} \uparrow \Rightarrow \text{lending} \uparrow \Rightarrow i \downarrow \Rightarrow I \downarrow \Rightarrow Y \downarrow$.

Contractionary monetary policy increases the interest rate, which in turn increases the problems of adverse selection and moral hazard. Similar to a tightened monetary policy, when a contractionary policy is implemented, lending and investment spending decrease.

2.4 Review of the empirical literature:

Recent studies discuss transmission mechanisms of monetary policy in various countries. To stress the importance of the structure and the nature of the various economies (differences and diversity of the financial markets, the role of the banking sector, the history of inflation...) in the process of monetary transmission, studies are classified according to principal groups of countries. It arises from the empirical literature on the transmission mechanisms of monetary policy that in the developed countries, the interest and exchange rates channels are most important; the effectiveness of the credit channel varies from one country to another.

Coudert and Mojon (1995) analyzed empirically by modeling VAR, the transmission mechanisms in 4 countries of the euro zone: Germany, France, Italy and the United Kingdom. Their model comprises the following variables: long interest rate, money supply, credit, exchange rate, price and production over the period 1976-1993. Simulations of shock of monetary policy show that a change in interest rate has varied effects from one country to another. The recessive effect is observed in France, in Italy and in the United Kingdom, it is not very significant in Germany.

Loayza (2002) presents an empirical study starting from a VAR model on Australia, Canada and the United Kingdom. The study confirms that the interest and exchange rates channels are effective in all these countries. Morsink (2000), by an analysis of quarterly macroeconomic data of Japan has following results: 67% of the direct impact of the shocks of the interest rate on the aggregate demand pass by the bank credit and 67% of change of the aggregate demand come from the private investment. The monetary shocks and the fluctuations of the bank balance sheet influence the real economy; the balance sheet channel dominating the other monetary channels. As mentioned in the following studies, the situation of the emerging countries is different from that of the developed countries.

Hericourt and Matei (2008) propose an empirical evaluation of the transmission mechanisms of the monetary policy in 8 central and eastern European countries (Czech Republic, Hungary, Poland, Slovak Republic, Estonia, Lithuania, Latvia and Slovenia) based on VAR models. The study made over the period (1995-2004) for the countries having maintained a fixed exchange rate regime shows the significant impact of the monetary aggregates on the real economy. The countries with a flexible exchange regime during the same period have heterogeneous behavior profiles. In Czech Republic, the interest and exchange rates channels are particularly active. On the other hand the quantitative channel (variation of the monetary aggregate M2) and the credit channel appear ineffective to impact the real economy.

2.5 Research Critiques:

Most of the available studies have investigated the effects of interest rate channel of monetary transmission mechanism. However the current study unlike the prior studies focuses credit channel analysis using long term data variable to enable capture the long term analysis and effects on the economy and also seek to clarify as suggested by Kigabo (2008) that development of infrastructure inform of financial innovation would translate in to a more effective credit channel in Rwanda. There has been mixed results since Pascal (2011) and Adha, suggest that financial innovation weakens the effectiveness of monetary policies while output in the case of interest policy shock changes insignificantly, it changes significantly in the case of financial innovation. On that vein therefore, the study seeks to analyze the credit channel and its long term effects on price movement, investment and relationship with financial sector performance.

2.6 Research Gap:

From literature, different authors have given mixed results, some bearing results that agree while others results that contradict each other, there is limited literature on the long run effects of credit channel effects on financial performance as the economy grows more dynamic and diversified.

3. RESEACH DESIGN AND METHODOLOGY

3.1 Introduction:

Research design is the structure and plan of investigation undertaken to obtain answers to research questions. According to (Robson, 2002) the overall scheme or program of research is the plan. (Cooper & Schindler, 2003) there are many definitions of research design but no one definition impacts the fool range of important aspects but should be noted that however, all definitions provides answers for questions such as ; what kind of sampling will be used ? What techniques will be used to gather data? How will time and cost constraints be dealt with? According to (Leedy, 1989) the study design should include an outline of what the researcher will do from writing hypothesis and their operational implications to the final analysis of the data.

3.2 Research Design:

The research design adopted in this study is the investigative econometric research design as it is meant to investigate and analyses the relationship between two or more variables, namely, credit to private sector investment and consumer price index inflation. This research study is both quantitative and qualitative. It is qualitative because it investigates how credit channel of monetary transmission mechanism influence monetary policy goals in Rwanda and the challenges they encounter in the attempt to apply it. It is also quantitative because it analyzed data statistically and frequencies will be used. In data collection researcher will use secondary data collected from BNR. Concerning methods of data analysis, I will use econometric approach tabulation, coding and comparison. Tabulation will be used whereby I put data into tables. Before putting them into tables, data entry will done through Excel. In Excel, the frequencies and percentages must be computed. This will allow me to do qualitative presentation and analysis.

3.3 Data Collection:

The study will use secondary data. The time series data of inflation, GDP, key Repo rate and exchange rate, volume of deposit, volume of credit to private sector broad money will collected from BNR these included quarterly data spanning the period from 2007Q1 to 2017Q4”.

3.4 Model Specification:

The research covered the period of 2007-2017. The data are taken from National Bank of Rwanda (NBR) Library .Given that the study is aimed at establishing relationships between variables, we employed the multiple regression and correlation analysis expressed functionally as follows:

$$\text{INVEST} = f(\text{M3}, \text{Lnr}, \text{Tbr}, \text{RR}, \text{Ree}, \text{Tdep}, \text{Rgdp}, \text{RIR}) \dots\dots\dots (1)$$

$$\text{CPI} = f(\text{M3}, \text{Lnr}, \text{Tbr}, \text{Rr}, \text{Ree}, \text{Tdep}, \text{Rgdp}, \text{RIR}) \dots\dots\dots (2)$$

$$\text{CPS} = f(\text{M3}, \text{Lnr}, \text{Tbr}, \text{Rr}, \text{Ree}, \text{Tdep}, \text{Rgdp}, \text{RIR}) \dots\dots\dots (3)$$

Econometrically, the regression models can be specified as:

$$\text{Invest} = \beta_0 + \beta_1\text{M3} + \beta_2\text{Lnr} + \beta_3\text{Rr} + \beta_4\text{Ree} + \beta_5\text{Tdep} + \beta_6\text{Tbr} + \beta_7\text{Rgdp} + \beta_8\text{RIR} + \varepsilon_t \dots (4)$$

$$\text{CPI} = \beta_0 + \beta_1\text{M3} + \beta_2\text{Lnr} + \beta_3\text{Rr} + \beta_4\text{Ree} + \beta_5\text{Tdep} + \beta_6\text{Tbr} + \beta_7\text{Rgdp} + \beta_8\text{RIR} + \varepsilon_t \dots\dots\dots(5)$$

$$\text{CPS} = \beta_0 + \beta_1\text{M3} + \beta_2\text{Lnr} + \beta_3\text{Rr} + \beta_4\text{Ree} + \beta_5\text{Tdep} + \beta_6\text{Tbr} + \beta_7\text{Rgdp} + \beta_8\text{RIR} + \varepsilon_t \dots\dots\dots(6)$$

Where:

INVEST =Gross investment

CPI=consumer price index inflation

CPS= credit private sector

M3= Broad money

LNR= Lending rate

TBR= Treasury bill rate RR= Repo rate

REE= Real effective exchange

TDEP= Total bank deposit

RGDP= real gross domestic products

RIR= Real interbank rate

β_0 = Intercepts

$\beta_1 \dots \beta_8$ = coefficients to be estimated

ε_t = Is the error terms respective?

3.5 Estimation Technique:

All these variables were assumed to be non-stationary in levels. See Kigabo (2008), Gichondo and Kimenyi (2012) among others. This study, therefore, used Augmented Dickey Fuller (ADF) and Philip-Perron tests for unit root of stationarity. Moreover, this study used vector autoregressive model to assess the linear interdependencies among the variables under study. It used error correction model to measure the speed of adjustment for any shock. Finally, it employed Granger causality test to show the causal effect between the variables under study.

3.5.1 Unit Root Test

One of the assumptions for existence of co integration is that all variables of the model equation be integrated to the same order. In other words, all the series are expected to exhibit a deterministic trend behavior. Two popular set of unit root test were utilized to test the order of integration of the variables – Philip Peron (PP) and Augmented Dickey Fuller test (ADF) tests with their results as presented in table 1 below.

3.5.2 Co integration Procedure

The co integration test establishes the existence or otherwise of a long run relationship among series of the variables included in the model equation. The confirmation of at least one or more co integrated equations is an indication that all the variables will tend to be co integrated at in the long run though they could be a mix of level and non-stationary trended data series currently present in the model. The co integration is the pre-condition which is normally conducted to determine the long run equilibrium state of the data prior to the application of vector error correction method. This is informed by the argument that the co integration test is based on the assumption that there is an existence of linear trends in the series. In other words the model allows the drifting of the non-stationary relations associated with its equation. Following the result of the co integration we can conclude that there exists at least one co integrating vector or otherwise. The existence of a co integrating equation implies that the included cases of 'n' variables are being held together by long run relationship among the series. In this process, the number of the residual series and invariably the error term is predetermined from the number of co integrating vectors. In this the Johansen (1988) and Johansen and Juselius (1990) procedure is examined.

3.5.3 Vector Error Correction

The identification of a co integrating relationship among the variables wherefore is an indication for an existence of an error correction representation of the model estimation. The presence of an error correction term further suggest that the variation in the endogenous variable are explained by the equilibrium disturbances in the long run co integrating equation. These changes are confirmed from the error terms and the variations from other exogenous variables in the model. The error correction term(s) basically captures the rate of adjustment process towards the long run equilibrium state. Although the Johansen co integration procedure indicates presence or absence of co integrating equations, it does not does not reflect the direction of causality. This is normally included in the estimated vector error correction result. The error correction terms represents the short run adjustment process to the long-run equilibrium state. The higher the error correction terms the better the speed of adjustment within a specific period. The magnitude of the error correction terms ranges between zero (0) and one (1) expressed in percentage and should be negatively signed with statistically significant T-value for an acceptable adjustment process to be achieved. The error correction terms arising from the cointegrating vectors are derived from the study using the Johansen multivariate co integration procedure. The lagged levels of the error correction terms incorporated among the pre-determined variables of the error correction model analysis as part of the exogenous determinants.

3.5.4 The granger causality test

Granger (1969) proposed a time-series data based approach in order to determine causality. He applies this concept to economic time series to determine whether one time series causes in the sense of precedes another. In the Granger-sense a

variable x is a cause of another variable y if it is useful in forecasting y , i.e x is able to increase the accuracy of the prediction of y with respect to a forecast, considering only past values of y . In a VAR framework Granger-causality is tested using the multivariate model that is extended in order to test for the simultaneity of all included variables. For this study, the model for testing causality was as follows:

$$y_t = \sum_{k=0}^n \alpha_k y_{t-k} + \sum_{i=1}^k \beta_{ixt} + \varepsilon_t$$

With y_t representing a variable considered as dependent variable while x_{t-1} representing lagged values for all remained, independent, variables. The existence of causality is determined by the significance of the β is coefficients of the lagged values of variables taken as independent variables.

4. PRESENTATION, ANALYSIS AND INTERPRETATION OF FINDINGS

4.1 Introduction:

This chapter reflects the empirical analyses with the data of all credit channel transmission mechanism in Rwanda. The data are quarterly data from 2007 to 2017, and the source comes from financial statistics databases of Rwanda. The variables include bank loans, total deposit, broad money, real GDP, treasury bill rate, real effective exchange, interbank rate or overnight rate all variable are chosen to represent credit channel and all variables are in log form. We also present the findings of the stationarity and diagnostic tests. First, the section describes the findings of the cointegration analysis and the error correction modelling. Finally, impulse response functions are presented. Impulse response function shows the dynamic response of the variable to an error term in the structural equation. Next, forecast error variance (FEV) decomposition demonstrates the variability degree of the particular variable evoked by its own shock and by the shocks to other variables.

Table 1: Descriptive Statistics

Statistics	INVEST	CPS	CPI	M3	LNR	REE	RGDP	RIR	RR	TBR	TDEP
Mean	5.2438	486.15	6.9154	6.3649	16.631	82.481	6.7834	0.4295	5.8438	7.8704	6.2157
Median	5.3471	374.60	6.0350	6.3331	16.750	80.100	6.7814	1.5000	5.9900	7.5500	6.1744
Maximum	5.9584	1148.1	22.190	7.3012	17.500	98.800	7.175	6.9000	9.1300	12.300	7.2000
Minimum	3.7625	133.10	0.1900	5.3371	15.400	72.900	6.3602	-14.800	1.9700	4.0000	5.1498
Std. De	0.5732	286.43	4.9579	0.5738	0.6095	6.6065	0.2397	4.8026	1.9801	2.0778	0.6055
Skewness	-1.286	0.7328	1.2505	-0.0936	-0.3010	0.6159	-0.1604	-1.3013	-0.2310	0.3127	-0.0774
Kurtosis	4.0998	2.4122	4.5055	1.9118	2.0231	2.3990	1.8791	4.7367	2.4077	2.4223	1.9155
Jarque-Bera	14.361	4.5717	15.623	2.2351	2.4143	3.4447	2.4921	17.949	1.0345	1.3288	2.1995
Probability	0.0007	0.1016	0.0004	0.3270	0.2990	0.1786	0.2876	0.0001	0.5961	0.5145	0.3329
Sum	230.72	21390	304.28	280.05	731.80	3629.2	298.47	18.900	257.13	346.30	273.48
Sum Sq. Dev.	14.128	352784	1056.9	14.162	15.975	1876.8	2.4708	991.83	168.59	185.65	15.776
Observations	44	44	44	44	44	44	44	44	44	44	44

Source: researcher's estimation from e-views8

Table 1 shows the descriptive statistics of the variables. The results indicate that the mean values are for ratio of total deposit (TDEP) 6.21; for ratio of Investment (INVEST) 5.24 and for ratio of credit to private sector (CPS) 486.15. The mean value for broad money (M3) is 6.36, for consumer price index inflation (CPI) is 6.91 and for return lending rate (LNR) the value is 16.63, for real effective exchange (REE) mean value is 82.48, real gross domestic product (RGDP) mean is 6.78 and real interbank rate (RIR) mean value is 0.42 for repo rate (RR) mean value is 5.84 and for treasury bills rate (TBR) mean value is 7.87. The Jarque-Bera statistics indicate that all the variables except RIR are normally distributed at the 5% level of significance.

4.2 Unit Root Tests:

Augmented Dickey-Fuller (ADF) tests and Phillips-Perron (PP) tests are applied to examine the null of the unit root in each variable. since all variables are time series, we examine the null of the unit root in each variable. Table 1 reports the test results for level and the first difference of data. By the results in table 1, the nonstationary null hypothesis of the unit roots cannot be rejected. However, all variables' first differences appear to be stationary with the rejection of the unit-root hypotheses. Therefore, all data series in our sample are integrated of order one

Table 2: Unit Root Tests

variables	ADF test			PP TEST		
	Level	1st difference	I(D)	Level	1st difference	I(D)
CPI	-0.014441	-0.657679	I	-0.017140	-0.657679	I
RGDP	-0.025238	-2.614170	I	-0.017190	-1.091165	I
INVEST	-0.088553	-1.242286	I	-0.088553	-0.931003	I
M3	-0.011862	-1.257438	I	-0.011696	-1.377692	I
TBR	-0.196157	-0.649355	I	-0.136764	-0.649355	I
RR	-0.102938	-0.830046	I	-0.102938	-0.830046	I
REE	-0.110646	-0.760240	I	-0.128154	-0.760240	I
LNR	-0.108114	-1.879390	I	-0.166765	-1.225815	I
RIR	0.116717	-0.247018	I	-0.195506	-0.554034	I
CPS	-0.386775	0.049300	I	0.049300	-0.386775	I
TDEP	-0.008171	-0.755434	I	-0.008171	-0.755434	I

Source: Author's estimation

Table 2: above presents the summary results of the ADF unit root tests. The results show that the null hypotheses of a unit root test for first difference series for all the variables can be rejected at all the critical values indicating that the level series which is largely time-dependent and non-stationary can be made stationary at the first difference and maximum lag of two. Thus, the reduced form model follows an integrating order of 1(1) process and is therefore a stationary process. It also reveals that the test of stationarity in the residuals from the level series regression is significant at all lags. Furthermore, this indicates that the regression is no more spurious but real. That is to say, all the variables are individually stationary and stable.

4.3 Co integration test:

The co integration relationship among the variables employed the VAR model of eight variables (M3, LNR, TBR, RR, REE, RGDP, RIR and TDEP) specification for the first differenced variables with constant term in linear deterministic trend in the data. This implies that though there is an existence of none stationary relationship among the variables at levels, a linear combination of the series would allow the relationship to drift, producing a co integrated (long-run) relationship. The procedure utilized the Johansen (1988, Johansen and Juselius, 1990) reduced rank approach to determine the number of co integrating equations as shown in table 2.

Table 3: The Johansen's Co-Integration Test Based on Trace and Maximal Eigen Value investment

Hypothesized	Trace statistics	0.05 critical value	P. value	maximum Eigen statistics	0.05 critical value	p. value
None*	320.6257	197.3709	0.0000	84.87727	58.43354	0.0000
At most 1*	235.7484	159.5297	0.0000	63.61565	52.36261	0.0024
At most 2*	172.1328	125.6154	0.0000	53.61136	46.23142	0.0069
At most 3	118.5214	95.75366	0.0006	45.55580	40.07757	0.0110
At most 4	72.96560	69.91889	0.0274	26.91279	33.87687	0.2680
At most 5	46.05281	47.85613	0.0731	20.77264	27.58434	0.2902
At most 6	25.28017	29.79707	0.1517	16.18398	21.13162	0.2143
At most 7	9.096189	15.49471	0.3566	8.960694	14.26460	0.2894
At most 8	0.135494	3.841466	0.7128	0.135494	3.841466	0.7128

Source: Author's estimation, (*) denotes rejection of the hypothesis at the 0.05 level

Table 3 shows the summary results of the Johansen Co-integration test employed to test for the long run co-integration relationship between investment and independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product(RGDP),real interbank rate (RIR)and, total deposit(TDEP), have three co-integrating equations each for both the trace tests and the maximum-eigenvalue test with one to two lag intervals taken at 5 percent significant level.

Table 4: long run Dynamics: Normalized cointegration coefficient Investment

INVEST	M3	LNR	TBR	RR	REE	RGDP	RIR	Tdep
1.000000	-29.12577	-6.001793	0.06756	-0.076818	0.080924	91.0773	-0.1074	0.067562
S.Error	4.77354	0.92371	0.23149	0.25350	0.03820	7.61346	0.0548	0.231490
T-stat	-6.10150	-6.4948	0.29184	-0.3030	2.11842	11.962	1.9598	0.29185

Source: researcher's estimation from e-views8

The result of the normalized co integrating vectors as shown in table 4 indicates a significant long run relationship between investment (invest) and independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP),real interbank rate (RIR)and, total deposit(TDEP).

Table 5: The Johansen's Co-Integration Test Based on Trace and Maximal Eigen Value inflation

Hypothesized	Trace statistics	0.05 critical value	P. value	maximum Eigen statistics	0.05 critical value	p. value
None *	370.4300	197.3709	0.0000	98.21532	58.43354	0.0000
At most 1 *	272.2147	159.5297	0.0000	76.88446	52.36261	0.0000
At most 2 *	195.3302	125.6154	0.0000	62.00659	46.23142	0.0005
At most 3 *	133.3237	95.75366	0.0000	46.86065	40.07757	0.0074
At most 4 *	86.46300	69.91889	0.0013	42.81587	33.87687	0.0033
At most 5 *	43.64713	47.85613	0.1176	20.59170	27.58434	0.3016
At most 6 *	23.05543	29.79707	0.2433	14.64090	21.13162	0.3149
At most 7	8.414527	15.49471	0.4222	7.331274	14.26460	0.4507
At most 8	1.083253	3.841466	0.2980	1.083253	3.841466	0.2980

Source: Author's estimation, (*) denotes rejection of the hypothesis at the 0.05 level

Table 5 shows the summary results of the Johansen Co-integration test employed to test for the long run co-integration relationship between inflation and independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product(RGDP),real interbank rate (RIR)and, total deposit(TDEP), have four co-integrating equations each for both the trace tests and the maximum-eigenvalue test with one to two lag intervals taken at 5 percent significant level.

Table 6: long run Dynamics: Normalized cointegration coefficient Inflation

CPI	M3	LNR	TBR	RR	REE	RGDP	RIR	TDEP
1.000000	308.8909	42.94636	-0.81504	1.342199	-1.150608	-1164.4	-0.9621	85.98379
S.E	40.4430	7.35944	1.72635	1.91825	0.31479	79.1663	0.42375	32.9375
T-stat	7.63768	5.83554	-0.4721	0.6996	-3.6551	-14.70	-2.270	2.61

Source: researcher's estimation from e-views8

The result of the normalized co integrating vectors as shown in table 6 indicates a significant long run relationship between inflation (CPI) and independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product(RGDP),real interbank rate (RIR)and, total deposit (TDEP).

Table 7: The Johansen's Co-Integration Test Based on Trace and Maximal Eigen Value credit to private sector

Hypothesized	Trace statistics	0.05 critical value	P. value	maximum Eigen statistics	0.05 critical value	p. value
None *	360.3359	197.3709	0.0000	90.17276	58.43354	0.0000
At most 1 *	270.1632	159.5297	0.0000	76.90677	52.36261	0.0000
At most 2 *	193.2564	125.6154	0.0000	58.88161	46.23142	0.0014
At most 3 *	134.3748	95.75366	0.0000	58.36300	40.07757	0.0002
At most 4 *	76.01180	69.91889	0.0147	33.81029	33.87687	0.0509

At most 5	42.20152	47.85613	0.1532	22.97871	27.58434	0.1744
At most 6	19.22280	29.79707	0.4770	11.83095	21.13162	0.5644
At most 7	7.391848	15.49471	0.5325	7.389215	14.26460	0.4442
At most 8	0.002633	3.841466	0.9566	0.002633	3.841466	0.9566

Source: Author's estimation (*) denotes rejection of the hypothesis at the 0.05 level

Table 7 shows the summary results of the Johansen Co-integration test employed to test for the long run co-integration relationship between credit to private sector and independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product(RGDP),real interbank rate (RIR)and, total deposit(TDEP), have five co-integrating equations each for both the trace tests and the maximum-eigenvalue test with one to two lag intervals taken at 5 percent significant level.

Table 8: Long run Dynamics: Normalized cointegration coefficient total credit to private sector

CPS	M3	LNR	TBR	RR	REE	RGDP	RIR	TDEP
1.000000	1234.800	323.7449	-48.3732	12.70472	-13.20209	-5071.4	19.8625	318.5586
S.E	406.380	68.7993	20.5975	19.5230	2.97190	568.850	4.26776	397.432
T-stat	3.038	4.705	-2.3484	0.650	-4.4422	-8.915	4.66	0.801

Source: researcher's estimation from e-views8

The result of the normalized co integrating vectors as shown in table 8 indicates a significant long run relationship between credit to private sector (CPS) and independent variables representing credit channel, namely: broad money (M3), lending rate (LNR), Treasury Bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and, total deposit (TDEP).

Hypothesis 1:

Credit channel does not have any significant impact on investment in Rwanda. Tables 9 shows the results of the parsimonious error correction for the impact on investment (INVEST) of the independent variables representing credit channel, namely: broad money (M3), lending rate(LNR), Treasury Bill rate (TBR),repo rate (RR), real effective exchange (REE), real gross domestic product(RGDP),real interbank rate (RIR)and, total deposit each lagged four periods.

Table 9: Short-run dynamics: Vector error correction model coefficients on investment

Dependent Variable: D(INVEST)

Method: Least Squares

Date: 06/07/18 Time: 14:18

Sample (adjusted): 2007Q4 2017Q4

Included observations: 41 after adjustments

Regressor	Coefficient	Std. Error	t-Statistic	Prob.
CEM	-0.004486	0.015961	-0.281083	0.7814
D(M3(-1))	2.919792	4.076864	0.716186	0.4818
D(LNR(-1))	0.084827	0.115584	0.733897	0.4711
D(TBR(-1))	-0.019235	0.039003	-0.493170	0.6270
D(RR(-1))	0.047682	0.051006	0.934830	0.3605
D(REE(-1))	-0.017618	0.017707	-0.994970	0.3311
D(RGDP(-1))	0.374665	1.164406	0.321765	0.7508
D(RIR(-1))	0.010150	0.012739	0.796812	0.4345
D(TDEP(-1))	-2.544518	3.914972	-0.649945	0.5228
R-squared	0.407501			
Adjusted R-squared	0.128569			
F-statistic	0.760164	Durbin-Watson stat		1.976752
Prob(F-statistic)	0.724075			

Source: researcher's estimation from e-views8

The Parsimonious Error Correction results in Table 9 on the impact of credit channel investment show that R-squared is 0.40 while adjusted R-squared is 0.12 indicating that 40 percent of changes in investment are attributable to the combined effect of the ratio of broad money (M3), the ratio of lending rate (LNR), Treasury bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and the total deposit (CPS). Also, from the table, we see that The Parsimonious Error Correction results in Table 9 on the impact of credit channel on investment reveal that none of the independent variables is statistically significant in the current period. F-statistic is 0.76 with a probability value of 0.72 indicating that the combined effect of all independent variables have non-significant impact on investment. Consequently, we accept the null hypothesis in short run but rejected in long run. Furthermore, the Error Correction Co-efficient of -0.004486 is appropriately signed, being negative and also insignificant at 5% level of significance. The co-efficient shows that the speed of adjustment of the model is approximately 12.8 percent quarterly due to a deviation from equilibrium.

Hypothesis 2:

Credit channel does not have any significant impact on inflation in Rwanda. Table 10 shows the results of the parsimonious error correction for the impact on inflation (CPI) of the independent variables representing credit channel, namely: broad money (M3), lending rate (LNR), Treasury Bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and, total deposit, each lagged two periods.

Table 10: Short-run dynamics: Vector error correction model coefficients on inflation

Dependent Variable: D(CPI)				
Method: Least Squares				
Date: 06/07/18 Time: 14:04				
Sample (adjusted): 2007Q4 2017Q4				
Included observations: 41 after adjustments				
Regressor	Coefficient	Std. Error	t-Statistic	Prob.
CEM	-0.750923	0.122892	3.669264	0.0014
D(M3(-1))	-16.34101	42.69093	-0.382775	0.0057
D(LNR(-1))	1.106165	0.412185	2.683663	0.0139
D(TBR(-1))	0.902021	0.617112	1.461682	0.1586
D(RR(-1))	0.284763	0.177215	1.606876	0.0230
D(REE(-1))	3.366807	1.292685	2.604507	0.0166
D(RGDP(-1))	-1.686176	0.597718	-2.821023	0.0102
D(RIR(-1))	30.43772	10.32270	2.948619	0.0077
D(TDEP(-1))	7.632877	40.99130	0.186207	0.8541
R-squared	0.836071			
Adjusted R-squared	0.687754			
F-statistic	5.637065	Durbin-Watson stat		2.978956
Prob(F-statistic)	0.000124			

Source: researcher's estimation from e-views8

The Parsimonious Error Correction results in Table 10 on the impact of credit channel of monetary transmission used by central bank on inflation reveal that all the eight independent variables, namely: broad money (M3), lending rate (LNR), Treasury Bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and, total deposit, have a significant impact on inflation. The overall result reveals that R-squared is 0.83 and adjusted R-squared is 0.68 indicating that 68 percent of the variations in inflation could be explained by the combined effect of changes in all independent variables.

Hypothesis 3:

Credit channel does not have any significant impact on credit to private sector in Rwanda. Table 11 shows the results of the parsimonious error correction for the impact on credit to private sector (CPI) of the independent variables representing

credit channel, namely: broad money (M3), lending rate (LNR), Treasury Bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and, total deposit (TEDP), each lagged four periods.

Table 11: Short-run dynamics: Vector error correction model coefficients on credit to private sector

Dependent Variable: D(CPS)
 Method: Least Squares
 Date: 06/07/18 Time: 14:36
 Sample (adjusted): 2007Q4 2017Q4
 Included observations: 41 after adjustments

Regress or	Coefficient	Std. Error	t-Statistic	Prob.
CEM	-0.753569	0.035070	1.242335	0.0278
D(M(-1))	-308.0670	454.8331	-0.677319	0.0556
D(LNR(-1))	25.80857	15.87428	1.625811	0.0189
D(TBR(-1))	-3.303031	4.332200	-0.762437	0.0543
D(RR(-1))	14.82574	5.720794	2.591552	0.0170
D(REE(-1))	1.333210	2.128449	0.626376	0.0378
D(RGDP(-1))	13.14543	115.4143	0.113898	0.0104
D(RIR(-1))	-0.527261	1.446951	-0.364395	0.0192
D(TDEP(-1))	247.1024	457.8563	0.539694	0.0451
R-squared	0.662967			
Adjusted R-squared	0.758033			
F-statistic	2.174132	Durbin-Watson stat		2.239146
Prob (F-statistic)	0.043590			

Source: researcher's estimation from e-views 8

The Parsimonious Error Correction results in Table 11 on the impact of credit channel of monetary transmission used by central bank on credit to private sector reveal that all the eight independent variables, namely: broad money (M3), lending rate (LNR), Treasury Bill rate (TBR), repo rate (RR), real effective exchange (REE), real gross domestic product (RGDP), real interbank rate (RIR) and, total deposit, have a significant impact on credit to private sector. The overall result reveals that R-squared is 0.66 and adjusted R-squared is 0.75 indicating that 75 percent of the variations in credit to private sector could be explained by the combined effect of changes in all independent variables.

5. RESEARCH FINDINGS AND DISCUSSION

5.1 Introduction:

This chapter consists of the conclusions, the summary of the major findings and policy recommendations.

5.2 Summary of findings:

The study was designed to the modeling the effectiveness credit channel of monetary transmission mechanism in Rwanda. The findings from variance decomposition depicts that there is a long run relationship between the real Effective Exchange (REE) and real GDP although real interbank rate lending rate, repo rate, total deposit treasury bill rate, M3 and CPI investment and private sector credit still there exists a pass through effect from a shock in the credit channel. From the study, investment has the weakest response to broad money shock but generally, findings suggest that the credit channel was effective in the long run analysis.

5.3 Conclusions:

The general objective of the study was to give measurement the effectiveness of the credit channel of monetary transmission mechanism in Rwanda. This objective was translated in to three specific objectives. The first specific objective was to determine the dynamic effect of credit channel on the consumer price index in Rwanda. The findings

suggests 37.3% variations in fluctuations in REE in the second quarter are attributed to a standard deviation shock in inflation, which maintains almost the same rate in the long run depicting 46.6% with the CPI suggesting that the impact is fingered after the ninth quarter. The second specific objective was to establish the relative importance of the credit channel on credit to private sector whereby the study suggests that 88.9% variations in fluctuations of CPS are as result of shock to itself and 10.2% as a result of shock from the repo rate. In the long run (10th quarter) 10.2% variations in fluctuation were as a result of one standard deviation repo rate shock. The shock is positively felt in the first quarter after which it neutralizes. Findings based on the third specific objective suggest that, credit to private sector variable peroxide by M3 was in the first quarter 87.3%. According to VAR, it had a significant influence of positive nature in second quarter. It was also observed that credit channel explains 26.4% variation in fluctuations in total deposit and 17.6 % fluctuations in GDP in the first quarter while in the 10th quarter; it explains 69.9% variations in fluctuations in CPS.

These results especially on GDP to a smaller extent does not tally with Cheng's (2006), whose results suggested insignificant influence of a monetary transmission shock to GDP of Kenya. Moreover, our findings also indicate that there is a long-run relationship between credit channel and the consumer price index, investment, private sector credit. The Johansen cointegration test applied in our study indicated the existence of a theoretical relationship between the credit channel and investment, consumer price index that they are in symmetry in the long run. Furthermore, our results from VAR indicate that the credit channel has a causal impact on the consumer price index inflation, investment and credit to private sector. Both the error-correction model and the generalized variance decomposition analyses applied in this paper tend to indicate that the variable representing credit channel are relatively more exogenous whereby the investment, consumer price index variables are relatively more endogenous or lagging.

Our findings are in line with the findings of barebereho (2008) who found that the growing importance of the non-bank and informal financial sector is demonstrated by its contribution to the financing of the economy. In 2006, the financing of this sector represented 29.6% of total credit. This constitutes an important limit on the effectiveness of the credit and interest rate channels. Nonetheless, the upward trend of credit demand by the private sector observed for several years, stemming from the dynamism of the Rwandan economy, is evidence of the contribution of the credit channel in recent years.

5.4 Recommendations:

There is need for constant revision of policy and instruments targeting framework and operating procedure to enhance monetary policy effectiveness particularly in stabilizing the exchange rate and keeping inflation levels at the generally recommended rate. There is need for NBR to harmonize and combine the functionality of all channels to achieve optimum output goals of monetary transmission mechanism. This could be complemented with adoption of one policy rate used to signal the market and by doing so, it will reduce on duplication of activities by different rates and lead to optimum outcomes of monetary policy goals by 2018.

Other factors could be used to control inflation other than monetary tools among them being diversification of energy sources large scale mechanized agriculture, engaging in avoidance activities so as to prevent the economy from price shocks occasioned by fluctuation of the dollar when importing this could assist in maintaining inflationary levels at a rate below the government recommended rate of 5%. In advent of financial innovation, it's advisable that the NBR combines other transmission channels of monetary policy to achieve optimum policy outcome as opposed to concentrating on single channel. By so doing, financial innovation may dampen the credit channel but through other channels it might be responsive.

5.5 Suggestions for Further Research:

The study sought modeling the effectiveness of credit channel of monetary transmission mechanism on investment, inflation levels and private sector performance. The study suggests further research on modeling the effectiveness of credit channel when interacted with financial innovation variable on asset prices. With increased access to world financial markets by local firms as a result of the Euro bond, the Rwandan financial markets is projected to improve pass through effects on asset prices. The study could also be further developed by including more variables to the regression model like the 90 days Tb rates and the recently formulated Rwanda Banks Reference Rate as policy rates. In addition, one can incorporate the interest rate channel interacted with credit to private sector.

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