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Bank credit and transmission mechanisms of monetary policy in Uganda

By Jimmy ALANI †

Abstract. This paper examines the effect of monetary policy on bank credit in Uganda during the January 2008 to December 2017 period. By using macro level monthly data, it tests for the existence of monetary policy transmission channels, in particular the presence of bank credit channel in the economy of Uganda. This is done by showing that bank credit growth in Uganda is affected by monetary policy shocks. Before conducting data analysis, tight bank credit models were built with the view of making the analysis mimic the actual behavior of bank credit and the monetary policy transmission mechanism. Data used in the empirical analysis are from Bank of Uganda. Empirical analysis is conducted by using the generalized least squares (GLS) technique. The advantage with the GLS method is that it is generally more efficient because it eliminates both serial correlation and variance values that are not constant. The empirical results establish presence of the bank credit channel of the monetary policy transmission mechanism in Uganda. Secondly, the empirical tests conducted establish that the relationship between reserves and loans typically operates in the reverse way to that described in some economics textbooks. Similarly, the relationship between bank deposits and bank deposits is found in principle to operate only during the current month in the reverse way to that described in some economics textbooks. Thirdly, empirical tests conducted indicate that 1 percent increase in money supply (M2) is responsible for causing 2.2 percent monthly increase in bank deposits in Uganda during the sample period, ceteris paribus.
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1. Introduction

The major objective of the study is to empirically examine the effect of monetary policy on bank credit in Uganda. There is widespread agreement on the key roles that banks play in the transmission of monetary policy initiatives to the economy. But there is considerable controversy over the precise roles that banks play. The paper focuses on examining whether bank credit (i.e. lending) played a special part in the monetary transmission mechanism particularly in Uganda during the 2008:1 to 2017:12 period. As a result the major research question of the paper is: Do monetary policy changes directly constrain bank credit? The

† Makerere University School of Economics, College of Business and Management Sciences (COBAMS), P.O. Box 7062, Kampala, Uganda.
☎. +44 7515 909 633 ✉. alanijimmy@gmail.com

existence of lending or credit channels influence the willingness and ability of banks to extend credit as well as the aggregate economic activities.

There are two channels within the credit channel that act as conduits of the role of banks in the transmission of monetary policies: (a) the balance sheet channel or the borrower's net worth channel and (b) the bank lending channel. The balance sheet channel is the channel through which policy can weaken the balance sheet of borrowers and affect their borrowing capacity. The bank lending channel occurs when tight monetary policy or an increase in the issuance of commercial papers by firms is shown to be related to a decrease in loan supply rather than a decline in loan demand. Therefore, the bank lending channel can only be possible under two conditions: if there are borrowers who are dependent on banks for their loan requirements and if the loan supply of these banks are affected by movements in monetary policy (Aban, 2013).

A conducive monetary policy is required for bank credit to play important roles in the monetary transmission mechanism. But there is conflicting evidence on how bank lending is directly constrained by monetary policy actions (Morris & Sellon, 1995). Therefore, the paper attempts to determine whether bank credit is indeed constrained by monetary policy.

Monetary policy is any policy measure designed by the Government or the Central Bank to control the cost, availability and supply of credit (Dare & Okeya, 2017). The major goals of monetary policy are mainly to control (a) inflation and (b) maintain a healthy balance of payment (BOP) position, in order to safeguard the external value of national currency and promote adequate and sustainable level of economic growth and development. The monetary (regulatory) authorities achieve these goals through control of money supply to enhance price stability (i.e. low and stable inflation). The Ministry of Finance is responsible for monetary management functions, whereas the central bank is responsible for its function of decision making on the monetary policy. As a result these responsibilities make the process of monitoring monetary policy a seemingly difficult task (Osiegbu, 2006).

Opolot & Nampewo (2014) by using pane data examines the relevance of the bank lending channel of the monetary policy transmission mechanism in Uganda by using micro–level data. His study focuses on the response of bank loans to the following variables: GDP, 91–day–treasury bill rate, inflation, liquidity and capitalization only. As a result, by using the generalized least squares technique, this paper examines the response of bank credit to GDP, inflation and liquidity (M2) including those variables that Opolot & Nampewo (2014) ignored: bank deposits, velocity of credit, velocity of money, real interest rate, exchange rate, net equity, currency in circulation, total deposits in the banking system, government bonds, demand deposits, external debt servicing, exports and imports.

More importantly, the paper rejects the empirical evidence by Werner (2014) regarding the three theories of banking. He claims that it is the one that is being belittled in the literature today as having the least influence

that is being supported by the empirical evidence. The three theories that Werner (2014) identify are: (a) The financial intermediation theory of banking which states that banks are merely intermediaries like other non–bank financial institutions, collecting deposits that are then lent out. (b) The fractional reserve theory of banking which claims that individual banks are mere financial intermediaries that cannot create money, but collectively they end up creating money through systemic interaction. (c) The credit creation theory of banking maintains that each individual bank has the power to create money out of nothing and does so when it extends credit.

Although Werner (2014) uses the balances sheet method, this paper employs the generalized least squares (GLS) technique and empirically rejects the notion that banks individually create money out of nothing. Implying that systemic issues emanating from the banking sector are possible to detect (a) in economic models that include banks and (b) in finance models that are based on individual, representative financial institutions that can be embed these appropriately into macroeconomic models contrary to what King (1994) King (1994) and Werner (2014) suggested.

2. Literature review

Contemporary economists evaluate monetary policy by examining monetary policy shocks represented by changes in nominal interest rates rather than changes in the money supply. Therefore, they define monetary policy as fixing the nominal interest rate in order to exert influences on macroeconomic outcomes such as output and expected inflation while allowing the money supply to be determined by interest rate and inflation expectations (Kamati, 2014).

Monetary policy examines issues regarding the effects of monetary policy variables on prices and real economic activity. It lies at the heart of macroeconomic theory and at the center of monetary policy. Economists generally agreed that monetary policy, specifically unanticipated monetary shocks, have a significant effect on the economy, even if it is at least in the short run. Changes in monetary policy variables are relayed throughout the economy via a transmission mechanism, commonly known as the monetary transmission mechanism (Robinson & Robinson, 1997).

Monetary policy transmission mechanism takes place largely through its influence on aggregate demand in the economy. In the long run, monetary policy determines the nominal or money values of goods and services i.e. the general price level. In other words, in the long run, monetary policy essentially determines the value of money i.e. movements in the general price level indicate how much the purchasing power of money has to change over time. Thus, inflation is regarded as a monetary phenomenon and there are several channels in the chain of causation running from monetary policy changes to their ultimate effects on the economy (Bank of England, 1999).

A central bank has the monopoly power to supply base money. It does so in order to determine a specific interest rate in the wholesale money markets. The operating procedure of a central bank is similar to that of many other central banks. But institutional details differ slightly from country to country. Thus, the central bank chooses the price at which it will lend high–powered (base) money to private sector institutions.

In many countries the central bank lends predominantly through sale and repurchase agreements (repo) at the two–week maturity and repo rate is the official rate. Change in the official rate has quantitative effect on movements of other interest rates. As a result effects of official rate on financial markets in general, will depend on the extent to which the policy change was anticipated and how the change affects expectations of future policy (Bank of England, 1999).

2.1. The three major theories of monetary policy

The Keynesian theory of monetary policy focuses on the liquidity preference theory. That is the Keynesian demand for money introduced in the monetary sector (Belke & Polleit, 2009). The liquidity preference theory is one of important features that distinguish Keynesian monetary theory from the general family of neoclassical theories. The Keynesian liquidity preference theory explains why people individually express demands for money; the motives for money as liquid asset (Lewis & Mizen, 2000). In the Keynesian theory of economics, the demand for money is determined by interactions between income and interest rate, that is, the price of demand.

As a result, the Keynesians argued that, to influence the demand for money, there should be direct control of either the price of money or indirect control by inducing changes through real income. In brief, the theory holds that a change in interest rate, other things being equal, affects individual preferences for holding liquid (cash) and illiquid assets (Akani & Imegi, 2017).

According to Cagan (1989), monetarism as a theory is associated with the view that (a) the quantity of money affects economic activity and price level, and (b) inflation can be controlled by a monetary policy that targets the growth of money supply. As a school of thought monetary theory has been spearheaded by Friedman & Schwartz (1982). Monetarists emphasize the role of money and the link between money growth and inflation (De Long, 2000).

The Monetarists describe the monetary policy transmission mechanism as a direct relationship between money and inflation as depicted in the quantity equation theory of money. This direct relationship is opposed to indirect link through financial markets as described in the Keynesian monetary theory. Friedman (1968) is viewed to be the father of monetarism and he asserts that there is clear evidences that monetary policy strongly affects the real variables in the short term (Akani & Imegi, 2017).

But rational expectations theory was formulated by Muth (1961). Muth (1961) states that the players in an economy will act in a way that conforms

to what can logically be expected in the future. That is, a person will invest or spend according to what he rationally believes will happen in the future.

There are two broad channels through which the monetary policy transmission mechanism operates: (a) credit channel and (b) assets price channel. The credit channel consists of (i) bank lending channel, (ii) balance sheet channel which also includes the cash flow channel and unanticipated price level channel (iii) expectations channel and (iv) household liquidity effects channel. The assets price channel consists of (i) interest rate channel, (ii) exchange rate channel, (iii) equity prices channel and (iv) wealth effects channel (Chileshe, 2017; Mishkin, 2004, p.619).

2.2. Theory of monetary policy transmission mechanism and bank credit channel

Monetary policy aims at controlling aggregate demand by directly controlling the money supply or by altering the rate of interest and backing this up by making any other necessary changes (Sloman & Wride, 2009). In general, monetary policy refers to any deliberate action by the central bank designed to change the availability or cost of money (Stanlake, 1974). Monetary policy can be referred to as either being expansionary, if it increases the money supply and lowers the rate of interest. The monetary policy can be referred to as contractionary, if it reduces the money supply and increases the rate of interest (Kalikeka & Sheefeni, 2013).

A correct assessment of the monetary policy transmission mechanism is vital for understanding and foreseeing the effects of the monetary conditions on the real economy (Pruteanu-Podpiera, 2007). As a result, the mechanism through which the monetary policy is transmitted to the real economy has been the topic of extensive theoretical and empirical research. Yet, the exact mechanism has not yet been completely unveiled, a situation which Barnanke & Gertter (1995) describe as a black box (Barnanke & Gertter, 1995; Oni & Ozemhoka, 2013). The macroeconomic response to policy–induced interest rate changes was considerably larger than implied by conventional estimates of interest elasticity's of consumption and investment. Thus, implying that mechanisms other than the interest rate channel were at work in the transmission of monetary policy (Barnanke & Gertter, 1995).

The monetary transmission mechanism looks at how a change in the money supply is channeled through particular models to influence real and nominal variables. Classical economists use the quantity theory to give a direct and mechanical link between money and prices. But the Keynesian economists put emphasis on the indirect mechanism through which money affects the price level via the interest rate (Akani & Imegi, 2017; Dennis, 1981; Oni & Ozemhoka, 2013). In using monetary policy, the central bank can push up market interest rates by reducing the supply of money. The central bank can sell government securities to the public in exchange for checks drawn on commercial banks in the economy. When the central bank debits the reserve accounts of the commercial banks, reserves in the

banking system fall relative to deposits (Morgan, 1992). Bank credit creation can be affected by monetary policy through two closely related sub–channels: bank balance sheet channels and the bank lending channels (Oni & Ozemhoka, 2013).

The traditional transmission model rules out (a) the existence of the financial sector and every profitable project at the prevailing interest rate according to Modigliani & Miller (1958), and (b) argues that the source of financing does not matter for the firm to make its (investment) decisions and that resources are always allocated efficiently.

As a result, in the context of symmetrical information and no transaction costs, financial intermediation serves no purpose and thus no resources are devoted to it. Therefore, the traditional transmission model, takes financial intermediaries particularly banks to exist as the economy's efficient response to information asymmetries between lenders and borrowers, its associated transaction and monitoring costs, and the presence of liquidity risks.

The traditional transmission model (TTM) also treats the financial intermediaries as if they exist in a world with multiple financial instruments; where at least two sources of financing must be recognized for firms.

Firstly, the external or intermediated funds is where the firms can access the financial market, but does not trade directly with individual investors, and they receive their funds through an intermediary (bank loans). Secondly, the TTM considers sources internal/direct funds, in which the firm can (a) either finances itself, without accessing the financial market, (b) or is able to raise fund directly from individual investors (through the issue of bonds or stocks). The implicit assumption in the traditional monetary transmission mechanism is problematic for the second source, because it can be restricted (totally or partially) for a significant number of firms. If so, the fall in investment may not depend, as in the traditional channel, on the project's profitability relative to its alternative costs but rather on the firm's access to bank credit.

Two major mechanisms have been proposed to explain the link between monetary policy actions and the cost, namely the balance sheet channel and the bank lending channel. This tries to separate the effects on the firms' borrowing capacity from the amount of credit offered by the banks. Both rely on a market imperfection, which conditions access to the financial market on the firm's characteristics, rather than on the profitability of its investment projects (Gerlach & Peng, 2005; Akani & Imegi, 2017).

2.2.1. The balance sheet channel

The credit channel of monetary policy consists of the bank lending channel, balance sheet channel, expectations channel and household liquidity effects channel. The bank lending channel operates on the banks' liability side. Tight monetary policy can drain reserves from the banking system. As a result, the banks are left with fewer loanable funds, thus causing reduction in lending (Bernanke & Blinder, 1988).

The balance sheet channel operates through banks' asset side. Through the balance sheet channel, monetary policy affects agency costs in bank lending, which leads to changes in firms' ability to qualify for credit. Monetary contractions reduce the net worth of borrowers, and consequently increases agency costs, primarily for low–net–worth firms (Bernanke *et al.*, 1996; Black & Rosen, 2016). As a result, increase in agency costs cause only relatively safer borrowers to continue qualifying for credit (Bernanke & Gertler, 1989).

Monetary policy models describe an economy in which there is an excess supply. It assumes the aggregate output to be demand determined in the short to medium run. Agents in this macro model consists of (a) households, (b) domestic firms, (c) the government; (d) the rest of the world who provides capital, goods and services demanded by the domestic economy and a market for domestic production and (e) the central bank. Furthermore, in the model, the central bank has the task of anchoring the nominal side of the economy. Consequently, to provide nominal stability in the economy, the central bank adopts an inflation targeting framework (IT). The IT is a flexible inflation targeting and the central bank sets a short–term interest rate to achieve an inflation target.

The monetary policy model assumes that there are lags and delays between a change in interest rate and inflation. Therefore, the use of a simple interest rate rule is required to anchor inflation in the long run, given these lags and price and wage rigidities, Moreover, the nominal short–term interest rates play leading role as instruments of monetary policy.

The monetary policy model takes the transmission mechanism to begin with the domestic interest rate policy (Clarida, Gali & Gertler, 2000). *Cash flow channel* is another balance sheet channel. It operates through its effects on cash flow, the difference between cash receipts and cash expenditures. Improvement in the balance sheets of firms can occur when expansionary monetary policy lowers nominal interest rates and raises cash flow. Increase in cash flow leads to improvement in the balance sheet because it increases the liquidity of the firm (or household) and thus makes it easier for lenders to know whether the firm (or household) will be able to pay its bills. *Unanticipated price level channel* is a third balance sheet channel. It operates through monetary policy effects on the general price level. Unanticipated rise in the price level lowers the value of firms' liabilities in real terms (decreases the burden of the debt) but does not lower the real value of the firms' assets (Mishkin, 2004, pp.622–623).

2.2.2. The bank lending channel

According to King (1991) the bank lending channel represents the credit view of this mechanism. According to this view, monetary policy works by affecting bank assets (loans i.e. credit) as well as banks' liabilities (deposits). More importantly, King (1991) contends that monetary policy besides shifting the supply of deposits also shifts the supply of bank loans. For

instance, an expansionary monetary policy that increases bank reserves and bank deposits increase the quantity of bank loans available. As a result, due to many borrowers who are dependent on bank loans to finance their activities, bank loans will increase and cause a rise in investment spending (and also consumer spending), leading ultimately to an increase in aggregate output (Y).

King (1994) provides a schematic presentation of the resulting monetary policy effects as follows:

$$M_n \uparrow \rightarrow Bank\ Deposits \uparrow \rightarrow Bank\ Loans \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow$$

The scheme provided by King (1994) appears to be wrong because it is not in line with the scheme advanced by Stroup (2006, pp.184–224) as follows:

$$C_r = D - BD$$
$$C_r = (mM_n/r_m) - BD$$

Thus, implying that

$$M_n \uparrow \rightarrow Bank\ Deposits \uparrow \rightarrow Bank\ Loans \downarrow \rightarrow I \downarrow \rightarrow Y \downarrow$$

Where M_n is money supply, C_r is bank credit (bank lending), D is total deposits in the banking system, m is the money multiplier and r_m is deposit multiplier. Therefore, the two schemes have to be evaluated for their correctness.

According to Tabak *et al.* (2016), the global banking crisis which started in 2007, prompted more debate about the role of banks in the monetary policy transmission process. As a result, the bank credit has received much attention from researchers as a channel for monetary policy transmission. Considering the fact that monetary policy directly affects bank deposits is important because deposits represent the supply of loan funds, which act as a driving force for credit. In the monetary policy transmission process, a restrictive monetary policy reduces the number of deposits in the banking system leading to a decline in loans. This happens when banks realize that the payments of credits already granted will not be sufficient to restore the reduction of deposits based on a possible increase in defaults. As a result, the banks increase interest rates on new loans due to a decline in the supply of credit (Bernanke & Blinder, 1988; Tabak *et al.*, 2016).

Again, according to Tabak *et al.* (2016), two traditional channels of monetary policy transmission mechanism exist. These two channels can explain the association between monetary policy and the evolution of the balances of bank deposits. Through these channels, the central bank can either (a) change the level of deposits by controlling of bank reserves and by manipulation of the money multiplier (Disyatat, 2010) or (b) making the bank lending channel possible through the influence of monetary policy on the soundness of bank balance sheets (Tabak *et al.*, 2016). Experiences from many central banks around the world has shown that there has been a shift

from the traditional interest rate targeting approach to monetary policy technique (Serletis *et al.*, 2013). The monetary policy approach focuses mainly on the central bank and its balance sheet. Central banks have decided to use quantitative measures of monetary policy such as quantitative easing and credit easing (Tabak *et al.*, 2016).

Spahn (2014) contends that although the doctrine of deposits availability appears flawed it is still accepted in the circle of central banks. According to the European Central Bank (2010a, p.63), bank lending tends to contract after a tightening in monetary policy. As a result an increase in the policy rate causes a reduction in the availability of bank deposits. Thus deposit holders shift their investments from deposits to assets that offer higher returns. Banks should compensate for the decline in deposits via other sources of funding, because the downward adjustment acts as a constraint on the asset side of banks' balance sheets, ultimately inducing a contraction in bank loans. On the contrary, the paper discovers that the doctrine of deposits availability is not flawed and it was concretely modeled using genuine derivations by (Stroup, 2006, pp.184–224).

But Disyatat (2010) argues that the doctrine of deposits availability suffers from a fallacy of composition and stresses that in the system as a whole, deposits cannot fall unless banks issue new liabilities to replace them or sell an asset to non-banks (including loan repayment). Disyatat (2010) thinks that attempts by individual agents to dispose of their deposit holdings by buying assets from other nonbank private sector agents simply redistributes deposits within the system leaving aggregate deposits unchanged. It should be noted that Disyatat (2010) does not distinguish between bank deposits and the deposits made by system of banks, but Stroup (2006) does.

2.2.3. The Expectations Channel

There is a consensus that expectations play a key role in shaping the behavior of economic agents as stipulated in modern macroeconomic theory. However, economists disagree on how these are generated. Friedman and other monetarists, postulate adaptive expectations. On the other hand, the new classical school lead by Lucas and the New Keynesian School argue for rational expectations.

The expectation channel is fundamental to the working of all channels of monetary policy transmission. That is because economic agents are assumed to be forward looking and rational. Although this channel is taken to be mainly operational in developed economies with well– functioning and deep financial markets (Davoodi *et al.*, 2013) they may be operational in less developed economies as well. For example, inflation expectations matter in two important ways. Inflation expectations may influence the level of the real interest rate and consequently determine the effect of any specific nominal interest rate. On the other hand inflation expectations may influence price and money wage–setting behavior and get into actual inflation in latter periods (Chileshe, 2017).

2.2.4. Household Liquidity Effects

The credit channel applies equally well to consumer spending, particularly on consumer durables and housing. That is because declines in bank lending induced by a monetary contraction may cause a decline in durables and housing purchases by consumers who do not have access to other sources of credit. Furthermore, the consumers' cash flow is adversely affected due to increases in interest rates by causing a deterioration in household balance sheets. In the liquidity effects channel, balance sheet effects work through their impact on consumers' desire to spend rather than on lenders' desire to lend. Consumer durables and housing are very illiquid assets due to asymmetric information about their quality. Thus, if consumers wanted to sell their consumer durables or housing to raise money due to a bad income shock, they would incur a big loss because they could not get the full value of these assets in a distress sale (Mishkin, 2004, p.264).

2.3. Theory of monetary policy transmission mechanism and bank asset price channel

The monetary policy transmission mechanism involves affects asset prices such as bonds, equity and real estate, changing firms' stock market values and household wealth. Movements in stock market values and household wealth in turn affect movements in aggregate demand. In the asset prices policy mechanism expansionary monetary policy increases the demand for equities (either by the Keynesian or by Monetarist argument). Thus raising equity prices and thereby boost market value of firms relative to the replacement cost of capital, consequently resulting in increased investment and as well as output. On the other hand higher equity prices raises the net–worth of firms and households. Thus improving their credit worthiness and access to funds. These effects would partly be reflected as the balance sheet channel of monetary policy (Afandi, 2005).

In the life cycle model of consumption monetary policy mechanism, monetary policy changes affect economic agents' long-term wealth and alters their consumption pattern. As a result consumers smooth out their consumption over time and this consumption depends on lifetime resources and not only current consumption (Mishkin, 1996). Expansionary monetary policy, lowers interest rates and changes consumers' portfolio composition in accordance with the risk of each asset class. Consequently, a decrease in the interest rates encourages people to reduce their holding of interest earning deposits and bonds and substitute them with equity/stocks, thus increasing stock prices (Afandi, 2005; Chileshe, 2017).

2.3.1. The interest rate channel

Any change in the short term official rate is quickly transmitted to other short term wholesale money–market rates of domestic currency. The transmission happens both to money–market instruments of different maturity and to other short term rates, such as interbank deposits. On changing the official rate (typically on the same day), banks adjust their

standard lending rates (base rates), usually by the exact amount of the policy change.

This change has instantaneous effects on the interest rates that banks charge their customers for variable loan rates, including overdrafts. Too, rates on standard variable rate of mortgages may be changed as well. Likewise, from time to time, rates offered to savers change, in order to preserve the margin between deposit and loan rates (Bank of England, 1999).

A change in the official rate unambiguously moves other short term rates in the same direction and the impact on longer term interest rates can go either way. That is because the long term interest rates are affected by an average of current and expected future short term rates. Therefore, the outcome depends upon the direction and extent of the effect of the official rate change on expectations of the future path of interest rates. The actual effect on long term rates of an official rate change depend partly on the effect of the policy change on inflation expectations (Bank of England, 1999).

2.3.2. The exchange rate channel

The exchange rate channel is one of the primary monetary policy transmission channels especially in economies with flexible exchange rate regimes. It is through interest rate that monetary policy can influence the exchanges (the popular uncovered interest rate parity condition). Movements in interest can be altered through direct intervention in foreign exchange markets or through inflationary expectations (Dabla–Norris & Floerkemeier, 2006).

In the exchange rate channel, monetary policy affects economic activity (e.g. output) through net exports. Expansionary monetary policy, can lead to a fall in domestic interest rates relative to the foreign interest rates. Thus, inducing capital outflows and leading to a depreciation of the local currency. In turn, exports become cheaper, resulting in increased net exports and consequently aggregate demand and output (Mishkin, 1996, 2001). The strength of the exchange rate channel originates from several factors such as the exchange rate regime, sensitivity of the interest rates, the size and openness of the economy, degree of capital mobility and the degree of expenditure switching between domestic and imported goods (Boivin *et al.*, 2010; Chileshe, 2017; Boivin *et al.*, 2010; Mishra *et al.*, 2010; Tahir, 2012; Chileshe, 2017).

2.3.3. The equity prices channel

The price of equity is significantly influenced by a number of factors e.g. book value of the firm, dividend per share, earnings per share, price–earning ratio and dividend cover (Gompers *et al.*, 2003). Equity price is determined mostly by basic factors that influence shares: demand and supply factors. If most people start buying equity shares then prices move up and if people start selling the equity shares then prices go down. Government policies as well as performance and potentials that firms and industries have, effect demand behavior of investors, both in the primary

and secondary markets. Both the macro and micro economic perspectives are factors that affect the price of an equity share. Macroeconomic factors that influence equity share include politics, general economic conditions. That is how the economy is performing, government regulations, and etcetera (Shubiri, 2010).

Stock markets in principle, are expected to accelerate economic growth by enhancing domestic savings and increasing the quantity and the quality of investment. Stock markets can encourage economic growth particularly by providing incentives for growing companies to raise capital at lower cost. Moreover, companies in countries with developed stock markets are less dependent on bank financing which can provide enough credit. The stock market is also expected to perform miracles by permitting long term investment.

Such investments could be financed by funds provided by individuals, many of whom wish to make them available for only a very limited period, or who wish to be able to withdraw them at will (Baumol, 1965; Shubiri, 2010).

2.3.4. Wealth effect channel

The wealth effect channel has deep roots in the literature on monetary policy and economic stabilization. It dates back to at least the earliest literature stimulated by Keynes' General Theory. Changes in consumer spending generated by countercyclical changes in the real value of the money stock could help provide an automatic stabilizing force to an economy subject to inflationary and deflationary forces (Gilbert, 1982; Ludvigson *et al.*, 2002). Subsequently, Modigliani (1944, 1963) and Patinkin (1965), illustrated the conditions required in the money, goods, and labor markets whereby the "real balance effect" could stabilize the economy at full employment. Furthermore, Modigliani and collaborators, expanded this theoretical literature on the real balance effect into a full–blown analysis of the impact of wealth changes induced by monetary policy (Ludvigson *et al.*, 2002).

2.4. The practice of monetary policy and bank credit in Uganda

2.4.1. Overview of banking history in Uganda

In 1906 the National Bank of India (NBI) was established in Uganda. The NBI later became Grindlays bank. Since then the banking sector has developed (Bategeka & Okumu, 2010). In 1962 before independence, the banking sector in Uganda was dominated by foreign owned commercial banks (Beck & Hesse, 2006). The Bank of Uganda (BOU) became the central bank in 1966. Since then, BOU has been controlling all currency issues and foreign exchange management (Nsambu, 2014). The East African Development Bank was established in 1967. In 1972 Uganda Development Bank and Uganda commercial banks were established whereby state–owned banks dominated the banking sector (Bategeka & Okumu, 2010; Nsambu, 2014).

Bank of Uganda supervises and regulates financial institutions in Uganda according to Bank of Uganda statute 1993; with the following objectives:

(i). to help ensure that, financial institutions maintain an adequate level of liquidity at all times, able to meet all known obligations and commitments and plans for unforeseen obligations and commitments.

(ii). to promote public confidence in financial institutions in Uganda through ensuring that they have adequate liquidity at all times.

(ii). to help ensure that financial institutions manage their liquidity by means of clear and well written policies which take into account all aspects of proper liquidity management.

(iv). to provide guidance on compilation of accurate and timely liquidity returns (Bank of Uganda Statute, 1993; Nsambu, 2014).

In July 1999, according to the Bank of Uganda policy statement, financial institutions are classified into four Tiers. Tier IV is composed of financial institutions which are not regulated by bank of Uganda and are not authorized to take in deposits from the public but may offer collateral or non-collateral loans. Tier III comprises of Microfinance and Deposit taking Institutions (MDIs).

Tier II consists of Credit institutions. Tier I is composed of Commercial banks. According to the classification, commercial banks are authorized to hold current, savings and fixed deposit accounts for both retail and corporate in local and international currency. On top of these, Commercial banks are authorized to transact the business of foreign exchange in all currencies (Nsambu, 2014).

2.4.2. Monetary policy environment in Uganda since 1987

In 1987, the IMF resumed the Structural Adjustment Program (SAP) in Uganda. One of the major aims of SAP was mainly to reduce inflation and restore the sustainable balance of payments. The other was focused on the Economic Structural Adjustment Program (ESAP), and was aimed at increasing (a) the competition in the financial sector, and (b) the range of financial instruments through an expanded financial infrastructure. The ESAP also targeted (i) the deregulation of interest rates, improving the overall process of financial intermediation, mobilization, and the allocation of resources and (ii) the removal of price controls and import licensing, as well as the progressive decontrol of foreign exchange management (Atingi–Ego & Sebudde, 2000).

Most of the structural adjustment and financial liberalization policies initiated in the early 1980s were meant for restoring the macro stability which did not fully happen until the 1990s (Kasekende & Atingi–Ego, 2003). Macroeconomic stability was not attained until 1992, five years after the adjustment process was agreed upon by the IMF and the World Bank. For instance, in Uganda during the period 1986 to 1992 average inflation rate was 108 percent per annum, average annual money supply growth was 105.5 percent, and the average annual GDP growth rate was 5.7 percent per year. Domestic financing of budget and money supply during

the 1986 to 1992 period was only 1.2 percent and 6.3 percent of GDP respectively (Nyorekwa & Odhiambo, 2014).

The liberalization of the exchange rate commenced in 1990. As a result Government of Uganda legalized the foreign exchange bureaus and the adoption of the foreign exchange auctions. In 1991, the Treasury bill market was transformed to a system whereby interest rates were market–determined. Controls on government expenditure were instituted in 1992. Thus, monetary policy was created to control inflation and the Foreign Exchange reserves (Mikkelsen & Peiris, 2005).

Before 1993, Uganda maintained strict restrictions on both current and capital account. But in July 1994, the interest rates were fully liberalized. Consequently, in July of 1997 the capital account of balance of payments was liberalized. As a result, there have been no restrictions on capital movements in or out of Uganda since then. The Uganda Capital Markets Authority and the Uganda Securities were established in 1996 and 1997 respectively. The liberalization and removal of restrictions on capital markets, opened doors for the external players to invest in the Uganda securities (Nyorekwa & Odhiambo, 2014).

The Bank of Uganda statute of 1993, mandates the Bank of Uganda with the exclusive responsibility for monetary policy. Consequently, the Reserve Money Program (RMP) was adopted. Thus, the post–independence monetary abandoned framework of direct controls. Since then, the reserve money became the operating target. The new policy is premised on the macro-economic targets of inflation, economic growth and balance of payments (Opolot *et al.*, 2013).

When the interest rates were liberalized, one of the monetary policy tools prevailing in the 1990s that BOU retained was the control of the rediscount rate.

The economic reforms lasted for almost a decade. But the weakness of the financial sector in Uganda remained as reflected by the numerous bank failures in the mid–1990s. Towards the end of the 1990s, a two–year moratorium was instituted against licensing any new banks. When it was lifted the number of banks increased from nine in 1991 to 20 in 1996. However, the number of banks reduced to 15 when a number of commercial banks became insolvent between 1997 and 2000. During this period government continued to divest its shares in the commercial banks (Opolot *et al.*, 2013; Nyorekwa & Odhiambo, 2014).

The Bank of Uganda, amended its role on the commercial banks through stringent and prudent enforcement of the Financial Institutions Act, 1993. The Act, was amended in 2002, with the aim of strengthening supervision and regulatory roles of the Central Bank. Subsequently the Micro Finance Deposit–taking Institutions Act of 2003 was set up. As a result four micro finance institutions were licensed to take deposits. This was followed by established of the Financial Stability Department in July 2009 at BOU with the mandate to analyze and monitor systemic risks to the financial system (Opolot *et al.*, 2013; Nyorekwa & Odhiambo, 2014).

In 2009, the Reserve Monetary Program (RMP) was modified, and a flexible version of the RMP was adopted, with Net Domestic Assets (NDA) as the operating target. As a result, in July 2011, the RMP base–money targeting was replaced by "Inflation Targeting Lite (IFL)". Consequently, and most importantly, monetary policy regime changed from monetary base to interest rate as the operating instrument for monetary policy i.e. the central bank rate (CBR). With the interest rate as the operating target of monetary policy, the CBR is set monthly and used to guide 7–day interbank interest rates. The BOU often uses the CBR to signal policy (Nyorekwa & Odhiambo, 2014).

In the monetary policy framework, the monetary policy objectives is inflation–targeting aimed at continually achieving (a) low and stable inflation since price stability is the primary objective, (b) a monetary policy mandate of enhancing economic growth through enhanced private sector credit, improvement balance of payments and financial stability. The monthly policy tool used to achieve financial stability are: policy rate, foreign exchange intervention, rediscount policy and open market operations (BOU, 2013; IMF, 2013; Nyorekwa & Odhiambo, 2014).

Uganda has experienced rapid growth from 1991 to 2011 with an average annual real growth rate of 7 percent. The high economic growth during the two decades was associated with increased monetization, financial deepening, and controlling inflation over the past two decades. However, the estimated money multiplier and the velocity have over the years been unstable in the short run (Davoodi *et al.*, 2013). The high interest rates in Uganda are partly due to the oligopolistic nature of the banking sector, the size and competition in the informal sector, coupled with the restrictive monetary policy (Adam, 2009; Bank of Uganda, 2013; Nyorekwa & Odhiambo, 2014).

2.4.3. Financial structure in Uganda

The financial system in Uganda is composed of small and concentrated private banks, a large informal financial sector, shallow capital markets, short–yield curves, and of recent more increased dollarization. The foreign currency deposits as a share of total deposits in the banking system account for 33.8 percent (BOU, 2013). This exceeds the IMF 2011 estimates of LICs, and the HIC share of 12.8% and 0.4%, respectively (Berg *et al.*, 2013).

By 2013, the financial system in Uganda was composed of the BOU, 26 commercial banks, 8 credit institutions, and 4 micron–finance deposit-taking institutions, the National Social Security Fund (NSSF), a postal bank, 25 insurance companies, 2 development banks, 102 foreign–exchange bureaus, and the Uganda Securities Exchange. In December 2012, the commercial banks owned approximately 99.98 percent of the total assets of the deposit–taking institutions in the financial system (Opolot *et al.*, 2013).

The banking industry is concentrated. The top five banks dominate the asset share. The stock market capitalization remains low in terms volume of stock traded as the share of GDP. Thus, the low development of the financial markets. However, banks in Ugandan remain well–capitalized.

With high profits, the banks have adequate capital buffers to withstand shocks. In June 2013, the Leverage ratio, as a new indicator of capital adequacy in banks, stood at 12. Percent. This far above the minimum of three per cent, as recommended by the Basel Committee on Bank Supervision (BOU, 2013; Twinoburyo & Odhiambo, 2017).

According to IMF Uganda is classified as a floating regime where the authorities intervene in the foreign exchange market to maintain stability in the foreign–exchange market. Since 2010, in order to build up reserve, the BOU has been conducting daily purchases, while occasionally engaging in targeted sales when necessary (Opolot *et al.*, 2013). In the updated financial index values of 2011, Uganda has a score of 2.44 (Chinn & Ito, 2007; Twinoburyo & Odhiambo, 2017).

From the time Uganda was liberalized, its capital account index indicates that the economy of Uganda has been the most open economy in the East African Region. In 1997 this index was 0.15 and it rose to 2.44 in 2011. By comparison, the index for Uganda was even higher than the index for the United States and the United Kingdom in 2011 which stood at 2.39.

The ratio of total external assets and liabilities to GDP for Uganda more than doubled, from 0.31 in 1991 to 0.66 in 2011, indicating an increase in the degree of openness of the economy to international capital flows (Lane & Milesi–Ferretti, 2006). In 1999 portfolio investments that were almost zero. But rose to US$0.25 million in 2000 and increased to US$1005 million in 2013. The highest rise observed was from US$335 million in 2012 to US$1005 in 2013 (Twinoburyo & Odhiambo, 2017).

2.4.4. Recent case of monetary policy and bank credit in Uganda

In 2011, when elections were over runaway inflation followed. To avoid inflation after the 2016 election year the Central Bank took high precautionary measures. Thus, during the first half of FY 2015/16, the Bank of Uganda (BOU) reinforced measures to counteract the inflationary pressures that it had forecasted. Thus, the Central Bank raised its key policy rate (CBR) from 13 percent in June 2015 to 17 percent in October 2015, a level that was maintained until April 2016.

Moreover, margins on the bank rate and rediscount rate were widened to make it harder for commercial banks to access funds from the BOU. Furthermore, the BOU reduced the level of currency in circulation through (a) net sales of its short–term instrument i.e. repurchase of security agreement and (b) sales of foreign currency valued to be in excess of US$ 400 million within a period of six months. Thus relieving pressure on the Uganda shilling (World Bank, 2016, p.6).

The yields on government securities increased sharply during the first half of FY2015/16, possibly due to market uncertainty in the period prior to the election. The 91–day Treasury bill rate rose to 18.3 percent by November 2015, up from 12.8 percent in July 2014. This increase might have strengthened the Ugandan currency by attracting inward portfolio flows as a result of increased investor demand for government securities. But it increased the cost of borrowing for the Government. The

Government reacted by reducing its borrowing from the financial system by 10 percent over the first half of FY 2015/16. Commercial banks responded by sharply increasing their average lending rates from 20.8 percent in 2014 to 25.2 percent between April 2015 and February 2016. Thus, tight monetary conditions, coupled with low commodity prices, reduced inflation pressure and the rate of inflation declined to 5.1 percent by April 2016 (World Bank, 2016, p.6).

During the first half of FY 2015/16, financial institutions experienced rapid increase in the supply of credit to the private sector. Within this period, the rate of credit growth on average was 24 percent, almost double the average rate of 13 percent recorded during the same period in FY 2014/15. In October 2015 the effect of high interest rates began to be felt, when the rate of growth of credit began to decelerate until it reached 8.7 percent per annum by March 2016. The highest proportion of the credit was utilized to finance activities in building, mortgage, construction and retail estate, which accounted for 23 percent of total credit. Next was trade, which accounted for 19.8 percent; comprising of personal and household sector (14.8 percent); and by the manufacturing sector (15 percent) (World Bank, 2016, p.7).

The total value of credit denominated in foreign currency grew by 38 percent during the first quarter of the year, compared to a growth of 21 percent during the corresponding period in FY 2014/15. During this period, the depreciation of the shilling rose up to 40 percent per annum in September 2015. The shilling denominated credit had very low growth rates, ranging from 8 percent to 15 percent in the same period. Thus, the dollar denominated credit accounted for 45 percent of the total value of credit by March 2016. Borrowing in foreign currency creates opportunities for borrowers to access lower cost credit; allows them to diversify loan portfolios; and to hedge the risks associated with the volatility of the local currency (World Bank, 2016, p.7).

Over the first half of the 2016, the value of the credit provided grew rapidly, at 57 percent in the case of the building, mortgage, construction, and real estate sector and at 53 percent in the case of the manufacturing sector. In contrast there was an average increase of five percent in the case of the former and a decrease of seven percent in the case of the latter during the corresponding period in FY 2014/15. The manufacturing sector generates revenues in foreign currency because it exports some of its produce. Similarly, some categories of real estate collect their rent in foreign currency. However, a significant proportion of the borrowers exposed to these businesses face high exchange rate risk because they operate domestically and have revenues solely denominated in shillings (World Bank, 2016, p.8).

2.5. Empirics of monetary policy and bank credit

Mankiw (1994) notes that "Monetary policy is not easy. Central bankers have multiple objectives and, over time, must confront a variety of

economic circumstances. They know their actions have powerful effects on the economy, but the timing, magnitude, and channels of those effects are not fully understood.

Their job is made all the more difficult by widespread disagreements among economists. Some economists view monetary policy as a potential cure for economic fluctuations. Others would be satisfied if monetary policy could avoid being a cause of fluctuations." The economists disagree. For instance the monetarist view of the transmission mechanism is sharply at odds with the neoclassical synthesis, which tends to view the main channels of transmission as working through credit availability and secondly through the effect of long–term interest rates on investment. Monetarists regarded both of those channels as secondary and focus on money rather than credit channels (Goodfriend & King, 1997).

The traditional view of the transmission mechanism is called the money view. It holds that contractionary monetary policy reduces spending by raising interest rates. Recently, attention has centered on an additional channel of monetary policy. Which is the reduction in bank lending that must accompany a reduction in reserves. Kashyap & Stein (1993) and Miron *et al.* (1993) offer alternative perspectives on the importance of this new lending view (Mankiw, 1994).

The traditional money view holds that there is one important distinction among types of assets: assets used for transactions (money) and those held only as a store of value (bonds). In contrast, under the lending view, there are three types of assets: money, bonds, and bank loans. Both bonds and bank loans earn interest. But bank loans are not perfectly substitutable with bonds. Banks make loans presumably because loans offer a higher return than bonds. The borrowers need these loans because they do not have access to bond markets. Lending view holds that when the central bank reduces reserves, it not only raises the interest rate on bonds, but it also reduces the supply of bank loans (Kashyap & Stein, 1993).

Miron *et al.* (1993) examine changes over time in the importance of the lending channel. Firstly, they employ a simple theoretical model to isolate the observable factors that affect this channel's strength. Secondly, they show that several changes in the economy; the composition of bank assets, the composition of external firm finance, and reserve requirements; should have made the lending channel stronger before 1929 than during the period immediately after World War 11. They find that conventional indicators of the importance of the lending channel, such as the spread between the loan rate and the bond rate and the correlation between loans and output, do not exhibit the predicted decline in the importance of the lending channel. They suggest that either the traditional indicators are not good measures of the strength of the lending channel, or the lending channel has not been quantitatively important in any era (Mankiw, 1994).

De Bond (1998) uses disaggregated data on balance sheets to examine the existence of credit channels of the monetary policy transmission mechanism (MPTM) in Europe as a whole for the 1990 to 1995 period. The

empirical results show the monetary credit channels of MPTM in Europe. In particular, the BLC is found to be strong in Germany, Belgium and the Netherlands. Meanwhile the BLC is found to be relatively strong again in Germany but to a lesser extent in France and Italy during the sample period. Motivated by the experience of South Korea during financial crisis, Kim (1999) examines whether the credit channel is the key monetary transmission mechanism in the country. The paper finds convincing evidence of the credit channel (the bank lending channel) in the aftermath of the financial crisis.

Therefore, bank lending is found to play a significant independent role in amplifying the real effects of tightened monetary policy, which was implemented in response to the crisis (Kim, 1999).

Alfaro *et al.* (2003) examines the presence of bank lending channel in Chile during the period 1990 to 2002 using data from both the banking sector and the corporate sector. They estimate a VAR system to test whether or not this channel exacerbates the effect of a monetary policy shock over macroeconomic activity. Their conclusion is that the bank lending channel in Chile has operated through a monetary policy transmission mechanism during the sample period. The transmission channel has an independent and significant effect in terms of macroeconomic activity (Alfaro *et al.*, 2003).

Sun *et al.* (2010) test the existence of the bank lending channel to explain the monetary policy transmission in China from 1997Q1 through 2008Q4. In the identified loan supply equation, loan supply is negatively related to required reserve ratios and official one–year lending rate in the long term. This confirms the existence of a lending channel for monetary transmission in China. The short term dynamics of the vector error correction model (VECM) show that the short–run disequilibria in the loan supply are corrected through changes in the lending rate, suggesting that monetary policy plays a role in restoring equilibrium in the credit market by affecting the official commercial bank lending rate. Thus, the result confirms that bank lending channel plays an important role in China's monetary policy transmission (Sun *et al.*, 2010).

Khundrakpam (2011) examines the operation of credit channel of monetary policy transmission in India through change in policy rate within the 2001:3 to 2011:3 period, when interest rate became the main instrument of signaling policy stance in India. Results obtained show that: (a) nominal or real bank credit in India is contemporaneously influenced by the corresponding growth in economic activity and nominal or real deposit/money supply growth. (b) The positive influence of economic activity on bank credit, policy induced expansion or contraction in deposit or money supply makes banks to adjust their credit portfolio correspondingly. (c) Inflation and exchange rate appreciation have negative effect on the growth of bank credit with a long lag of nine months. This lag in transmission is found to be consistently true across various sub-sample

periods obtained through rolling regression technique (Khundrakpam, 2011).

Oni & Ozemhoka (2013) assess the impact of monetary policy on bank credit creation in Nigeria during the 1980 to 2010 period. They use the ordinary least square (OLS) method of regression analysis. Their results indicate positive linear relationship between total credit and (a) total deposits and (b) total credit and treasury bills rate. But the reserve requirement ratio and interest rate are found to be negatively related to total credit creation (Oni & Ozemhoka, 2013). Mugume (2011) applies structural VAR models to quarterly data for 1999–2009. He finds all the channels of monetary transmission to be ineffective. In particular, the interest rate channel remains weak, even though there is some evidence for a transmission of Treasury bill rate changes to lending interest rates.

Opolot *et al.* (2013) examines the relevance of the bank lending channel in monetary policy transmission of Uganda using a bank level data for the period Q1 2001 to Q4 2012. Investigations are conducted on effects of individual bank characteristics (size, liquidity, and capitalization) on the loan supply function of banks.

The dynamic panel data framework is estimated by using a generalized method of moment (GMM) dynamic panel estimator of Arellano & Bond (1991). His study finds that individual bank characteristics of liquidity and capitalization play a significant role in influencing the supply of bank loans. Therefore, his empirical results indicate the presence of the bank lending channel of the monetary policy transmission mechanism in Uganda.

Antigi–Ego (2000) compares interest rate with monetary base targeting as a monetary policy instrument in the Ugandan economy by using a small structural VAR model that captures the structural dynamic features representing Uganda's economy. His research analysis is done using the VAR model with a sample data on Uganda for the period 1981:1 to 1997:4. The SVAR results he gets indicate that the transmission effects from interest rate is rapid compared to the effects from base money (Kamati, 2014).

Loayza & Schmidt–Hebbel (2002) empirically examines monetary transmission channels in Australia, Canada and the United Kingdom. By using the VAR approach, he finds the interest rate and exchange rate channels to be important in all of the aforementioned countries, but finds the asset price and credit channels not to be important in any of these countries. Angeloni *et al.* (2001) examines the monetary transmission mechanisms in euro area countries, by using the aggregate euro countries data. They find that the monetary policy has a significant effect on output and price. Secondly, they find that a temporary reduction on output for increases in short term interest rate while the response of price is slow. Thirdly, by employing a country specific data of some European countries: Austria, Germany, France, Italy, Belgium, Spain, Portugal, they show that interest rate and credit channels are the most significant transmission channels in the area (Mohammed, 2013).

Morsink & Bayoumi (2003) use the VAR models with quarterly, seasonally adjusted data from 1980Q1 to 1998Q3, to analyze the effect of monetary shock on the Japanese economy. They find that both interest rate and broad money significantly affect output. They then conclude that both monetary policy and banks' balance sheets channels are important sources of output shocks. Secondly, they conclude that bank lending channel play a crucial role in transmitting monetary shocks to economic activity. Al–Mashat & Billmeier (2008) investigates the monetary transmission mechanism in Egypt, by using VAR model on seasonally adjusted monthly data within the period 1998 to 2008. They find that the exchange rate channel plays a greater role more than the bank lending and asset price channels do in propagating monetary shocks to output and prices (Mohammed, 2013).

Mohammed, (2013) investigates empirically the monetary transmission mechanism in Ethiopia by using vector error correction mechanism (VECM). In addition, impulse response functions (IRF) and variance decompositions (VDC) techniques are employed to assess the relative strength of each channel. He finds that monetary policy in Ethiopia has a relatively significant influence on the real activity through the direct monetary transmission and exchange rate channel. Secondly, his results suggest an inactive interest rate channel and implies weak existence of a credit channel.

Cheng (2006) uses recursive and non–recursive structural vector autoregression (SVAR) to monthly data in Kenya for the period 1997 to 2005 and finds evidence for the presence of the traditional transmission channels.

The study finds that a contractionary monetary policy (a measure of monetary policy used in the paper) leads to an initial increase in the price level, followed by a fall in the price level. This effect is found to be statistically significant for about two years following the shock. In response to a contractionary monetary policy, output rises initially but falls eventually, though the decline is not statistically significant (Davoodi *et al.*, 2013).

Maturu *et al.* (2010) applied a similar methodology to that of Cheng (2006) in their study monetary transmission mechanism in Kenya using quarterly data for the period 200 to 2010. They use M3 as the monetary policy instrument and find that an exogenous shock to M3 (i.e. an expansionary monetary policy) has no effect on real output, but leads to rising prices for almost 18 months, and is found to be statistically significant. A positive shock to the interest rate leads to falling prices, much like Cheng (2006) finds, but the effect is not statistically significant. Movements in M3 explains as much of inflation variability arising from movements in interest rate that Cheng (2006) finds (Davoodi *et al.*, 2013).

Sichei & Njenga (2012) empirically investigates bank lending channel (BLC) of monetary policy.

Transmission in Kenya using annual bank level panel data for the period 2001 to 2008. They find that BLC exists in Kenya based on bank liquidity and capitalization. They therefore, conclude that banks with less liquid balance sheets and low total capital to risk–weighted asset ratios could have been hit most by monetary policy. They reason that since low liquidity and banks with low capital base are generally large banks comprising of 82 percent of total bank credit, BLC is found to be significant in Kenya. As a result, the existence of BLC implies that monetary policy has asymmetric effects on banks and borrowers in Kenya. Therefore, bank credit may be used as a nominal anchor for monetary policy and a leading indicator for economic activity in Kenya.

Chileshe (2017) examines the bank lending channel of monetary policy in Zambia by using a bank level panel data covering the period Q1 2005 to Q4 2016. The study investigates the effects of monetary policy changes on loan supply by commercial as well as the effect of response of loan supply to monetary policy shocks. Using a dynamic panel data approaches developed by Arellano & Bond (1991), the results indicate that a bank lending channel exists in Zambia. The results further show that loan supply is negatively related to policy rate, implying that when monetary policy is tightened loan supply shrinks. Secondly, the results indicate that size, liquidity and bank competiveness effect credit supply while capitalization has no effect. Thirdly, the results show that bank size has negative effect on credit supply while liquidity and market power enhance credit supply (Chileshe, 2017).

Kigabo (2018) uses the VAR model to assess monetary transmission mechanisms in Rwanda during the period 2006Q–2014Q4. The findings show that the banking sector in Rwanda is small and banks are more competitive in the deposit rather than in the loan market. Therefore, the effect of monetary policy actions on the cost of banking loans is constrained because the interest rate pass through to the lending rate remains very weak.

Due to the introduction of a more flexible exchange rate policy and the decline in foreign resources, the exchange rate channel has started improving. There is clear evidence that the credit channel is active in Rwanda and that could be due to increasing monetization of the domestic economy (Kigabo, 2018).

According to Berg *et al.* (2013), many central banks in Sub-Saharan Africa countries are modernizing their monetary policy frameworks. They note that standard statistical procedures have had limited success in identifying the channels of monetary transmission in such countries. As a result they take a narrative approach, following Romer & Romer (1989), and center on a significant tightening of monetary policy that took place in 2011 in four members of the East African Community: Kenya, Uganda, Tanzania and Rwanda (Berg *et al.*, 2013). However, this paper takes a more efficient and simplified version of the standard statistical procedure, the generalized least squares (GLS) technique.

Moreover, the paper finds it appropriate to use monthly data in the empirical analysis because According to Walsch (2010), standard macroeconomic theory suggests that monetary policy has little impact on the growth of real output in the long run. Real sector variables (e.g. skills and technology) determine the long run steady state output (Sichei & Njenga, 2012). Meanwhile in the short term, monetary policy can significantly influence the course of the real economy (Barnanke & Gertter, 1995). The challenges to identifying the transmission mechanism in the data are great anywhere particularly in Low Income Countries (LICs). Studies embracing the effects of monetary policy on activity and prices in LICs have greatly relied on the use of statistical techniques such as VARs, SVAR, VECMs, and single–equation estimation, and often find weak or insignificant effects of monetary policy (Davoodi *et al.,* 2013; Mishra *et al.,* 2012).

As elsewhere, policy is endogenous to events in the economy. More than elsewhere, the structure of the economy itself is evolving, for example as the financial system develops. Meanwhile, large supply shocks are frequent and data noisy and scarce. Thus, analysis based on VARs; which require relatively long times series with consistent policy frameworks is likely to be unfruitful (Berg *et al.,* 2013). This paper avoids the errors by making use of a simple GLS technique. Romer & Romer (1989) advocate for the "narrative approach" for identifying the effects of monetary policy. The narrative approach deals with the identification of monetary shocks through non–statistical procedure. The method involves using the historical records to identify episodes when there were large shifts in monetary policy or in the behavior of monetary policy that were not driven by developments on the real side of the economy." (Romer & Romer, 1989, p.1).

Views on the real effects of monetary policy in the United States have been more influenced by the narrative arguments of Friedman & Schwartz (1963), than by formal statistical analysis (Romer & Romer, 1989; Summers, 1991). By using the narrative approach Berg *et al.* (2013) find that the events in their study suggests that the transmission mechanism in the East African economies is alive and well. They observe that after a large policy induced rise in the short-term interest rate, lending and other interest rates rise, the exchange rate tends to appreciate, output tends to fall, and inflation declines. In particular, they find the clearest transmission in Uganda, where the Inflation Targeting Lite regime, itself is simpler and more transparent (Berg *et al.,* 2013).

2.6. Money creation in the modern economy

In the modern economy, money is largely created by commercial banks making loans. The vast majority of money held by the public is composed of bank deposits. However, where the stock of bank deposits comes from is often misunderstood.

One common fallacy is that banks act simply as intermediaries, lending out the deposits that savers keep with them. In this view deposits are

typically created by the saving decisions of households, and banks then 'lend out' those existing deposits to borrowers. What households save in bank accounts are deposits that come simply at the expense of deposits that would have otherwise gone to companies in payment for goods and services. Savings raise the deposits or funds available for banks to lend. Thus, viewing banks simply as intermediaries ignores the fact that, in reality in the modern economy, commercial banks are the creators of deposit money (McLeay & Radia, 2014).

Another common fallacy is that the central bank determines the quantity of loans and deposits in the economy by controlling the quantity of central bank money. According to this view central banks execute monetary policy by choosing the size of reserves. Thus, for banks to crate money optimally, the central bank must directly determine the number of reserves. The truth is that rather than controlling the quantity of reserves, central banks today are compelled to implement monetary policy by setting the price of reserves i.e. interest rates (McLeay & Radia, 2014).

The relationship between reserves and loans typically operates in the reverse way to that described in some economics textbooks. The amount of bank deposits determines how much of central bank money, banks want to hold in reserve (to meet withdrawals by the public, make payments to other banks, or meet regulatory liquidity requirements). Normally, the deposits are supplied by the central bank. Lending creates aggregate deposits in the banking system called broad money. Broad money is total amount of money held by the households and companies in the economy. Broad money is composed of deposits. In the modern economy, bank deposits are mostly created by commercial banks. For instance in the United Kingdom bank deposits constituted 97 percent of the total amount of money in circulation as of December 2013 (McLeay & Radia, 2014).

Commercial banks create money, by making new loans out of bank deposits. For instance, when a bank makes a loan to its customer as a mortgage to buy a house, in principle it does not give them thousands of banknotes. Rather, it credits the bank account of the customer with a bank deposit of the size of the mortgage, and instantly a new money is created. The new deposits increase the assets of the consumers (i.e. households and companies). Meanwhile, the new loan increases their liabilities. The bank deposits are just records of how much the bank itself owes its customers. Thus they are a liability of the bank, not an asset that could be lent out. A bank's business model is based on the rule of receiving a higher interest rate on the loans (or other assets) than the rate it pays out on its deposits (or other liabilities) (McLeay & Radia, 2014).

It is interesting to note that Werner (2014) rejects the notion that commercial banks create money, by making new loans out of bank deposits. Instead, he believes that banks individually create credit and money out of nothing and they do this when they extend credit. In a similar way some economists have referred to bank deposits as 'fountain pen

money,' created at the stroke of bankers' pens when they approve loans (McLeay & Radia, 2014). Fountain pen money is what

Tobin (1963) takes to be the fact that banks cannot create unlimited amounts of money in practice.

Due to the central importance of deposits in the monetary policy transmission mechanism (MPTM), it can be used in the determination of the transmission channels of monetary policy. Moreover, when combined with other variables, the bank deposit can be used to determine their joint and individual effects on bank credit as well as their role in enhancing the (MPTM).

2.7. New contributions to knowledge

The study is quite different from the previous papers because it examines the influence of various monetary and fiscal variable on bank credit in Uganda during the period January 2008 to December 2017. The paper makes an evaluation of the existence of the bank credit channel in Uganda, in terms examining the response of bank credit to the following variables:

(a) Annual Treasury bill
(b) Bank deposits
(c) Consumer price index (CPI=P)
(d) Claims on central government
(e) Currency in circulation
(f) Demand deposits rate
(g) Demand for money (M2/P)
(h) Domestic credit
(i) Domestic deposit
(j) Exchange Rate
(k) Exports
(l) External debt servicing
(m) Government bond
(n) Imports
(o) Interbank Rate
(p) Interest rate (real lending rate)
(q) Monetary base
(r) Money supply (M2)
(s) Net Equity
(t) Net foreign assets
(u) Real gross domestic product (GDP)
(v) Rediscount rate
(w) Reserves
(x) Savings rate
(y) Velocity of Money in the entire economy
(z) Velocity of money in the credit market

At a theoretical level the paper develops models (i.e. equations) for deeper understanding of the role of bank credit in the monetary policy transmission mechanism. It attempts to point out the fallacy existing in the quantity theory of credit advanced by Werner (2014) and in particular the notion of velocity of credit. The paper then advances another theory of quantity theory of money and in particular the velocity of money in the credit market as well as the velocity of money in the deposit market.

The paper disagrees with idea advanced by Werner (2014) that individual banks create money out of nothing. Instead the paper accepts the notion that banks create money out of deposits when an individual bank offers loans to its customers. At both the theoretical and empirical levels the paper that (a) the relationship between deposits and credit work in the reverse direction, (b) the relationship between reserves and bank credit work in the reverse direction.

At the methodological level, the study is quite different from most of the previous studies that tended to use the OLS, VAR and ECM in their analysis of issues pertaining to the monetary policy transmission mechanism (MPTM). Instead, the paper uses the generalized least squares (GLS) method to analyze issues regarding the MPTM. Moreover, the paper goes to discover a new GLS technique with full proof.

At an empirical level the paper finds the existence of the bank credit channel in Uganda contrary to what some previous studies conducted on MPTM in the country have found. Other channels like exchange rate channel, asset prices channel, interest rate channel and fiscal channel were found to be present in Uganda during the sample period. It should be noted that in principle the paper agrees with Greenwood *et al.* (2016) that monetary policymakers can undertake large scale asset purchase program to effectively retire net national debt and reduce the interest expense of the government (Jordan, 2017).

3. Theoretical framework

3.1. Theoretical framework of the bank credit and monetary policy transmission mechanism

The monetary base (MB) is also called high–powered money. The MB is the addition of currency in circulation is (Cc) and the total reserves in banking system (Re). The monetary base is given by

$$MB = Cc + Re \tag{1}$$

The central bank controls the monetary base through its purchases or sale of government securities in the open market, called open market operations, and through its extension of discount loans to banks. A bond purchase by the central bank is called an open market purchase, and a bond sale by the central bank is called an open market sale. The effect of open market operations is much more certain on the monetary base than on the reserves. As a result, the central bank can control its monetary base more effectively through open market operations than it can do through reserves. However, the effect on deposit expansion is the same, whether a bank chooses to use its excess reserves to make loans or to purchase securities (Mishkin, 2004, pp.359–370).

An increase in the deposit multiplier r_m is generated by the multiple increase in deposits D generated from an increase in the reserves (Re) within the banking system.

$$Re = r_m D \tag{2}$$

Substituting Equation (2) in (1) provides

$$MB = Cc + r_m D \tag{3}$$

To obtain a relationship between bank credit and bank deposits (i.e. demand deposits), let the sum of deposits (D_i) in the banking system of bank i equals the money originally deposited BD_i in vault of bank i plus the maximum possible credit expansion C_{ri} in bank i (Stroup, 2006, p.184-224).

$$C_{ri} = D_i - BD_i \qquad i = 1,2,\dots,N \tag{4}$$

Therefore, the total amount of bank credit (Cr) equals the entire sum of deposits in the banking system having N system of banks minus bank deposits and is given by:

$$\sum_i^N C_{ri} = \sum_i^N D_i - \sum_i^N BD_i \tag{5}$$

or

$$D = C_r + BD \tag{6}$$

Therefore, the relationship between deposits in the banking sector (D), share of the banking sector in the monetary base (ω) and the monetary base (MB), is represented by

$$D = \omega MB \tag{7}$$

or

$$C_r + BD = \omega MB \tag{8}$$

Hence, substituting Equation (3) in Equation (8) the relationship between bank credit and bank deposits is expressed as

$$C_r + BD = \omega(C_c + r_m D) \tag{9}$$

The central bank can control the monetary base better than it can control reserves. Thus it makes sense to link the money supply (Mn) to the monetary base (MB) as given in Equation (8), where m is the money multiplier (Mishkin, 2004, p.375).

$$Mn = mMB \tag{10}$$

Substituting Equation (10) in Equation (8) provides

$$C_r + BD = (\omega/m)Mn \tag{11}$$

or

$$C_r = (\omega/m)Mn - BD \tag{12}$$

Since the demand for money ($Md = Mn/P$) is the ratio of money supply (Mn) to domestic price level (P) then Equation (12) can be rewritten as:

$$C_r = (\omega/m)(Md.P) - BD \tag{13}$$

Similarly, since the money supply (Mn) in the quantity theory of money is a function of velocity on money (V), output (Y) and the general price level (P) in domestic economy then Equation (12) can be rewritten as:

$$C_r = (\omega/m)PY/V - BD \tag{14}$$

Dividing through Equation (11) by the quantity of money supply we obtain

$$(C_r/Mn) + (BD/Mn) = (\omega/m) \tag{15}$$

or

$$V_{LC} + V_{BD} = (\omega/m) \tag{16}$$

Where V_{LC} is the velocity of money (liquidity) in the credit market and V_{BD} is the velocity of money in the bank deposit market; implying that the idea of the velocity of money in credit market and the velocity of money in the bank deposits market are not problematic because their effects cancel out each other.

As a result, in very simple terms the quantity of credit in the credit market becomes the product of money supply and the velocity of money in the credit market and is given by Equation (17). Thus this equation becomes the new quantity theory of credit.

$$C_r = MnV_{LC} \tag{17}$$

Similarly, in very simple terms the quantity of bank deposit in the bank deposit market becomes the product of money supply and the velocity of money in the bank deposit market and is given by Equation (18). Thus this equation becomes the new quantity theory of bank deposit.

$$BD = MnV_{BD} \tag{18}$$

These two simple theories of velocity of money in money and bank deposit markets that the paper is advancing are important because they help in showing that growth in the velocity of money in the economy (V) has negative consequences in quantity of credit as well as quantity of bank deposits.

3.2. Werner's quantity theory of credit

According to Werner (2017) by the mid–1980s, the existing approaches in all the schools of economics: classical, neoclassical, Keynesian, monetarist and post–Keynesian approaches including eclectic models; although had their differences, they had much in common. That is because they still maintained monetary aggregate linked to nominal GDP through

the quantity equation. The quantity theory of money for the entire economy is commonly given by

$$PY = MnV \tag{19}$$

Where P is the price level of aggregate real income (output) in the economy, Y is the real output (GDP) in the economy, Mn (measured and defined as Mo, M1, M2, M3 or M4) is the nominal quantity of money in the economy and V is the income velocity of money (Werner, 2017).

In Werner (2017), quantity theory of credit model, simplifies to

$$MnV = PY = PQ = \alpha P_R Q_R = \alpha M_R V_R \tag{20}$$

and

$$MnV = PY = PQ = \beta P_F q_F = \beta M_F V_F \tag{21}$$

According to Werner (2017): "This was first successfully implemented by Werner (1997, 1992). Substituting the slightly more intuitive letter 'Q' for the quantity of transactions, and following this framework, we choose to disaggregate both sides of (19), on the one hand into money used for transactions that are part of GDP (called $(M_R V_R)$ and those that are not (called $(M_F V_F)$, and on the other hand the value of transactions that are part of GDP $(P_R Q_R)$ which should be accurately proxied by nominal GDP $(P_R Y)$, and those that are not $(P_F Q_F)$ …."

"With a stable 'real' velocity of money, V_R, the effective amount of money used for GDP transactions during any period of time $(M_R V_R)$ must be equal to nominal GDP. Meanwhile, the amount of money effectively used for non–GDP transactions will be equal to the value of these non–GDP transactions." Equations (19) and (20) have also been suggested by Werner (1992, 1994, 1995b, 1995a, 1996, 1997, 2002, 2003).

Werner (2017) went ahead to avoid confusion by replacing letter 'M' with 'C', for credit. Hence the Quantity Theory of Credit (QTC) as presented by Werner (1997, 1992) boils down to:

$$CV = PQ = \mu MnV = \mu PY \tag{22}$$

Therefore, Equation (22) implies that there is a positive relationship between credit $(C = C_r)$ and velocity of nominal money supply $(M = M_n)$ i.e. $\partial C_r / \partial V > 0$.

From Equation (22) it can be deduced that the money supply function is given by

$$\mu Mn = \mu PY/\mathrm{V} \tag{23}$$

Substitution of Equation (23) in Equation (11) provides

$$C_r + BD = \mu \left(\frac{\omega}{m}\right) PY/V \tag{24}$$

The constants α, β, μ are used with intention of pinning down the fallacy existing in the QTC equations advanced by Werner (2017) and Werner (2018). Therefore, Equation (24) implies that there is a negative relationship between credit ($C = C_r$) and velocity of nominal money supply ($M = M_n$) i.e. $\partial C_r/\partial V < 0$. Hence, Werner (2017) and Werner (2018) quantity theory of credit equations must be rejected because they provide equations of QTC that are inconsistent with reality, other theories and most probably empirical results regarding the relationship between bank credit and velocity of money.

3.3. Interest rate and exchange rate channels

The general price level (P)is a function of nominal interest rate (Rn) real interest rate (R) representing the return on assets (bonds, equities and physical assets) and is given by:

$$P = f(Rn) = f(R) \tag{25}$$

Substitution of equation (25) in (13) provides the interest rate channel through which the monetary policy transmission mechanism influences bank credit.

$$C_r = \frac{mY/R}{r_m} - BD \tag{26}$$

or

$$C_r = \frac{mMn/(RnV)}{r_m} - BD \tag{27}$$

For the exchange rate channel it is clear that when demand for the domestic currency (money) increases the demand to hold the foreign currency falls, thus causing the nominal price of the foreign currency to fall, while the nominal price of the domestic currency rises; thus the foreign exchange rate depreciates (increases) in nominal terms vice versa. Thus the relationship between the demand for money and the nominal exchange rate becomes as shown in Equation (28).

$$M_d = f(ER) = \varphi ER \tag{28}$$

Therefore, substituting Equation (28) in Equation (13) provides

$$C_r = (\omega/m)(\varphi ER.P) - BD \tag{29}$$

4. Methodology

4.1. Generalized least squares

One of the assumptions of the classical linear regression model is that the error term u is linearly and independently distributed (IID) with mean 0 and variance σ_u^2 as presented in Equation (30).

$$u = IID(0, \sigma_u^2) \quad (30)$$

The generalized least squares (GLS) model is expressed as y is a function of the x variables where X is a matrix of independent variables, β is a vector of coefficients and u is a vector of error terms.

$$y = X\beta + u \quad (31)$$

Where mean error is

$$E(u) = 0 \quad (32)$$

The variance is given by

$$var(u) = \Sigma \quad (33)$$

Where $\boldsymbol{\Sigma}$ is a general symmetric positive matrix.
Suppose that $\boldsymbol{\Sigma}$ is known then

$$P'P = \Sigma^{-1} \quad (34)$$

Where P is an upper triangular matrix.
Thus

$$P'P\Sigma = I_n \quad (35)$$

or

$$P'P\Sigma P' = P' \quad (36)$$

or

$$P\Sigma P' = I_n \quad (37)$$

Pre multiplying all the terms in Equation (31) by vector P provides

$$Py = PX\beta + Pu \quad (38)$$

Equation (38) is simplified as follows:

$$y^* = X^*\beta + u^* \quad (39)$$

Where

$$y^* = Py, X^* = PX, \text{and } u^* = Pu. \quad (40)$$

Therefore the variance of $u^* = Pu$ is given by

$$E[Puu'P'] = P\Sigma P' = I_n \quad (41)$$

Equation (12) satisfies the following assumptions:

$$E(u^*) = 0 \quad (42)$$

$$var(u^*) = I_n \quad (43)$$

In other words the GLS estimator is just the OLS estimator applied to a transformed model.

$$\hat{\beta}_{GLS} = (X^{*\prime}X^*)^{-1}X^{*\prime}y^* \quad (44)$$

or

$$\hat{\beta}_{GLS} = (X'P'PX)^{-1}X'P'y \quad (45)$$

or

$$\hat{\beta}_{GLS} = (X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}y \quad (46)$$

The GLS is estimator is unbiased under the same circumstances where the OLS is unbiased. Therefore, given that X is non–stochastic (i.e. fixed in repeated sampling), then

$$\mathrm{E}[\hat{\beta}_{GLS}] = [(X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}y] \quad (47)$$

or

$$\mathrm{E}[\hat{\beta}_{GLS}] = [(X'\Sigma^{-1}X)^{-1}X'\Sigma^{-1}(X\beta + y)] \quad (48)$$

$$\therefore$$

$$\mathrm{E}[\hat{\beta}_{GLS}] = \beta \quad (49)$$

The variance of the GLS estimator can be obtained by rewriting Equation (44) as follows:

$$\hat{\beta}_{GLS} = (X^{*'}X^*)^{-1}X^{*'}(X^*\beta + u^*) \quad (50)$$

Thus

$$\hat{\beta}_{GLS} = \beta + (X^{*'}X^*)^{-1}X^{*'}u^* \quad (51)$$

$$\therefore$$

$$E[(\hat{\beta}_{GLS} - \beta)(\hat{\beta}_{GLS} - \beta)'] = E[(X^{*'}X^*)^{-1}X^{*'}u^*u^{*'}X^*(X^{*'}X^*)^{-1}] \quad (52)$$

$$\therefore$$

$$var(\hat{\beta}_{GLS}) = (X^{*'}X^*)^{-1}X^{*'}(X^{*'}X^*)(X^{*'}X^*)^{-1} \quad (53)$$

$$\therefore$$

$$var(\hat{\beta}_{GLS}) = (X^{*'}X^*)^{-1} \quad (54)$$

Hence

$$var(\hat{\beta}_{GLS}) = (X^{*'}\Sigma^{-1}X^*)^{-1} \quad (55)$$

After the transformation of the GLS model into the OLS model by using the appropriate P vector, results regarding the desirable properties of the least squares estimator hold, since the transformed model satisfies the classical linear assumptions. Consequently, tests become valid by using the OLS formulae as long as substitution of X^* is made in place of X. Thus any test that involves σ_u^2 can set it to 1. The GLS estimator is more efficient than the OLS estimation technique, since it is based on (a) the Gauss–Markov Theorem and (b) a model that satisfies the classical assumptions, but the OLS estimator is less efficient. Hence, the GLS is more efficient because:

$$Var(\hat{\beta}_{GLS}) - var(\hat{\beta}_{OLS}) = (X'X)^{-1}X'\Sigma'\Sigma X(X'X)^{-1} - (X'\Sigma^{-1}X)^{-1} = A\Sigma A \quad (56)$$

Where

$$A = [(X^{*'}X^{*})^{-1}X^{*'} - (X'\Sigma^{-1}X)^{-1} \quad (57)$$

Therefore, the matrix is used to weight the residuals (Creel, 2014, pp. 168–180).

4.2. A new generalized least squares (GLS) technique discovered

In the process of conducting research on bank credit and monetary transmission mechanism in Uganda a new and simpler (i.e. user friendly) GLS technique is discovered. This new technique is applicable where before regression each variable is multiplied by the reciprocal of $d(d(Y_t^2))$ such that Y_t^2 is the quantity of the dependent variable, X_{it} represents quantity of the ith independent variable, β_0 is the constant term, β_i denotes the value of parameter for variable X_{it}, and u_t is the value of the error term at time t.

In econometrics a linier regression line can be expressed as

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \cdots \beta_k X_{kt} + u_t \quad (58)$$

When Equation (58) is lagged by one period the resulting equation is given by

$$Y_{t-1} = \beta_0 + \beta_1 X_{1t-1} + \beta_2 X_{2t-1} + \cdots \beta_k X_{kt-1} + u_{t-1} \quad (59)$$

In terms of estimated values of $\hat{Y}_t$ Equations (58) and (59) may be rewritten as

$$Y_t = \hat{Y}_t + u_t \quad (60)$$

$$Y_{t-1} = \hat{Y}_{t-1} + u_{t-1} \quad (61)$$

Subtracting Equation (61) from Equation (60) gives

$$(Y_t - Y_{t-1}) = (\hat{Y}_t - \hat{Y}_{t-1}) + (u_t - u_{t-1}) \quad (62)$$

Differencing Equation (62) provides

$$d(Y_t - Y_{t-1}) = d(\hat{Y}_t - \hat{Y}_{t-1}) + d(u_t - u_{t-1}) \quad (63)$$

or

$$d(Y_t - Y_{t-1}) = d(u_t - u_{t-1}) \quad (64)$$

The $d(\hat{Y}_t - \hat{Y}_{t-1}) = 0$ because the slope of a regression line is constant. In other words after differencing for each term the difference equals zero since $\hat{\beta}_i[d(X_{it}) - d(X_{it-1})]$ equals zero in all cases, where $i = 1,2, \ldots, k$.

After differencing Equation (58) in order to derive an appropriate vector for making variance of the error terms i.e. $(u_t - u_{t-1})$ constant, the variance in Equation (64) is taken and the end result is:

$$Var[d(Y_t - Y_{t-1})] = Var[d(Y_t) - Var(Y_{t-1})] \quad (65)$$

or

$$Var[d(Y_t) - d(Y_{t-1})] = Var(Y_t - Y_{t-1}) - Var(Y_{t-1} - Y_{t-2}) \quad (66)$$

or

$$Var[d(Y_t - Y_{t-1})] = [Var(Y_t) - Var(Y_{t-1})] - [Var(Y_{t-1}) - Var(Y_{t-2})] \quad (67)$$

Further decomposition of the variance of terms in Equation (67) gives:

$$Var[d(Y_t - Y_{t-1})] = [E(Y_t^2 - \bar{Y}^2) - E(Y_{t-1}^2 - \bar{Y}^2)] - [E(Y_{t-1}^2 - \bar{Y}^2) - E(Y_{t-2}^2 - \bar{Y}^2)] \quad (68)$$

or

$$Var[d(Y_t - Y_{t-1})] = E[Y_t^2 - \bar{Y}^2 - Y_{t-1}^2 + \bar{Y}^2] - E[Y_{t-1}^2 - \bar{Y}^2 - Y_{t-2}^2 + \bar{Y}^2] \quad (69)$$

Or

$$Var[d(Y_t - Y_{t-1})] = E[Y_t^2 - Y_{t-1}^2] - E[Y_{t-1}^2 - Y_{t-2}^2] \quad (70)$$

or

$$Var[d(Y_t - Y_{t-1})] = E[d(Y_t^2) - d(Y_{t-1}^2)] \quad (71)$$

or

$$Var[d(Y_t - Y_{t-1})] = E[d(d(Y_t^2))] \quad (72)$$

or

$$Var[d(Y_t - Y_{t-1})] = Var[d(u_t - u_{t-1})] = E[d(d(Y_t^2))]\,)] = E[d(d(u_t^2))] \quad (73)$$

or

$$E[d\Big(d(Y_t^2)\Big)] = d(d(E(u_t^2))) \quad (74)$$

Hence

$$d(d(Y_t^2)) = d(d(\sigma_{u_t}^2)) \quad (75)$$

Thus, a constant variance (1) can be obtained after multiplying the difference of the errors in a regression $[(u_t - u_{t-1})]$ by the reciprocal of the vector $[1/d(d(\sigma_{u_t}^2))]$ as follows:

$$Var\left[\frac{(u_t - u_{t-1})}{d\Big(d\Big(\sigma_{u_t}^2\Big)\Big)}\right] = \frac{Var[(u_t - u_{t-1})]}{d\Big(d\Big(\sigma_{u_t}^2\Big)\Big)} = \frac{\sigma_{u_t}^2 - \sigma_{u_{t-1}}^2}{d(d\Big(\sigma_{u_t}^2\Big))} = \frac{d(\sigma_{u_t}^2)}{d\Big(\sigma_{u_t}^2\Big) - d(\sigma_{u_{t-1}}^2)} = \frac{d[\sigma_{u_t}^2/\sigma_{u_{t-1}}^2]}{d[\sigma_{u_t}^2/\sigma_{u_{t-1}}^2] - d(1)} = 1 \quad (76)$$

4.3. Description of variables used in empirical analysis

Each of the variables considered falls at least under one of the following channels (a) asset price channel: interest rate, exchange rate, equity prices and wealth effect, and (b) credit channel: bank lending, balance sheet and unanticipated prices. All the quantities of the variables considered are in terms of monthly figures running from January 2008 to December 2017. However, some of the variables were estimated by using estimator (i.e. formulae) for example the velocity of money (V) variable was estimated by

using the formula: $V = (PY/M_n)$, where Y is gross domestic product, P is the price level of aggregate goods and services and (M_n) is the quantity of money supply in the economy.

Table 1. *List of variables used in empirical analysis along with their descriptions*

1.	ATB	364–day (annual) Treasury bill yield interest rate in percent
2.	BD	bank deposit in shillings
3.	CC	currency in circulation in shillings
4.	CG	claims on central government in shillings
5.	CR	commercial bank credit to the private sector in shillings
5.	DC	domestic claims in shillings
6.	DDR	demand deposits rate
7.	DT	total deposit in the banking system in shillings
8.	EDS	external debt service in US$
9.	FER	gross foreign exchange reserves in US$
10.	ER	exchange rate end of period (Shs/US$)
11.	GB	stock of government Treasury bond in shillings
12.	GT	government treasury bills in shillings
13.	IR	interbank rate in percent
14.	M	imports of goods and services FOB in US$
15.	MB	monetary base in shillings
16.	MN	nominal money supply shillings
17.	NEQ	net equity (shares and other equity) in shillings
18.	NFA	net foreign assets in shillings
19.	NX	net exports in US$
20.	P	consumer price index (CPI core base: 2009/10=100)
21.	TB	91 day Treasury bill yield in percent
22.	TDR	time deposit rate in percent
23.	R	real interest rate in percent
24.	RR	rediscount Rate in percent
25.	RN	nominal interest rate in percent
26.	SR	savings rate in percent
27.	V	velocity of money
28.	VC	velocity of credit
29.	X	exports of goods and services FOB in US$
30.	Y	gross domestic product (GDP) in shillings at constant 2009/10 prices

Data Source: Bank of Uganda. Data collected were monthly data for the period January 2008 to December 2017.

Table 2 lists variables (VARs) used in analysis along with their mean, standard deviation and order of integration (O.I.) determined in each test by the calculated Augmented Dickey Fuller (ADF) test statistic (CA.T.) in comparison with the critical ADF test (CR.T.) at 1 percent level of significance (i.e. MacKinnon critical value for rejection of hypothesis of rejection). The calculated ADF after dividing the variable by Y are denoted as CA.N with the aim of stabilize such variables. As can be observed from the table, almost all variables have order one (I(1)) level of integration.

Table 2. *List of Variables with their Means, Standard Deviations and Order of Integration*

#	VARs	Mean	S.D.	CR.T.	CA.T.	O.I.	CA.N.	O.I.
1	ATB	14.23	4.17	-3.49	-4.28	I(1)	-4.43	I(1)
2	BD	3.05×10^{12}	1.04×10^{12}	-3.49	-5.93	I(1)	-6.40	I(1)
3	CC	4.48×10^{12}	2.16×10^{12}	-3.49	-5.94	I(1)	-6.63	I(1)
4	CG	7.43×10^{12}	2.40×10^{12}	-3.49	-6.18	I(1)	-6.19	I(1)
5	CR	7.48×10^{12}	2.95×10^{12}	-3.49	-6.84	I(2)	-7.10	I(1)
5	DC	8.48×10^{12}	4.29×10^{12}	-3.49	-3.79	I(1)	-6.58	I(1)
6	DDR	1.52	0.30	-3.49	-4.64	I(1)	-4.90	I(1)
7	DT	6.59×10^{12}	2.33×10^{12}	-3.49	-4.57	I(1)	-8.10	I(1)
8	EDS	7.29×10^{6}	6.71×10^{6}	-3.49	-12.0	I(1)	-11.9	I(1)
9	FER	7.48×10^{12}	7.48×10^{12}	-3.49	-4.74	I(1)	-5.98	I(1)
10	ER	2650.74	599.49	-3.49	-5.24	I(1)	-7.13	I(1)
11	GB	2.47×10^{12}	9.91×10^{11}	-3.49	-3.73	I(1)	-5.01	I(1)
12	GT	1.14×10^{10}	4.54×10^{9}	-3.49	-3.90	I(1)	-4.14	I(1)
13	IR	10.26	4.82	-3.49	-5.96	I(1)	-5.96	I(1)
14	M	3.42×10^{8}	5.34×10^{7}	-3.49	-7.34	I(1)	-6.31	I(1)
15	MB	3.41×10^{12}	1.16×10^{12}	-3.49	-5.87	I(1)	-6.11	I(1)
16	MN	8.73×10^{12}	3.06×10^{12}	-3.49	-4.94	I(1)	-8.45	I(1)
17	NEQ	4.48×10^{12}	2.16×10^{12}	-3.49	-4.77	I(1)	-5.46	I(1)
18	NFA	8.00×10^{12}	2.43×10^{12}	-3.49	-5.72	I(1)	-6.69	I(1)
19	NX	-1.71×10^{8}	4.61×10^{7}	-3.49	-6.89	I(1)	-6.60	I(1)
20	P	127.42	24.87	-3.49	-5.93	I(2)	-8.47	I(1)
21	R	14.42	4.71	-3.49	-5.16	I(1)	-5.14	I(1)
22	RN	22.22	2.11	-3.49	-5.19	I(1)	-6.69	I(1)
23	RR	15.42	4.65	-3.49	-4.08	I(1)	-4.49	I(1)
24	TB	2.47×10^{12}	9.97×10^{11}	-3.49	-3.73	I(2)	-5.01	I(1)
25	TDR	11.69	3.26	-3.49	-4.42	I(1)	-4.40	I(1)
26	SR	2.84	0.52	-3.49	-5.68	I(1)	-5.59	I(1)
27	V	188.67	15.99	-3.49	-3.51	I(0)	-4.35	I(1)
28	VC	78.22	34.32	-3.49	-6.69	I(1)	-8.02	I(1)
29	X	2.21×10^{8}	3.36×10^{7}	-3.49	-7.15	I(1)	-7.15	I(1)
30	Y	1.24×10^{13}	1.83×10^{12}	-3.49	-9.08	I(1)	-8.10	I(1)

Table 3, Appendix 1 represents the values of correlation coefficients for the variables listed in Table 1. The relationship between bank credit and each of other variables is represented by the respective correlation coefficient as follows: nominal interest rate (0.35), real interest rate (0.61), CPI (0.99), exchange rate (0.96), money supply (0.99), real GDP (0.93), income velocity of money (-0.45), time deposit rate (0.22), rediscount rate (0.35), exports (0.75), imports (0,48), external debt service (0.41), net foreign assets (0.95), government treasury bill (0.50), government bonds (0.92), net exports (-0.01), demand deposit ratio (0.63), savings ratio (0.74), interbank rate (0.30), domestic credit (0.99), bank deposits (0.97), claims on government (0.49), total deposits in the banking system (0.98), currency in circulation (0.99), monetary base (0.99), treasury bill (0.92), net equity (0.98).

Our correlation matrix shows very high correlation between some of the variables implying that probably there is transmission of monetary policy signals through some of the variables. But correlation does not necessarily mean causation (Mishkin, 2010, p.606). To examine whether the monetary policy transmission mechanism could have been transmitted through the bank credit in Uganda during the sample period, the Granger causality

tests are conducted. Only the causality between bank credit and each of the other variables is reported (see Appendix 2, Table 4).

Changes in bank credits may entail significant changes in real output and inflation. Granger causality tests have been conducted, to examine the causality between variables, in particular the relationships between bank credits and selected monetary, financial and real sector indicators. Using two lags, results of the Granger causality tests on data set from January 2008 to December 2017 reveal that at 10% level of significance bank credit Granger caused the following variables: currency in circulation, external debt service, nominal exchange rate, Government bonds, Treasury bonds, monetary base, net foreign assets, nominal interest rate, savings rate, exports, real income (GDP), reserves, and velocity of money in the deposits market. These aforementioned variables existing in the economy of Uganda therefore were part of the economic interactions.

Secondly, the causality between bank credit and the selected variables show that variables that Granger caused bank credit in Uganda during the sample period were as follows: bank deposits, total deposits in the banking system, imports, money supply, time deposits rate, velocity of money, velocity of money in the bank credit market and money multiplier. Thirdly, the causality tests show that there is a bidirectional causality between bank credit and each of the following selected variables: annual Treasury bill, domestic credit, net equity, consumer price index (CPI), real interest rate, rediscount rate, and velocity of money in the bank credit market.

Fourthly, at 10% level of significance the monetary policy transmission is found to have operated as follows: from real interest rate (R), to money supply (M_n), to bank deposits (BD), to bank credit (CR), to CPI (P), to GDP (Y) and to nominal exchange rate (ER). Symbolically the monetary transmission mechanism is found to have operated as follows:

$$R \rightarrow M_n \rightarrow BD \rightarrow CR \leftrightarrow P \rightarrow Y \leftrightarrow ER$$

However, one feedback loop is found to run from bank credit back to real interest rate, four feedback loops is found to run from CPI back to real interest rate, money supply, bank deposits and bank credit, one feedback bidirectional loop is found to run from CPI back to bank deposits, one feedback loop is found to run from GDP back to real interest rate, and two feedback loops is found to run from nominal exchange rate to CPI and real interest rate.

5. Empirical results and discussion

5.1. Objectives and scheme of evaluation (Assessment)

The main objectives of this section are to (a) test the bank credit channel of monetary policy and (b) test the determinants of bank credit in Uganda. The section addresses the following questions:

(a) Does monetary policy affect inflation through the credit channel?
(b) How important are the different transmission channels?

(c) Does the relative importance of these channels depend on whether the borrowers are households or firms?

(d) What are the determinants of bank credit in Uganda?

The study is important because in Uganda the empirical evidence on bank credit is still scanty. The transmission of monetary policy through the interest rate and exchange rate channels that have become pronounced in Uganda during the inflation targeting regime and the bank credit channel matters in transmission of impulses to the real economy.

Evaluation of MPTM considered are conducted in five steps as follows:

(a) Imposing the monetary policy route into the model formed.

(b) Solving the model using the solution algorithms by Granger causality technique.

(c) Observing the property of stochastic steady state (stationarity) distribution of variables.

(d) Choosing the route that gives the most stationary performance in particular with regression results.

(e) Checking the results for robustness using other models (Taylor, 2002).

Timelessness is a very important approach used in evaluating the MPTM. By focusing on stationarity distribution, ensures that the policy rule is not different from one that follows under the same conditions at any other time (McCallum, 1999).

This section provides a quantitative assessment of bank credit channel of monetary policy of Uganda. The regression results obtained are out of the dynamic economy wide models because monetary policy has effect on entire economy. The dynamic models used take into account the fact that there are lags in the monetary policy transmission mechanism (MPTM) and expectations of the future are important in financial markets. According to Bayangos (2010), initiatives to analyze the interaction between credit and monetary policy include studies by Bernanke *et al.* (1999), Carlstrom & Fuerst (2001), Iacoviello (2005) and Van den Heuvel (2002).

There are two broad strategies of empirical studies on the importance of bank lending or credit channel of MPTM. The first strategy is based on aggregate data. It is concerned with examining the reaction of bank loans, deposits and bonds to monetary policy shocks, using impulse response functions from a vector autoregression (VAR) model and reduced form methods. But this strategy does not allow for the quantitative identification of supply and demand effects on credit growth. Thus, the evidences found using the first technique in principle are treated as indicative only. The second strategy employs bank level data. This strategy attempts to identify shifts in loan supply from shifts in loan demand. The identification is done with the assumption that certain bank characteristics determine the degree to which banks respond to monetary policy shocks. "Most studies specify loan growth for each bank as a function of its lagged values, aggregate variables (GDP growth, short–term interest rate change, and inflation) and bank specific characteristics.

However, in most studies, this strategy does not address the issue that the change in monetary policy may not be exogenous, which makes it hard to identify the true effect of higher interest rates on loan supply." (Bayangos, 2010). The strategy of our empirical analysis is to estimate the quantitative importance of credit at the macroeconomic level that includes the relevant macroeconomic variables. Such approach provides a better insight into the relevant quantitative effect of changes in bank credit in Uganda. By using the generalized least squares method the paper is able to trace the effect of macroeconomic linkages in Uganda from 2008:1 to 2017:12.

5.2. The bank lending channel of monetary policy transmission mechanism (MPTM)

Each of the 38 regression equations is assessed for basic diagnostic tests. The signs and magnitudes of individual coefficients in each equation, such as t statistic, the adjusted R–Squared (R^2), Durbin Watson(DW), Koenker–Basset heteroscedasticity t statistic (H_T) and F statistic are all examined. All calculated t and F values are higher than the critical values, at the 5% level of significance, thereby indicating that all the parameters are significantly different from zero and there is a significant degree of reliability of coefficients of determination as well as absence of heteroscedasticiy. The heteroscedasticity t statistic indicates that each of the repressions has constant variance. The Durbin–Watson test for serial correlation show that all regression results do not suffer from autocorrelation.

5.2.1. Bank credit is created out of bank deposits

The paper finds that bank credit is not created out of nothing but bank deposits. This finding is supported by Equations A1, A10, A13, A14, A19, A20, A21, A22, A28, A30 and A33 in Appendix 3 where in the current month reduction in bank deposits by 1% might have caused bank credit to increase within the range of 0.12% to 0.40% during the sample period, ceteris paribus. A month later the credit that has been created is then remitted into the deposits system as savings. That is why regression of bank credit on the lag of bank deposits provides a positive coefficient.

Recall, commercial banks create money, by making new loans out of bank deposits. For instance, when a bank makes a loan to its customer as a mortgage to buy a house, in principle it does not give them thousands of banknotes. Rather, it credits the bank account of the customer with a bank deposit of the size of the mortgage, and instantly a new money is created. Thus deposits are typically created by the saving decisions of households, and banks then 'lend out' those existing deposits to borrowers. What households save in bank accounts are deposits that come simply at the expense of deposits that would have otherwise gone to companies in payment for goods and services. Savings raise the deposits or funds available for banks to lend. Similarly, according to coefficients in Equations A1 (i.e. -0.42) and A2 (i.e. 0.39), money that leaks out of the monetary base

as deposits in the current month comes back to increase the monetary base in form of savings.

5.2. Monetary policy transmission mechanism operates through the bank credit channel

At the end of section 4 of this present paper the Granger causality tests conducted shows that the transmission mechanism of monetary policy in Uganda during the sample period was procyclycle. One of the key variables responsible involved in the MPTM is inflation that might have caused quantity of bank credit to increase probably by making products of firms more profitable.

A 1% increase in inflation might have caused growth in bank credit to increase within the range of 0.508% to 0.853% within one month as depicted by Equations A4, A5, A10, A14, A16, A21, A22, A23, A24, A25, and A28 in Appendix 3. As a result, the finding confirms the presence of MPTM in Uganda during the sample period. These findings concur with monetary Authorities assumption that policy actions are transmitted to market interest rates instantaneously, symmetrically and in a linear fashion; in our case within one or two months only. It should be noted that the range is close to the explicit inflation target that BOU set at 5 percent per annum.

Before October 2009, the Bank of Uganda (BOU) adhered closely to its money targets. Shocks to money demand thus generated substantial movements in interbank rates that did not signal policy intentions and which were often temporary and, as a result, had little effect on lending rates or other aspects of the transmission mechanism. Since October 2009 the BOU has allowed for more flexibility in daily money market operations in order to smooth short term money market rates. This immediately has reduced the volatility of interbank rates (Berg *et al.,* 2013).

Uganda is classified as a floating regime. The monetary authorities intervene in the foreign exchange market in order to maintain stability in the foreign exchange market. Since 2010, the Bank of Uganda (BOU) has been conducting daily purchases for reserve buildup purposes. The BOU engages in targeted sales occasionally as deemed necessary and there are no capital controls. Furthermore, the BOU publishes information on its interventions in its monthly, quarterly and annual reports, including the amounts purchased or sold through the reserve buildup program and through targeted transactions.

More importantly, the findings support Berg *et al.* (2013) claim that the transmission mechanism in the economy of Uganda is alive and well: after a large policy–induced rise in the short–term interest rate, lending and other interest rates rise. As a result, the exchange rate tends to appreciate, output tends to fall, and inflation declines. The finding gives the clearest transmission in Uganda, where the Inflation Targeting (IT) lite regime itself is simpler and more transparent. The explicit inflation target is set at 5 percent. The recent evolution of Uganda's monetary policy regime shows

generally that the transmission mechanism depends on the policy framework itself and on the operational procedures of monetary policy implementation.

Secondly, the result in Equation A22 Appendix 3 shows that MPTM was transmitted from the 91–day Treasury bill (TB) through the bank credit channel because a 1% decrease in the TB growth is associated with growth in bank credit by 0.064% per month during the sampling period, ceteris paribus. On the other hand By using micro–level data Opolot *et al.,* (2013) finds that in a two–step GMM estimation, the corresponding effect of a one percentage point increase in the BOU 91–day Treasury bill rate is a decline in bank loan supply by 0.098 percentage points in Uganda. The central bank usually responds to inflation by tightening the monetary policy stance, and affect the commercial banks loan supply function with a lag. It is this monetary policy variable that affects the banks' loan supply with a lag, and releases some impulse in the transmission mechanism.

In July 2011 the BOU announced and officially launched the inflation targeting lite (IT–lite) regime and introduced the Central Bank Rate (CBR) to target the interbank rate a move away from monetary targeting. These changes to the policy framework and operations set the stage for changes in short term interest rates (specifically the CBR) to have a larger impact on the economy. Under the new regime, an interest rate is the operating target of monetary policy called the Central Bank Rate (CBR). The CBR is set once a month and used to guide 7 day interbank interest rates along with the rediscount policy used often used by the BOU to signal policy (Berg *et al.,* 2013).

Thirdly, according to result in Equation A26 Appendix 3, a 1 percent decline in the 7-day interbank interest rates (IR) is followed by 0.038 percent growth per month on average, ceteris paribus. In practice when the Bank of Uganda simultaneously switched to an IT–lite monetary policy framework, the tightening phase started in July 2011. Thus, the BOU introduced a policy rate, and stepped up its communication efforts to enhance the credibility of the new framework. In the second half of 2011 the BOU decided to tighten monetary policy with the intention of fighting inflation. A negative commodity price shock began during 2010–2011, with food and fuel prices rising substantially. Coupled with strong credit growth, a weakening currency and low real interest rates, the shock led to soaring inflation (Abuka *et al.,* 2015).

In mid–2011 the Bank of Uganda raised the policy rate by a cumulative 1,000 basis points (bps) over the course of five months. In the following eleven months BOU reduced it by a total of 1,100 bps. These changes occurred over relatively short period of time. Consequently, it reduces the likelihood that structural transformation of the economy might respond to an analysis of the effectiveness of monetary policy. For instance, following the tightening, credit growth collapsed to negative levels by the second half of 2012 (Abuka *et al.,* 2015). Like Abuka *et al.* (2015) this present paper finds a strong balance sheet channel for the transmission of monetary policy.

Nevertheless, the expansionary phase of credit began in January 2012 when the policy rate was gradually reduced over the following three quarters from 23 percent to 11 percent. The average marginal lending rate on local currency loans increased during the tightening period from close to 15 percent to almost 25 percent and subsequently returned to about 20 percent (Abuka *et al.*, 2015).

Fourthly, the degree to which a 1% growth in each of the various variables was causing growth in bank credit in Uganda during the sample period, holding other things constant is presented in Table 3 that lists various effects of other variables on bank credit. All the signs on the coefficients conform to theories regarding the relationships between the bank credit and the individual variables. Thus, all the variables that contributes to yields on credit (ATB, R, Rn, RR, IR and TDR) have negative influence on bank credit.

In a nut shell variables that have positive contributions on bank credit are: claims on central government, demand for money, deposits within the banking system, domestic credit, exchange rate, exports, government bond, monetary base, money supply, net equity, net foreign assets, real gross domestic product, savings rate treasury bonds, velocity of money in the entire economy and velocity of money in the credit market. Meanwhile the variables that have negative effects on bank credit are: annual Treasury bill, currency in circulation, Demand deposits ratio, external debt servicing, imports, nominal interest rate, real interest rate, rediscount rate, reserves, and time deposits rate. These findings suggest that the credit, exchange rate, bank credit, interest rates, equity price, expectations and wealth effects channels are interlinked. Besides the MPTM is invigorated when banks react to policies set by the monetary authorities. For instance, in 2010 when BOU raised its bank rate from 13% to 23%, banks raised their prime lending rates to the range of 18% to 34% (Nakayiza, 2013).

Table 3. *List of other Variables along with the Degree of their Influence on Bank Credit*

(i) Annual Treasury bill (ATB) -0.042% (Equation A16).
(ii) Claims on central government (CG) 0.119% to 0.120% (Equation A17, A26).
(iii) Currency in circulation(CC) -0.254% (Equation A9).
(iv) Demand deposits ratio (DDR) -0.030% (Equation 20).
(v) Demand for money (M_d) 0.239% (Equation A4).
(vi) Deposits within the banking system 0.688% (D_t) (Equation A1).
(vii) Domestic credit (DC) 0.228 (Equation A17).
(viii) Exchange rate (ER) 0.142% to 0.77% (Equations A9, A13, A14, A16, A20, A24-A26, A28).
(ix) Exports 0.073 (Equation A18).
(x) External debt servicing (EDS) -0.015% (Equation A27).
(xi) Government bond (Gb) 0.146% (Equation A26).
(xii) Imports (M) -0.082 (Equation A18).
(xiii) Investment Spending (I) 0.258% (Equation A4).
(xiv) Monetary base (M_b) 0.329% (Equation A6).
(xv) Money supply (M_n) 0.317% to 0.722% (Equations A14, A16, A17, A20, A23, A25).
(xvi) Net equity (NEQ) 0.073% (Equation 22).
(xvii) Net foreign assets (NFA) 0.657% (Equation A27).
(xviii) Nominal interest rate (Rn) -0.394% (Equation 23).
(xix) Real gross domestic product (Y) 0.124% to 0.218% (Equations A13, A14, A19, A28).

(xx) Real interest rate (R) -0.028% to -0.45% (Equations A5, A13, A16, A19, A21, 24, A28).
(xxi) Rediscount rate (RR) -0.069% (Equation 25).
(xxii) Reserves (Re) -0.047% (Equation A6).
(xxiii) Savings rate (S_r) 0.039% to 0.069% (Equations A9, A17, A20, A26).
(xxiv) Time deposit rate (TDR) -0.032% to -0.051% (Equation A14, A20, A24, A25).
(xxv) Treasury bonds (TB) 0.132% to 0.030% (Equations 17, Equation A26).
(xxvi) Velocity of money in the entire economy (V) 0.128% to 164% (Equations A12, A15).
(xxvii) Velocity of money in the credit market (V_{CL}) 0.151 to 0.308% (Equations A1, A15).

5.3. Passing the monetary policy transmission mechanism to inflation

From Equations (A12), (15A) and (A31) it can be deduced that a 1 percent increase in bank credit, velocity of money in the credit market, income velocity of money, bank deposits, interbank rate and output in the previous period growth was responsible for 0.58%, 0.14% to 0.15%, 0.13% to 0.19%, 0.03% to 0.08% and -0.02% and 0.06% increase respectively in inflation during the sample period, other things being constant. Thus implying that the MPTM was in existence.

5.4. Wealth effects channel of monetary policy transmission mechanism

Equation (A29) and (A11) satisfy liquidity preference theory which says that (a) as interest rates increase, real money balance declines, leading velocity to rise. The results in Equations (A29) and (A11) show that a 1 percent rise in growth of bank credit, velocity of money, price level and interest rate growth is found to have been associated with 0.21%, 0.75% to 1.09%, -0.77% and -0.10% rise respectively in economic growth during the sample period, ceteris paribus.

Meanwhile, Equations (30) shows that a 1 percent increase in bank deposits, exchange rate and interest growth is found to have been the cause of growth in equity by -0.22%, 1.22% and 0.44% respectively during the sample period, ceteris paribus. Hence, indicating that the wealth channel of monetary poicy transmission mechanism PTM was operational in the economy of Uganda within the given period. Moreover, from Equation (38A) it is clear that raising output and exchange rate causes reduction in balance of payments deterioration. Meanwhile increasing interest rate, bank credit and bank deposits promote balance of payments problem, probably due to huge imports bills incurred in importation of machinery and equipment.

5.5. Exchange rate channel of monetary policy transmission mechanism

Empirical Results in Equation (A34) show that a 1% growth in money supply in the previous period, real interest rate, net equity, price level, government bonds, and exports in the previous period is associated with 0.14%, 0.03%, 0.19%, 0.84, -0.08% and -0.05% increase respectively in

exchange rate depreciation. Thus the exchange rate channel of MPTM exists, though causality runs from exchange rate to prices.

5.6. Fiscal channel of monetary policy transmission mechanism

It can be discerned from Empirical Results in Equation (A33) that a 1% rise in growth of demand for: bank credit in the previous period, bank deposits in the previous period, equity and money supply, and real interest rate is associated with 0.30%, -0.26%, 0.43%, 0.13% and -0.89% growth respectively in demand for government bond during the sample period. Thus, there could have been in existence the fiscal monetary policy mechanism in Uganda between 2008:1 and 2017:12.

5.7. Interest rate channel of monetary policy transmission mechanism

From Equations (A32) and (A35) it can be deduced that increases in interest growth by -6.52% to -5.02%, 2.91%, 0.60%, 3.21%, 1.17%, 1.51% and -0.34%; could have been caused by increase in growth of money supply in the previous period, real income, net exports, nominal exchange rate, government bond, total deposits in the banking system, and rediscount rate respectively are associated with 1% increase in interest rate, during the sample period, ceteris paribus. The implication of these results is that inflation targeting lite might be preventing wild growth in rate interest rate by greatly reducing money supply growth.

5.8. Money rate channel of monetary policy transmission mechanism

It is clear from Equations (A7), (A8) and (A36) that increases in money supply growth by 0.30% to 0.75%, 0.31% to 0.18%, 0.60%, -0.12%, and 0.15%; might have been caused by increase in growth of bank credit, bank deposit, level of prices in the previous, velocity of money and are associated with 1% increase in money supply, during the sample period, ceteris paribus. The implication of these results is that inflation targeting lite might enabled the BOU to make money supply growth be in line with movements in the inflation rate. Equations (A2) and (A3) indicate that a 1% growth in bank credit, bank deposit in the current period and bank deposit in the previous period could have been responsible for 0.24% to 0.35%, -0.42% and 0,39% growth respectively in the monetary base during the sample period, ceteris paribus.

This finding shows that when deposits are created, they are first extracted from the monetary system in the first month and then after one month included in the monetary system. Granger causality test indicates that it is bank deposits that causes bank credit in the case of Uganda.

6. Conclusion

This paper examines the transmission mechanism of monetary policy by testing the existence of various channels of the MPTM with respect to the bank credit channel. This paper undertakes a dynamic, structural, economy wide macro econometric model of Uganda from 2008:1 to 2017:12 to particularly examine the bank credit channel of monetary policy in Uganda. The paper attempts to build models to situate the bank credit into the monetary model as an endogenous variable with diverse effects on the macro economy. Evidence on bank lending channel is obtained by estimating a credit behavior along with its interactions with other monetary and macroeconomic variables. The major task of the paper is to examine the MPTM channels and determine whether bank credit matters in transmitting impulses to the real economy in the Uganda.

Each of the separate links in the bank credit transmission mechanism is examined in more detail, by using separate regression equations by using a simple but more accurate econometric technique, a new GLS tool. The results from the macro model suggest that bank credit channel plays a role in the monetary policy transmission mechanism in Uganda. The Granger causality results indicate feedback loop from real output to bank credit.

These findings have important implications for monetary policy as it revisits the connection between monetary policy and stability in the banking sector. In particular, one crucial issue to note regarding use of IT in central banks, is whether an IT framework could be a reasonable option. Although banking stability is not a primary objective for central banks, central banks may benefit from the awareness of risks posed to banking stability. Thus, there is a need for monitoring banking stability in general and the degree of bank capitalization in particular from a better monetary policy framework in order to better assess the transmission of monetary impulses.

Therefore, central banks should be concerned about how bank credit relates to the broader issue of the relationship between monetary and financial stability. Thus, there is need for central banks to combine monetary and regulatory policies into a macro financial stability framework. So that the first primary suggestion would be to focus on systemic developments. The second one would be to build closer cooperation between monetary authorities and financial regulators in assessing the buildup of systemic risks and in deciding what to do to mitigate them. The third one would be a much more counter–cyclical way for conducting both monetary and regulatory policies, one that would use both instruments to lean in a systematic way against credit excesses in the upswing of the cycle (White, 2009).

More specifically, monetary policy would control the growth of credit (and asset prices), particularly if accompanied by unusual spending patterns that would open up a real risk of subsequent reversal. Such efforts to combine monetary and supervision policy would need to be done broadly. This all–encompassing scale is important because attempts to

reduce risk in one sector of the financial system (for example, the banking system) may only shift risk–taking activity away to other sectors or markets (Bayangos, 2010).

Appendix

Appendix 1. *Correlation Matrix*

	CR	RN	R	P	ER	MN	Y
CR	1.0000	0.3500	0.6108	0.9897	0.9625	0.9850	0.9339
RN	0.3500	1.0000	0.1373	0.4063	0.2915	0.2439	0.2490
R	0.6108	0.1373	1.0000	0.6143	0.5199	0.6197	0.5998
P	0.9897	0.4063	0.6143	1.0000	0.9361	0.9741	0.9269
ER	0.9625	0.2915	0.5199	0.9361	1.0000	0.9531	0.8946
MN	0.9850	0.2439	0.6197	0.9741	0.9531	1.0000	0.9417
Y	0.9339	0.2490	0.5998	0.9269	0.8946	0.9417	1.0000
V	-0.4467	0.0972	-0.3444	-0.3998	-0.4574	-0.5045	-0.2794
VC	0.9915	0.3872	0.6009	0.9870	0.9526	0.9699	0.8843
TDR	0.2176	0.8160	-0.2167	0.2519	0.1673	0.1063	0.1364
ATB	0.2948	0.6282	-0.2505	0.2891	0.2935	0.1710	0.1647
RR	0.3545	0.7589	-0.1976	0.3716	0.3160	0.2458	0.2334
X	0.7517	0.3199	0.4415	0.7815	0.7064	0.7695	0.7626
M	0.4789	0.3214	0.2287	0.4930	0.3829	0.4835	0.4091
EDS	0.4059	-0.0401	0.2275	0.4114	0.3947	0.4354	0.3705
NFA	0.9451	0.2241	0.6195	0.9404	0.9433	0.9615	0.9052
GT	0.4962	0.7031	-0.1179	0.4869	0.4799	0.3887	0.3682
GB	0.9239	0.3179	0.6613	0.9241	0.8728	0.9023	0.8742
NX	-0.0080	-0.1397	0.0563	-0.0027	0.0703	-0.0004	0.0808
DDR	0.6327	0.2481	0.6069	0.6667	0.5340	0.6216	0.5905
SR	0.7427	0.4827	0.5236	0.7417	0.7174	0.6955	0.6711
IR	0.2987	0.6858	-0.3027	0.3137	0.2714	0.2033	0.1831
DC	0.9916	0.2911	0.5750	0.9712	0.9701	0.9855	0.9281
BD	0.9719	0.1956	0.6466	0.9618	0.9312	0.9940	0.9424
CG	0.4861	0.4480	0.4464	0.5564	0.3356	0.4732	0.4561
DT	0.9800	0.2303	0.6306	0.9707	0.9452	0.9989	0.9415
CC	0.9856	0.2724	0.5802	0.9688	0.9626	0.9894	0.9312
MB	0.9864	0.2662	0.6012	0.9693	0.9585	0.9884	0.9371
TB	0.9239	0.3179	0.6613	0.9241	0.8728	0.9023	0.8742
NEQ	0.9795	0.2746	0.5867	0.9571	0.9860	0.9696	0.9186

Appendix 1. *Correlation Matrix (Continued)*

	V	VC	TDR	ATB	RR	X	M
CR	-0.4467	0.9915	0.2176	0.2948	0.3545	0.7517	0.4789
RN	0.0972	0.3872	0.8160	0.6282	0.7589	0.3199	0.3214
R	-0.3444	0.6009	-0.2167	-0.2505	-0.1976	0.4415	0.2287
P	-0.3998	0.9870	0.2519	0.2891	0.3716	0.7815	0.4930
ER	-0.4574	0.9526	0.1673	0.2935	0.3160	0.7064	0.3829
MN	-0.5045	0.9699	0.1063	0.1710	0.2458	0.7695	0.4835
Y	-0.2794	0.8843	0.1364	0.1647	0.2334	0.7626	0.4091
V	1.0000	-0.4669	0.1920	0.1701	0.1168	-0.1902	-0.4482
VC	-0.4669	1.0000	0.2436	0.3233	0.3869	0.7363	0.4863
TDR	0.1920	0.2436	1.0000	0.8254	0.8993	0.1879	0.2908
ATB	0.1701	0.3233	0.8254	1.0000	0.8808	0.1139	0.1409
RR	0.1168	0.3869	0.8993	0.8808	1.0000	0.2721	0.3242
X	-0.1902	0.7363	0.1879	0.1139	0.2721	1.0000	0.5178
M	-0.4482	0.4863	0.2908	0.1409	0.3242	0.5178	1.0000
EDS	-0.2021	0.4136	-0.0848	-0.0476	0.0259	0.3508	0.2218
NFA	-0.3855	0.9356	0.0673	0.1362	0.2122	0.8016	0.4000
GT	-0.0525	0.5165	0.8579	0.9149	0.9261	0.2821	0.3181
GB	-0.2455	0.9189	0.1599	0.2743	0.3075	0.7211	0.3137
NX	0.3811	-0.0278	-0.2003	-0.0804	-0.1778	0.1277	-0.7824
DDR	-0.1647	0.6467	0.0633	0.0880	0.1680	0.4702	0.2060
SR	-0.1651	0.7511	0.3264	0.3263	0.4187	0.5896	0.3388
IR	0.0531	0.3279	0.8629	0.8196	0.9035	0.2366	0.3394
DC	-0.4773	0.9797	0.1720	0.2813	0.3257	0.7219	0.4439
BD	-0.4943	0.9531	0.0501	0.1183	0.1942	0.7632	0.4693
CG	-0.3278	0.4965	0.3234	0.0662	0.2691	0.4872	0.6053
DT	-0.5160	0.9639	0.0847	0.1393	0.2222	0.7676	0.4897
CC	-0.4688	0.9720	0.1644	0.2595	0.3048	0.7586	0.4547
MB	-0.4587	0.9709	0.1526	0.2537	0.2949	0.7446	0.4486
TB	-0.2455	0.9189	0.1599	0.2743	0.3075	0.7211	0.3137
NEQ	-0.4164	0.9686	0.1386	0.2721	0.2928	0.7209	0.3711

Appendix 1. *Correlation Matrix (Continued)*

	EDS	NFA	GT	GB	NX	DDR	SR
CR	0.40586	0.94505	0.49615	0.92391	-0.00799	0.63270	0.74268
RN	-0.04015	0.22415	0.70306	0.31786	-0.13974	0.24806	0.48274
R	0.22745	0.61950	-0.11790	0.66133	0.05626	0.60690	0.52356
P	0.41145	0.94043	0.48686	0.92407	-0.00268	0.66669	0.74174
ER	0.39470	0.94327	0.47989	0.87279	0.07032	0.53405	0.71742
MN	0.43541	0.96148	0.38867	0.90232	-0.00037	0.62161	0.69551
Y	0.37049	0.90524	0.36821	0.87418	0.08082	0.59053	0.67111
V	-0.20208	-0.38554	-0.05249	-0.24554	0.38114	-0.16472	-0.16515
VC	0.41364	0.93557	0.51650	0.91895	-0.02778	0.64669	0.75110
TDR	-0.08484	0.06729	0.85786	0.15994	-0.20027	0.06330	0.32638
ATB	-0.04763	0.13623	0.91492	0.27429	-0.08039	0.08802	0.32629
RR	0.02591	0.21219	0.92614	0.30746	-0.17781	0.16799	0.41865
X	0.35085	0.80164	0.28210	0.72115	0.12767	0.47022	0.58962
M	0.22182	0.39997	0.31808	0.31365	-0.78242	0.20602	0.33877
EDS	1.00000	0.45683	0.03889	0.36904	-0.00177	0.30331	0.21888
NFA	0.45683	1.00000	0.31423	0.90176	0.11984	0.59734	0.70627
GT	0.03889	0.31423	1.00000	0.40773	-0.16341	0.17005	0.46962
GB	0.36904	0.90176	0.40773	1.00000	0.16131	0.76977	0.72541
NX	-0.00177	0.11984	-0.16341	0.16131	1.00000	0.10344	0.03646
DDR	0.30331	0.59734	0.17005	0.76977	0.10344	1.00000	0.54574
SR	0.21888	0.70627	0.46962	0.72541	0.03646	0.54574	1.00000
IR	0.02001	0.14783	0.87387	0.22703	-0.22127	0.08109	0.33902
DC	0.41233	0.93532	0.48505	0.91625	0.01083	0.61927	0.71875
BD	0.44622	0.95619	0.32750	0.90251	0.01156	0.64280	0.67498
CG	0.11799	0.39972	0.23601	0.39618	-0.34710	0.48650	0.36549
DT	0.44013	0.95766	0.36330	0.89595	-0.00892	0.62630	0.68570
CC	0.41597	0.95680	0.45591	0.90499	0.02503	0.59326	0.71026
MB	0.41672	0.95252	0.44529	0.91020	0.02200	0.60686	0.71796
TB	0.36904	0.90176	0.40773	1.00000	0.16131	0.76977	0.72541
NEQ	0.40857	0.95751	0.44987	0.92154	0.09457	0.60007	0.73624

Appendix 1. *Correlation Matrix (Continued)*

	IR	DC	BD	CG	DT	CC	MB	TB	NEQ
CR	0.2987	0.9916	0.9719	0.4861	0.9800	0.9856	0.9864	0.9239	0.9795
RN	0.6858	0.2911	0.1956	0.4480	0.2303	0.2724	0.2662	0.3179	0.2746
R	-0.3027	0.5750	0.6466	0.4464	0.6306	0.5802	0.6012	0.6613	0.5867
P	0.3137	0.9712	0.9618	0.5564	0.9707	0.9688	0.9693	0.9241	0.9571
ER	0.2714	0.9701	0.9312	0.3356	0.9452	0.9626	0.9585	0.8728	0.9860
MN	0.2033	0.9855	0.9940	0.4732	0.9989	0.9894	0.9884	0.9023	0.9696
Y	0.1831	0.9281	0.9424	0.4561	0.9415	0.9312	0.9371	0.8742	0.9186
V	0.0531	-0.477	-0.494	-0.328	-0.516	-0.469	-0.459	-0.246	-0.416
VC	0.3279	0.9797	0.9531	0.4965	0.9639	0.9720	0.9709	0.9189	0.9686
TDR	0.8629	0.1720	0.0501	0.3234	0.0847	0.1644	0.1526	0.1599	0.1386
ATB	0.8196	0.2813	0.1183	0.0662	0.1393	0.2595	0.2537	0.2743	0.2721
RR	0.9035	0.3257	0.1942	0.2691	0.2222	0.3048	0.2949	0.3075	0.2928
X	0.2366	0.7219	0.7632	0.4872	0.7676	0.7586	0.7446	0.7211	0.7209
M	0.3394	0.4439	0.4693	0.6053	0.4897	0.4547	0.4486	0.3137	0.3711
EDS	0.0200	0.4123	0.4462	0.1180	0.4401	0.4160	0.4167	0.3690	0.4086
NFA	0.1478	0.9353	0.9562	0.3997	0.9577	0.9568	0.9525	0.9018	0.9575
GT	0.8739	0.4850	0.3275	0.2360	0.3633	0.4559	0.4453	0.4077	0.4499
GB	0.2270	0.9162	0.9025	0.3962	0.8960	0.9050	0.9102	1.0000	0.9215
NX	-0.2213	0.0108	0.0116	-0.347	-0.009	0.0250	0.0220	0.1613	0.0946
DDR	0.0811	0.6193	0.6428	0.4865	0.6263	0.5933	0.6069	0.7698	0.6001
SR	0.3390	0.7188	0.6750	0.3655	0.6857	0.7103	0.7180	0.7254	0.7362
IR	1.0000	0.2792	0.1492	0.2471	0.1830	0.2547	0.2423	0.2270	0.2324
DC	0.2792	1.0000	0.9729	0.4136	0.9805	0.9867	0.9875	0.9162	0.9859
BD	0.1492	0.9729	1.0000	0.4806	0.9955	0.9758	0.9774	0.9025	0.9560
CG	0.2471	0.4136	0.4806	1.0000	0.4873	0.4206	0.4225	0.3962	0.3434
DT	0.1830	0.9805	0.9955	0.4873	1.0000	0.9819	0.9818	0.8960	0.9626
CC	0.2547	0.9867	0.9758	0.4206	0.9819	1.0000	0.9963	0.9050	0.9764
MB	0.2423	0.9875	0.9774	0.4225	0.9818	0.9963	1.0000	0.9102	0.9774
TB	0.2270	0.9162	0.9025	0.3962	0.8960	0.9050	0.9102	1.0000	0.9215
NEQ	0.2324	0.9859	0.9560	0.3434	0.9626	0.9764	0.9774	0.9215	1.0000

Appendix 2.

Table 4. Pairwise Granger Causality Tests with Two Lags

Causality between Bank Credit (i.e. Lending) and Other Individual Variables
Sample Period: 2008:01 to 2017:12

Null Hypothesis:	Obs.	F-Statistic	Probability
LOG(CR) does not Granger Cause LOG(ATB)	118	4.39968	0.01445
LOG(ATB) does not Granger Cause LOG(CR)		4.63883	0.01158
LOG(CR/MN) does not Granger Cause LOG(ATB)	118	7.78786	0.00068
LOG(ATB) does not Granger Cause LOG(CR/MN)		2.91386	0.05835
LOG(CR) does not Granger Cause LOG(BD)	118	0.76948	0.46566
LOG(BD) does not Granger Cause LOG(CR)		3.73187	0.02695
LOG(CR) does not Granger Cause LOG(CC)	118	8.99683	0.00024
LOG(CC) does not Granger Cause LOG(CR)		0.08519	0.9184
LOG(DC) does not Granger Cause LOG(CR)	118	3.34506	0.03878
LOG(CR) does not Granger Cause LOG(DC)		3.28504	0.04104
LOG(DDR) does not Granger Cause LOG(CR)	118	0.10391	0.90139
LOG(CR) does not Granger Cause LOG(DDR)		1.389	0.25355
LOG(DT) does not Granger Cause LOG(CR)	118	4.69807	0.01097
LOG(CR) does not Granger Cause LOG(DT)		0.45708	0.6343
LOG(EDS) does not Granger Cause LOG(CR)	118	0.25138	0.77816
LOG(CR) does not Granger Cause LOG(EDS)		10.0358	9.70E-05
LOG(ER) does not Granger Cause LOG(CR)	118	1.62635	0.20122
LOG(CR) does not Granger Cause LOG(ER)		2.66683	0.07384
LOG(GB) does not Granger Cause LOG(CR)	118	0.09822	0.90652
LOG(CR) does not Granger Cause LOG(GB)		4.31375	0.01565
LOG(GT) does not Granger Cause LOG(CR)	118	1.86593	0.15949
LOG(CR) does not Granger Cause LOG(GT)		3.88202	0.02341
LOG(M) does not Granger Cause LOG(CR)	118	0.9791	0.37881
LOG(CR) does not Granger Cause LOG(M)		3.34022	0.03896
LOG(MB) does not Granger Cause LOG(CR)	118	0.19093	0.82645
LOG(CR) does not Granger Cause LOG(MB)		8.65678	0.00032
LOG(MN) does not Granger Cause LOG(CR)	118	3.78117	0.02573
LOG(CR) does not Granger Cause LOG(MN)		1.35313	0.26258
LOG(NEQ) does not Granger Cause LOG(CR)	118	2.45752	0.09021
LOG(CR) does not Granger Cause LOG(NEQ)		4.90514	0.00906
LOG(NFA) does not Granger Cause LOG(CR)	118	0.67192	0.51276
LOG(CR) does not Granger Cause LOG(NFA)		2.49466	0.08706

Source: Computations performed by Eviews, Date: 12/31/18 Time: 15:16

Table 4. Pairwise Granger Causality Tests with Two Lags

Causality between Bank Credit (i.e. Lending) and Other Individual Variables
Sample Period: 2008:01 to 2017:12

Null Hypothesis:	Obs.	F-Statistic	Probability
LOG(-NX) does not Granger Cause LOG(CR)	118	1.59584	0.20727
LOG(CR) does not Granger Cause LOG(-NX)		0.50661	0.6039
LOG(P) does not Granger Cause LOG(CR)	118	2.43955	0.09178
LOG(CR) does not Granger Cause LOG(P)		10.1725	8.70E-05
LOG(R) does not Granger Cause LOG(CR)	118	3.14515	0.04685
LOG(CR) does not Granger Cause LOG(R)		7.79696	0.00067
LOG(RN) does not Granger Cause LOG(CR)	118	5.56616	0.00495
LOG(CR) does not Granger Cause LOG(RN)		0.46623	0.62857
LOG(RR) does not Granger Cause LOG(CR)	118	2.68371	0.07266
LOG(CR) does not Granger Cause LOG(RR)		2.78774	0.0658
LOG(SR) does not Granger Cause LOG(CR)	118	0.10815	0.89759
LOG(CR) does not Granger Cause LOG(SR)		6.8031	0.00162
LOG(TDR) does not Granger Cause LOG(CR)	118	5.3052	0.00628
LOG(CR) does not Granger Cause LOG(TDR)		1.95147	0.14682
LOG(V) does not Granger Cause LOG(CR)	118	4.42431	0.01413
LOG(CR) does not Granger Cause LOG(V)		0.91804	0.40226
LOG(X) does not Granger Cause LOG(CR)	118	0.41621	0.66055
LOG(CR) does not Granger Cause LOG(X)		4.65392	0.01142
LOG(Y) does not Granger Cause LOG(CR)	118	0.3758	0.6876
LOG(CR) does not Granger Cause LOG(Y)		19.8691	4.00E-08
LOG(MB-CC) does not Granger Cause LOG(CR)	118	0.81215	0.44647
LOG(CR) does not Granger Cause LOG(MB-CC)		14.3521	2.80E-06
LOG(CR/MN) does not Granger Cause LOG(CR)	118	3.78117	0.02573
LOG(CR) does not Granger Cause LOG(CR/MN)		1.12204	0.32922
LOG(BD/MN) does not Granger Cause LOG(CR)	118	1.17839	0.31153
LOG(CR) does not Granger Cause LOG(BD/MN)		2.46498	0.08957
LOG(MN/MB) does not Granger Cause LOG(CR)	118	2.92599	0.05769
LOG(CR) does not Granger Cause LOG(MN/MB)		1.71886	0.18392

Source: Computations performed by Eviews, Date: 12/31/18 Time: 15:16

Appendix 3. *Regression Equations of Empirical Results*

Regression of growth in bank credit (Cr) on growth in: bank deposits (Bd), velocity of money in the bank credit market (V_{LC}) and total deposits in the banking system(Dt).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = -\frac{0.204d\left(\log\left(\frac{Bd}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.308d\left(\log\left(\frac{V_{LC}}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.688d\left(\log\left(\frac{Dt}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A1)}$$

t $\quad -6.29 \quad 20.94 \quad 26.43$

$R^2 = 0.997\, DW = 2.05 \quad F = 17657 \quad H_T = 0.117$ Sample Period: 2008:03-2017:12

Regression of growth in monetary base (Mb) on growth in: bank credit (Cr) and bank deposits (Bd).

$$\frac{d\left(\log\left(\frac{M_b}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} = \frac{0.239d\left(\log\left(\frac{C_r}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} - \frac{0.424d\left(\log\left(\frac{Bd}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} \quad \text{(A2)}$$

t $\quad 37.43 \quad -3.22$

$R^2 = 0.999998\ DW = 2.02 \quad F = 5.5 \times 10^7 \quad H_T = 0.0000$ SP: 2008:03-2017:12

Regression of growth in monetary base (Mb) on growth in: bank credit (Cr) and bank deposits in the previous month ($Bd(-1)$).

$$\frac{d\left(\log\left(\frac{M_b}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} = \frac{0.35d\left(\log\left(\frac{C_r}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} + \frac{0.39d\left(\log\left(\frac{Bd(-1)}{Mn}\right)\right)}{d\left(d(M_b^2)\right)} \quad \text{(A3)}$$

t $\quad 31.46 \quad 8.37$

$R^2 = 0.999996\ DW = 2.06 \quad F = 8.1 \times 10^7 \quad H_T = 0.0000$ SP: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: investments (I) and consumer price index (P).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.258d\left(\log\left(\frac{I}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.626d\left(\log\left(\frac{P}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A4)}$$

t $\quad 11.50 \quad 21.94$

$R^2 = 0.995\, DW = 1.99 \quad F = 23242 \quad H_T = 0.098$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: demand for money (Md), CPI (P) and real interest rate (R).

$$\frac{d\left(\log\left(\frac{Cr}{Mb}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.239d\left(\log\left(\frac{Md}{Mb}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.726d\left(\log\left(\frac{P}{Mb}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.045d\left(\log\left(\frac{R}{Mb}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A5)}$$

t $\quad 6.36 \quad 25.11 \quad -14.21$

$R^2 = 0.996\, DW = 1.87 \quad F = 15303 \quad H_T = 0.135$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: reserves (Re), nominal interest rate (Rn) and consumer price index (P).

$$\frac{d\left(\log\left(\frac{Cr}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} = -\frac{0.047d\left(\log\left(\frac{Re}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.165d\left(\log\left(\frac{Rn}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.736d\left(\log\left(\frac{P}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A6)}$$

t $\quad -10.35 \quad -8.19 \quad 21.48$

$R^2 = 0.977\, DW = 1.74 \quad F = 2445 \quad H_T = 0.348$ Sample Period: 2008:03-2017:12

Regression of growth in money supply (Mn) on growth in: bank credit (Cr), price in the previous month (P) and velocity of money (V).

$$\frac{d\left(\log\left(\frac{Mn}{CC}\right)\right)}{d(d((\log(Mn))^2))} = \frac{0.298d\left(\log\left(\frac{Cr}{CC}\right)\right)}{d(d((\log(Mn))^2))} + \frac{0.598d\left(\log\left(\frac{P(-1)}{CC}\right)\right)}{d(d((\log(Mn))^2))} - \frac{0.117d\left(\log\left(\frac{V}{CC}\right)\right)}{d(d((\log(Mn))^2))} \quad \text{(A7)}$$

t $\quad 3.84 \quad 9.43 \quad -4.45$

$R^2 = 0.998\, DW = 1.87 \quad F = 29062 \quad H_T = 0.012$ Sample Period: 2008:03-2017:12

Regression of growth in money supply (Mn) on growth in: bank credit (Cr) and bank deposits (Bd).

$$\frac{d\left(\log\left(\frac{Mn}{CC}\right)\right)}{d(d((\log(Mn))^2))} = \frac{0.754d\left(\log\left(\frac{Cr}{CC}\right)\right)}{d(d((\log(Mn))^2))} + \frac{0.129d\left(\log\left(\frac{Bd}{CC}\right)\right)}{d(d((\log(Mn))^2))} \quad \text{(A8)}$$

t 20.40 3.33

$R^2 = 0.997\ DW = 2.02\quad F = 34431\quad H_T = 0.117$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: monetary base (Mb), savings ratio (Sr), nominal exchange rate (ER) and currency in circulation (CC).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.329d\left(\log\left(\frac{Mb}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.069d\left(\log\left(\frac{Sr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.639d\left(\log\left(\frac{ER}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.254d\left(\log\left(\frac{CC}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A9)}$$

t 9.85 5.01 13.47 4.82

$R^2 = 0.99\ \ DW = 2.05\quad F = 4938\quad H_T = 0.040$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: money supply (Mn), bank deposits (Bd) and consumer price index (P).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d(d((\log(Cr))^2))} = \frac{0.450d\left(\log\left(\frac{Mn}{Y}\right)\right)}{d(d((\log(Cr))^2))} - \frac{0.213d\left(\log\left(\frac{Bd}{Y}\right)\right)}{d(d((\log(Cr))^2))} + \frac{0.627d\left(\log\left(\frac{P}{Y}\right)\right)}{d(d((\log(Cr))^2))} \quad \text{(A10)}$$

t 23.20 −15.25 50.34

$R^2 = 0.999\ DW = 1.73\quad F = 81030\quad H_T = 0.025$ Sample Period: 2008:03-2017:12

Regression of growth in real income (Y) on growth in: bank credit (Cr), velocity of money (V) and consumer price index (P).

$$\frac{d\left(\log\left(\frac{Y}{Mn*Dt}\right)\right)}{d(d((\log(Y/Mn))^2))} = \frac{0.209\left(\log\left(\frac{Cr}{Mn*Dt}\right)\right)}{d(d((\log(Y/Mn))^2))} + \frac{1.087d\left(\log\left(\frac{V}{Mn*Dt}\right)\right)}{d(d((\log(Y/Mn))^2))} - \frac{0.771d\left(\log\left(\frac{P}{Mn*Dt}\right)\right)}{d(d((\log(Y/Mn))^2))} \quad \text{(A11)}$$

t 8.35 59.08 −115.01

$R^2 = 0.999\ DW = 1.78\quad F = 86564\quad H_T = 0.097$ Sample Period: 2008:03-2017:12

Regression of growth in price level i.e. inflation (P) on growth in: bank credit (Cr), velocity of money in the credit market in the previous period ($V_{LC}(-1)$), income velocity on money (V) and real output in the previous period ($Y(-1)$).

$$\frac{d\left(\log\left(\frac{P}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} = \frac{0.577\left(\log\left(\frac{Cr}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.140d\left(\log\left(\frac{V_{LC}(-1)}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.128d\left(\log\left(\frac{V}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.057d\left(\log\left(\frac{Y(-1)}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} \quad \text{(A12)}$$

t 44.79 10.22 4.69 3.21

$R^2 = 0.99\ \ DW = 2.20\quad F = 5261\quad H_T = 0.175$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: real income (Y), bank deposits (Bd), real interest rate (R) and price level in the previous period $P(-1)$).

$$\frac{d\left(\log\left(\frac{Cr}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.166d\left(\log\left(\frac{Y}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.270d\left(\log\left(\frac{Bd}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.033d\left(\log\left(\frac{R}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.287d\left(\log\left(\frac{P(-1)}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.177d\left(\log\left(\frac{ER}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A13)}$$

t 8.38 −7.42 −3.69 6.22 3.74

$R^2 = 0.98\ \ DW = 1.91\quad F = 1616\quad H_T = 0.067$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: bank deposits (Bd), money supply (Mn), real income (Y), price level (P), exchange rate (ER) and time deposits rate (TDR).

$$\frac{dlog\frac{Cr}{Dt}}{ddlogC_r^2} = -\frac{0.123dlog\frac{Bd}{Dt}}{ddlogC_r^2} + \frac{0.722dlog\frac{Mn}{Dt}}{ddlogC_r^2} + \frac{0.051dlog\frac{Y}{Dt}}{ddlogC_r^2} + \frac{0.611dlog\frac{P}{Dt}}{ddlogC_r^2} + \frac{0.172dlog\frac{ER}{Dt}}{ddlogC_r^2} - \frac{0.032dlog\frac{TDR}{Dt}}{ddlogC_r^2} \quad \text{(A14)}$$

t -6.40 12.37 3.05 13.98 5.37 -5.83

$R^2 = 0.999\, DW = 2.08 \quad F = 16444 \quad H_T = 0.087$ Sample Period: 2008:03-2017:12

Regression of inflation (P) on growth in: bank credit (Cr), velocity of money in the credit market in (V_{LC}), income velocity on money (V) and bank deposits (Bd).

$$\frac{d\left(\log\left(\frac{P}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} = \frac{0.576\left(\log\left(\frac{Cr}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.151d\left(\log\left(\frac{V_{LC}}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.164d\left(\log\left(\frac{V}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.028d\left(\log\left(\frac{Bd}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} \quad \text{(A15)}$$

t 43.39 11.03 8.39 2.74

$R^2 = 0.99 \quad DW = 2.20 \quad F = 5140 \quad H_T = 0.196$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: real interest rate (R), price level (P), nominal exchange rate (ER), money supply (Mn) and annual Treasury bill (ATB).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} = -\frac{0.032d\left(\log\left(\frac{R}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} + \frac{0.613d\left(\log\left(\frac{P}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} + \frac{0.151d\left(\log\left(\frac{ER}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} + \frac{0.317d\left(\log\left(\frac{Mn}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} - \frac{0.042d\left(\log\left(\frac{ATB}{Y}\right)\right)}{d\left(d\left(C_r^2\right)\right)} \quad \text{(A16)}$$

t -3.87 11.04 3.09 9.43 -3.19

$R^2 = 0.997\, DW = 1.80 \quad F = 8176 \quad H_T = 0.2210$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: government bonds (Gb), money supply (Mn), real income (Y), time deposit rate (TDR), domestic credit rate (DC), claims on government (CG) and savings ratio (Sr).

$$\frac{dlog\frac{Cr}{Y}}{d\left(d\left(C_r^2\right)\right)} = \frac{0.132dlog\frac{Gt}{Y}}{d\left(d\left(C_r^2\right)\right)} + \frac{0.581dlog\frac{Mn}{Y}}{d\left(d\left(C_r^2\right)\right)} - \frac{0.037dlog\frac{TDR}{Y}}{d\left(d\left(C_r^2\right)\right)} + \frac{0.228dlog\frac{DC}{Y}}{d\left(d\left(C_r^2\right)\right)} + \frac{0.119dlog\frac{CG}{Y}}{d\left(d\left(C_r^2\right)\right)} + \frac{0.047dlog\frac{Sr}{Y}}{d\left(d\left(C_r^2\right)\right)} \quad \text{(A17)}$$

t 24.52 12.20 -3.89 7.04 5.53 6.04

$R^2 = 0.999\, DW = 1.93 \quad F = 3314 \quad H_T = 0.555$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: real income (Y), exports (X) and imports (M).

$$\frac{d\left(\log\left(\frac{Cr}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} = \frac{0.365d\left(\log\left(\frac{Y}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} + \frac{0.073d\left(\log\left(\frac{X}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} - \frac{0.082d\left(\log\left(\frac{M}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} \quad \text{(A18)}$$

t 15.31 4.53 -2.95

$R^2 = 0.93 \quad DW = 1.74 \quad F = 804 \quad H_T = 0.105$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: real income (Y), real interest rate (R), CPI i.e. price level in the previous period $P(-1)$), income velocity of money in the previous period $V(-1)$) and bank deposits (Bd).

$$\frac{d\left(\log\left(\frac{Cr}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} = \frac{0.218d\left(\log\left(\frac{Y}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} - \frac{0.043d\left(\log\left(\frac{R}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} + \frac{0.597d\left(\log\left(\frac{P(-1)}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} - \frac{0.163d\left(\log\left(\frac{V(-1)}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} - \frac{0.209d\left(\log\left(\frac{Bd}{Dt}\right)\right)}{d\left(d\left(C_r^2\right)\right)} \quad \text{(A19)}$$

t 11.22 -5.19 11.84 -4.07 -5.10

$R^2 = 0.98 \quad DW = 1.89 \quad F = 1649 \quad H_T = 0.145$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: savings ratio (Sr), money supply (Mn), demand deposits ratio (DDR), bank deposits (Bd), exchange rate (ER), CPI i.e. price level in the previous period $P(-1)$), time deposits rate (TDR) and real interest (R).

Dependent Variable: d(log(CR/Y))/d(d(C_r^2)), Sample Period: 2008:03 to 2017:12

Variable (A20)	Coefficient	t–Statistic
d(log(Sr/Y))/d(d(C_r^2))	0.051	5.11
d(log(Mn/Y))/d(d(C_r^2))	0.676	12.36
d(log(DDR/Y))/d(d(C_r^2))	-0.030	-5.13
d(log(Bd/Y))/d(d(C_r^2))	-0.204	-5.31
d(log(ER/Y))/d(d(C_r^2))	0.309	6.75
d(log(P(-1)/Y))/d(d(C_r^2))	1.040	6.21
d(log(TDR/Y))/d(d(C_r^2))	-0.044	-3.65
d(log(R/Y))/d(d(C_r^2))	-0.028	-3.39

$R^2 = 0.997$ $DW = 2.05$ $F = 4967$ $H_T = 0.027$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: bank deposits (Bd), consumer price index (P) and bank deposits(Bd).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = -\frac{0.397d\left(\log\left(\frac{Bd}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.640d\left(\log\left(\frac{P}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.128d\left(\log\left(\frac{Bd}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A21)}$$

t 11.42 24.63 -4.04

$R^2 = 0.996$ $DW = 2.05$ $F = 13609$ $H_T = 0.075$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: bank deposits (Bd), net equity (NEQ), consumer price index (P) and Treasury bill(TB).

$$\frac{d\left(\log\left(\frac{Cr}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} = -\frac{0.115d\left(\log\left(\frac{Bd}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.073d\left(\log\left(\frac{NEQ}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.853d\left(\log\left(\frac{P}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.064d\left(\log\left(\frac{TB}{Dt}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A22)}$$

t -9.10 4.66 21.44 -3.18

$R^2 = 0.99$ $DW = 2.08$ $F = 2739$ $H_T = 0.075$ Sample Period: 2008:05-2017:12

Regression of growth in bank credit (Cr) on growth in: money supply (Mn), consumer price index (P), nominal interest rate (Rn) and bank deposits(Bd).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.394d\left(\log\left(\frac{Mn}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.689d\left(\log\left(\frac{P}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.058d\left(\log\left(\frac{Rn}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.126d\left(\log\left(\frac{Bd}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A23)}$$

t 14.18 24.61 -3.32 -4.44

$R^2 = 0.997$ $DW = 1.93$ $F = 12047$ $H_T = 0.097$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: government bonds (Gb), money supply (Mn), real income (Y), Treasury bonds (TR), domestic credit rate (DC), claims on government (CG) and savings ratio (Sr).

$$\frac{dlog\frac{Cr}{Mn}}{d\left(d(C_r^2)\right)} = \frac{0.124dlog\frac{Y(-1)}{Mn}}{d\left(d(C_r^2)\right)} + \frac{0.508dlog\frac{P}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.029dlog\frac{R}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.172dlog\frac{Bd}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.051dlog\frac{TDR}{Mn}}{d\left(d(C_r^2)\right)} + \frac{0.142dlog\frac{ER}{Mn}}{d\left(d(C_r^2)\right)} \quad \text{(A24)}$$

t 7.17 12.83 -4.67 -6.99 -6.27 3.75

$R^2 = 0.98$ $DW = 1.94$ $F = 990$ $H_T = 0.132$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: money supply (Mn), rediscount rate (RR), consumer price index (P) and nominal exchange rate (ER).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.334d\left(\log\left(\frac{Mn}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.069d\left(\log\left(\frac{RR}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.714d\left(\log\left(\frac{P}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.187d\left(\log\left(\frac{ER}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A25)}$$

t 8.15 -3.86 12.10 3.52

$R^2 = 0.996$ $DW = 1.93$ $F = 8528$ $H_T = 0.119$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: Treasury bonds (GT), nominal exchange rate (ER), interbank rate (IR), claims on government (CG), savings ratio (Sr) and government bond (GB).

$$\frac{dlog\frac{Cr}{Y}}{d\left(d(C_r^2)\right)} = \frac{0.030dlog\frac{Gt}{Y}}{d\left(d(C_r^2)\right)} + \frac{0.458dlog\frac{ER}{Y}}{d\left(d(C_r^2)\right)} - \frac{0.038dlog\frac{IR}{Y}}{d\left(d(C_r^2)\right)} + \frac{0.120dlog\frac{Cg}{Y}}{d\left(d(C_r^2)\right)} + \frac{0.039dlog\frac{Sr}{Y}}{d\left(d(C_r^2)\right)} + \frac{0.146dlog\frac{GB}{Y}}{d\left(d(C_r^2)\right)} \quad \text{(A26)}$$

t 3.65 8.38 −6.73 7.04 7.65 6.45

$R^2 = 0.995\ DW = 1.84\quad F = 4099\quad H_T = 0.041$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: monetary base in the previous period deposits ($Mb(-1)$), net foreign assets (NFA) and external debt service (EDS).

$$\frac{d\left(\log\left(\frac{Cr}{Y}\right)\right)}{d\left(d(C_r^2)\right)} = \frac{0.116d\left(\log\left(\frac{Mb(-1)}{Y}\right)\right)}{d\left(d(C_r^2)\right)} + \frac{0.657d\left(\log\left(\frac{NFA}{Y}\right)\right)}{d\left(d(C_r^2)\right)} - \frac{0.015d\left(\log\left(\frac{EDS}{Y}\right)\right)}{d\left(d(C_r^2)\right)} \quad \text{(A27)}$$

t 4.22 8.89 −7.65

$R^2 = 0.96\ \ DW = 1.81\quad F = 1483\quad H_T = 0.297$ Sample Period: 2008:03-2017:12

Regression of growth in bank credit (Cr) on growth in: real GDP in the previous period ($Y(-1)$), domestic price level (P), real interest rate (R), bank deposits (Bd), time deposits ratio (TDR) and nominal exchange rate (ER).

$$\frac{dlog\frac{Cr}{Mn}}{d\left(d(C_r^2)\right)} = \frac{0.124dlog\frac{Y}{Mn}}{d\left(d(C_r^2)\right)} + \frac{0.508dlog\frac{P}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.029dlog\frac{R}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.172dlog\frac{Bd}{Mn}}{d\left(d(C_r^2)\right)} - \frac{0.051dlog\frac{TDR}{Mn}}{d\left(d(C_r^2)\right)} + \frac{0.143dlog\frac{ER}{Mn}}{d\left(d(C_r^2)\right)} \quad \text{(A28)}$$

t 7.17 12.83 −4.67 −6.99 − 6.27 3.75

$R^2 = 0.98\ \ DW = 1.94\quad F = 990\quad H_T = 0.132$ Sample Period: 2008:03-2017:12

Regression of growth in real income (Y) on growth in: velocity of money (V) and real interest rate (R).

$$\frac{d\left(\log\left(\frac{Y}{Mn*Dt}\right)\right)}{d\left(d\left(\left(\frac{Y}{Mn}\right)^2\right)\right)} = \frac{0.747\left(\log\left(\frac{V}{Mn*Dt}\right)\right)}{d\left(d\left(\left(\frac{Y}{Mn}\right)^2\right)\right)} - \frac{0.101d\left(\log\left(\frac{R}{Mn*Dt}\right)\right)}{d\left(d\left(\left(\frac{Y}{Mn}\right)^2\right)\right)} \quad \text{(A29)}$$

t 12.07 −3.82

$R^2 = 0.93\ \ DW = 1.77\quad F = 1579\quad H_T = 0.0000$ Sample Period: 2008:03-2017:12

Regression of growth in demand for net equity (NEQ/P) on growth in: bank deposits (Bd), nominal exchange rate (ER) and real interest rate (R).

$$\frac{d\left(\log\left(\frac{NEQ}{P*Y}\right)\right)}{d(d(NEQ^2))} = -\frac{0.223d\left(\log\left(\frac{Bd)}{Y}\right)\right)}{d(d(NEQ^2))} + \frac{1.219d\left(\log\left(\frac{ER}{Y}\right)\right)}{d(d(NEQ^2))} + \frac{0.044d\left(\log\left(\frac{R}{Y}\right)\right)}{d(d(NEQ^2))} \quad \text{(A30)}$$

t −8.01 95.51 7.57

$R^2 = 0.96\ \ DW = 1.73\quad F = 4584\quad H_T = 0.644$ Sample Period: 2008:03-2017:12

Regression of growth in price level i.e. inflation (P) on growth in: bank credit (Cr), interbank rate (IR)), income velocity on money (V) and bank deposits (Bd).

$$\frac{d\left(\log\left(\frac{P}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} = \frac{0.652\left(\log\left(\frac{Cr}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} - \frac{0.015d\left(\log\left(\frac{IR}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.191d\left(\log\left(\frac{V}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} + \frac{0.078d\left(\log\left(\frac{Bd)}{Dt*CC}\right)\right)}{d\left(d\left(\left(\frac{P}{CC}\right)^2\right)\right)} \quad \text{(A31)}$$

t 27.58 −7.66 8.41 5.50

$R^2 = 0.99\ \ DW = 2.06\quad F = 3756\quad H_T = 0.680$ Sample Period: 2008:03-2017:12

Regression of growth in real interest rate (R) on growth in: money supply in the previous period ($Mn(-1)$), real income (Y), net exports (NX) and nominal exchange rate (ER).

$$\frac{\frac{d(R)}{R*Dt}}{d(d(R^2))} = -\frac{6.518\frac{d(Mn(-1))}{Mn(-1)*Dt}}{d(d(R^2))} + \frac{2.909\frac{d(Y)}{Y*Dt}}{d(d(R^2))} + \frac{0.604\frac{d(NX)}{NX*Dt}}{d(d(R^2))} + \frac{3.210\frac{d(ER)}{ER*Dt}}{d(d(R^2))} \quad \text{(A32)}$$

t	-5.92	5.06	7.41	9.73

$R^2 = 0.90$ $DW = 1.90$ $F = 346$ $H_T = 0.133$ Sample Period: 2008:03-2017:12

Regression of growth in demand for government bonds (Gb/P) on growth in: demand for bank credit in the previous month $(Cr(-1)/P(-1))$, demand for bank deposits in the previous month $(Bd(-1)/P(-1))$, net growth in demand for equity (NEQ/P), real interest rate (R) and demand for money (Mn/P).

$$\frac{d\left(\log\left(\frac{Gb}{P}\right)\right)}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} = \frac{0.30d\left(\log\left(\frac{Cr(-1)}{P}\right)\right)}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} - \frac{0.26d\left(\log\left(\frac{Bd(-1)}{P}\right)\right)}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} + \frac{0.43d\left(\log\left(\frac{NEQ}{P}\right)\right)}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} + \frac{0.13d(\log(R))}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} - \frac{0.89d\left(\log\left(\frac{Mn}{P}\right)\right)}{d\left(d\left(\left(\frac{Gb}{P}\right)^2\right)\right)} \quad \text{(A33)}$$

t	3.88	-5.86	6.14	11.81	-10.52

$R^2 = 0.96$ $DW = 1.85$ $F = 668$ $H_T = 0.085$ Sample Period: 2008:03-2017:12

Regression of growth in nominal exchange rate (ER) on growth in: savings ratio (Sr),, money supply in the previous month $(Mn(-1))$, real interest rate (R), net equity (NEQ), prices (P), government bonds Gb, exports in the previous month (X) and imports in the previous month (M).

Dependent Variable: $d(\log(ER/Dt))/d(d(ER^2))$
Sample Period: 2008:03 to 2017:12

Variable	Coefficient	t–Statistic	(A34)
$d(\log(Mn(-1)/Dt))/d(d(ER^2))$	0.141	5.23	
$d(\log(R/Dt))/d(d(ER^2))$	0.025	8.05	
$d(\log(NEQ/Dt))/d(d(ER^2))$	0.185	9.58	
$d(\log(P/Dt))/d(d(ER^2))$	0.836	14.35	
$d(\log(Gb/Dt))/d(d(ER^2))$	-0.075	-7.60	
$d(\log(X(-1)/Dt))/d(d(ER^2))$	-0.079	-13.30	
$d(\log(M(-1)/Dt))/d(d(ER^2))$	0.053	4.71	

$R^2 = 0.997$ $DW = 1.94$ $F = 1688$ $H_T = 0.104$ Sample Period: 2008:03-2017:12

Regression of growth in real interest rate (R) on growth in: money supply in the previous month $(M(-1))$, government bonds (Gb), total deposits in the banking system (Dt) and rediscount rate (RR).

$$\frac{d\left(\log\left(\frac{R}{CC}\right)\right)}{d(d(R^2))} = -\frac{5.015d\left(\log\left(\frac{Mn(-1)}{CC}\right)\right)}{d(d(R^2))} + \frac{1.165d\left(\log\left(\frac{Gb}{CC}\right)\right)}{d(d(R^2))} + \frac{1.510d\left(\log\left(\frac{Dt}{CC}\right)\right)}{d(d(R^2))} - \frac{0.339d\left(\log\left(\frac{RR}{CC}\right)\right)}{d(d(R^2))} \quad \text{(A35)}$$

t	-11.52	8.08	5.60	-7.82

$R^2 = 0.91$ $DW = 1.81$ $F = 404$ $H_T = 0.576$ Sample Period: 2008:05-2017:12

Regression of growth in money supply (Mn) on growth in: bank credit (Cr), bank deposits (Bd) and velocity of money in the monetary base activity (Mb/Mn).

$$\frac{d\left(\log\left(\frac{Mn}{CC}\right)\right)}{d(d((\log(Mn))^2))} = \frac{0.625d\left(\log\left(\frac{Cr}{CC}\right)\right)}{d(d((\log(Mn))^2))} + \frac{0.176d\left(\log\left(\frac{Bd}{CC}\right)\right)}{d(d((\log(Mn))^2))} + \frac{0.151d\left(\log\left(\frac{Mb}{Mn*C}\right)\right)}{d(d((\log(Mn))^2))} \quad \text{(A36)}$$

t	10.41	4.23	2.69

$R^2 = 0.997$ $DW = 1.95$ $F = 18142$ $H_T = 0.082$ Sample Period: 2008:03-2017:12

Regression of growth bank credit (Cr) on growth in: savings ratio (Sr), money supply (Mn), demand deposits ratio (DDR), bank deposits (Bd), nominal exchange rate (ER), consumer price index (P), time deposits rate (TDR) and total deposits in the banking system in the previous month $(Dt(-1))$.

Dependent Variable: $d(Cr/Y))/d(d(C_r^2))$
Sample Period: 2008:03 to 2017:12

Variable	Coefficient	t–Statistic	(A37)
$d(Sr/Y)/d(d(C_r^2))$	7.70×10^{10}	4.55	
$d(Mn/Y)/d(d(C_r^2))$	0.317	9.75	
$d(DDR/Y)/d(d(C_r^2))$	-6.70×10^{10}	-3.90	
$d(Bd/Y)/d(d(C_r^2))$	-0.216	-2.92	
$d(ER/Y)/d(d(C_r^2))$	3.51×10^{8}	4.11	
$d(P/Y)/d(d(C_r^2))$	2.00×10^{10}	9.04	
$d(TDR/Y)/d(d(C_r^2))$	-1.70×10^{10}	-4.52	
$d(Dt(-1)/Y)/d(d(C_r^2))$	0.171	4.19	

$R^2 = 0.999$ $DW = 2.01$ $F = 13230$ $H_T = 0.070$ Sample Period: 2008:03-2017:12

Regression of growth in net exports (NX) on growth in: real interest rate in the previous month ($R(-1)$), real income in the previous month ($Y(-1)$), bank deposits in the previous month ($Bd(-1)$), nominal exchange rate (ER), and bank credit (Cr).

$$\frac{\frac{d(NX)}{NX}}{d(d(NX^2))} = \frac{0.181\frac{d(R(-1))}{R(-1)}}{d(d(NX^2))} - \frac{1.720\frac{d(Y(-1))}{Y(-1)}}{d(d(NX^2))} + \frac{2.490\frac{d(Bd(-1))}{Bd(-1)}}{d(d(NX^2))} - \frac{2.490\frac{d(ER)}{ER}}{d(d(NX^2))} + \frac{3.025\frac{d(Cr)}{Cr}}{d(d(NX^2))} \quad \text{(A38)}$$

t	6.62	-13.58	34.44	-6.03	8.28

$R^2 = 0.92$ $DW = 2.03$ $F = 339$ $H_T = 1.113$ Sample Period: 2008:03-2017:12

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