

**INVESTIGATING THE EFFECTIVENESS OF TRANSMISSION MECHANISMS OF
MONETARY POLICY IN SIERRA LEONE**

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ABSTRACT

Investigating the effectiveness of transmission mechanisms of monetary policy is crucial for an economy. It is essential to understand how effectiveness the channels of transmission are in affecting economic activity. This study investigates the effectiveness of transmission mechanisms of monetary policy in Sierra Leone with particular focus on the interest rate, exchange rate, and credit channels. It used a Vector Autoregression (VAR) approach to estimate time series annual data from 1980 to 2012. The study employed techniques such as unit root tests, cointegration, Granger causality test, impulse responses and variance decomposition. The cointegration test result revealed that cointegration exists. The Granger causality test showed that gross capital formation Granger causes exchange rate and real interest rate. The impulse response function showed that output responded positively to monetary shocks, as interest rate increased. Output increased for a short period and then declined.

In the case of exchange rate and private domestic credit, output showed that even in the long run, the effects of the shocks might not be transitory in order to converge towards a steady state. The variance decomposition indicated that fluctuations in gross domestic product per capita (GDPPC) were attributed to itself. While the total contribution of real interest rate (RIR) and exchange rate (ER) was relatively insignificant. The error forecast of RIR was attributed by itself with an insignificant contribution of GDPPC and none by ER and private domestic credit (PDC). Fluctuations in forecasting ER were greatly attributed to itself and trivial contributions by the other variables. The error forecast of PDC was greatly dominated by itself. As the trend fell, there was a slight increase in the contribution of the other variables. The results provided evidence of ineffective channels in the Sierra Leone economy.

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DEDICATION

This work is dedicated to my aunty Madam Marie Kanu may her soul rest in peace.

DECLARATIONS

I, Mohamed Lavally, declare hereby that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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Date.....

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTORY BACKGROUND

A successful implementation of any monetary policy regime requires an accurate and informed assessment of how fast the effects of policy changes propagate to other parts of the economy and how large these effects are. This requires a thorough understanding of the mechanism through which monetary policy actions and other forms of shocks affect economic activity. Specifically, such an understanding should provide an informed assessment of the channels through which monetary policy affects prices and economic activity. Most Central Banks that have been successful at controlling inflation and stabilising output within their domestic economies have done so largely through an understanding of these mechanisms (Abradu-Otoo, Amoah & Bawumia, 2003).

The Keynesian school of thought provides that monetary policy does not only affect inflation but also systematically affects investment, production, employment and real incomes (at least in the short-run). The non-neutrality of monetary policy arises from market frictions, imperfect information, nominal rigidities or a synchronized price and wage setting behaviour, or even different norms of decision makers (Akerlof, 2007). Some Keynesian scholars argue that economic developments are path dependent and thus, the demand shocks through monetary policy can lead to long-lasting effects on economic activities (Akerlof, 2007; Ball, 2009 & Mankiw 2001).

The Monetarist argument was that monetary policy affects the economy in the short run, but with uncertain lags and uncertain magnitudes. In the long run, monetary policy affects nominal variables only and inflation is a purely monetary phenomenon. Monetary policy is nevertheless important because inflation is costly but monetary policy can influence the inflation rate. Thus, the overriding objective of monetary policy should be price stability. This is the main contribution that monetary policy can provide (Friedman, 1968).

The New Classical Economists put forward their rational expectations and full employment equilibrium argument. They believed that only unexpected monetary policy shocks have an impact on economic activities, while systematic monetary policy actions are expected by economic agents and thus have no effect on the economy (Lucas, 1972, 1973, 1996; Sargent, 1976). However, since policies do not systematically mislead all the people, monetary policy eventually merely plays a minor role in influencing economic developments. In the world of perfect markets, or the world with information imperfections but with rational expectations, monetary policy is simply neutral.

A useful way to understand monetary policy is to focus separately on central bank policy actions and the transmission mechanisms through which those actions work their effect. The central bank's policy rule embodies its response to deviations in macroeconomic variables in order to achieve its ultimate policy objectives. Monetary transmission mechanism refers to the process through which changes in monetary policy instruments (such as monetary aggregates or short-term policy interest rates) affect the rest of the economy and, in particular, output and inflation.

Monetary policy impulses transmit through various channels, affecting different variables and different markets, and at various speeds and intensities (Loayza & Schmidt-Hebbel, 2002).

Monetary policy affects output and prices through its influence on key financial variables such as interest rates, exchange rates, asset prices, credit and monetary aggregates. At the same time, changes in the structure of the economy tend to alter the effects of a given monetary policy measure. This requires central banks to continuously reinterpret monetary transmission channels (Kamin, Turner & Van 't dack, 1998).

Since the inception of the Bank of Sierra Leone (BSL) in 1964, monetary policy has solely been conducted by the central bank using market-based instruments. The major objectives have been the attainment of price stability, curbing of inflationary shocks and rebuilding foreign reserves which are geared towards the creation of suitable macroeconomic environment. These objectives are complemented by maintaining a higher reserve-requirement ratio and using interest rates more effectively. The BSL Act 2011 mandated the central bank to formulate, adopt and execute monetary policy. The Monetary Policy Technical Committee (MPTC) within the central bank was given the task to execute such functions under the auspices of the Bank Governor. The main objective set by the committee was the maintenance of low inflation, high sustainable economic growth and price stability.

Before 1992, the Central monetary authority was using a combination of direct and indirect monetary policy instruments such as reserve requirements, special deposits requirements, selective credit control and moral suasion to achieve its objectives. This meant that growth of money and credit were therefore sought to be limited by the Central Bank through direct

constraint on the growth of commercial banks' balance sheets. It indicated that interest rates on government securities were determined by the monetary authorities. In relation to reserve requirements, commercial banks were urged to hold a minimum of 40 percent of their total deposits liabilities as reserve asset with the BSL. Moral suasion was considered as a vibrant monetary policy instrument at that time because the Central Bank's Governor was able to convince the Managing Directors (MDs) of commercial banks to cooperate with the objectives and policies of the central bank (Mansaray & Swarray, 2012).

Although in recent years Sierra Leone has made great strides in achieving macroeconomic stability, inflation has remained stubbornly in double digits. Since the end of the civil conflict in 2002, real GDP growth has rebounded, averaging close to 8 percent a year for ten years, but inflation has averaged over 12 percent. One of the major objectives of the Bank of Sierra Leone (BSL) is to maintain low inflation. To control inflation more effectively and coupled with the other objectives of the central bank such as maintaining price stability and rebuilding foreign reserves, it is important to understand the workings of monetary transmission mechanism(s), a process by which monetary policy decisions affect key economic variables (Toe, Chen, Kalonji, Nsengiyumva, & Takats, 2008).

It is important to identify the most effective channel(s) in Sierra Leone to determine the set of policy instruments, the timing of policy changes, and restrictions that the central bank is faced in making decisions. The effectiveness of a channel depends whether the central bank would achieve its objectives that are geared towards macroeconomic stability. For interest rate channel to work effectively and efficiently, changes in the short-term policy rate should feed into the

bank and other market rates in the economy. The critical issue is the pass-through, that is, the degree and the speed with which the variations in monetary policy stance are passed on to the interest rate spectrum of the economy. Arbitrage between long-term bonds on the one hand, and equities and real assets, on the other, affects stock market values and real estate prices, which in turn affect household wealth and consumer spending, constituting the asset channel. Arbitrage between assets denominated in domestic and foreign currencies affects the real exchange rate, which alters the composition of both consumption and investment spending between domestic and foreign goods. This constitutes the exchange rate channel. Finally, credit market frictions imply that some borrowers have access to external funds only through bank credit, while others must pay a premium over the risk-free rate that depends on their net worth (the external finance premium). The credit channel captures the dual effects that changes in the supply of banking system reserves exert on aggregate demand through changes in the terms on which bank customers have access to loans (the bank lending channel) as well as through changes in the external finance premium (Mishra, Montiel, & Spilimbergo, 2011).

1.2 STATEMENT OF THE PROBLEM

In most countries, particularly in developing economies, the major objective of monetary authorities is to create a suitable macroeconomic environment. The monetary transmission mechanisms that are effective depend on whether the monetary policies meet the set goals of the authorities (Ndekwa, 2013). According Mishkin (1996), there are a number of channels through which monetary policy impacts real economic variables. Among them, the interest rate, exchange rate, and bank lending channels which are pertinent to Sierra Leone given the structure of its economy and the underdeveloped state of its financial sector.

Over the years, Sierra Leone has been faced with numerous difficulties in the conduct of monetary policy to achieve macroeconomic stability. Ogunkola and Tarawallie (2008) investigated the monetary transmission mechanism in Sierra Leone using a Vector Error Correction Model for the period 1990 to 2006 and found that the credit channel (bank lending channel) is the main medium through which the effect of monetary policies are transmitted into the domestic economy. Unlike the study by Ogunkola and Tarawallie (2008) which only focused on the civil war period (1991 to 2001), the current study will go an extra mile by investigating the effectiveness of transmission mechanisms in the context of extending the time series to cover three periods which are: pre-war (before 1991); war (1991 -2001); and after war (subsequent to 2001). Thus, the study period will be from 1980 to 2012. In addition, their study used three groups of variables. The first includes real GDP and domestic prices; the second comprises domestic short term interest rate, real effective exchange rate, and private sector credit; and the last consists of an index of world fuel prices and US Federal Fund rate. In contrast to their series, this study will use the following variables such as real interest rate, exchange rate, gross capital formation, consumer price index, private domestic credit and gross domestic product per capita which give a clearer financial and monetary policy stance of a country like Sierra Leone as compared to those used by previous study.

1.3 OBJECTIVES OF THE STUDY

The main objective of the study is to investigate the efficacy of transmission mechanisms of monetary policy vis-à-vis the applicable channels.

The specific objective is to determine the effectiveness of transmission mechanism channels of monetary policy.

1.4 HYPOTHESES OF THE STUDY

The null hypotheses (H_0) in this study are specified as follows:

- The interest rate channel of transmission mechanism of monetary policy in Sierra Leone is effective.
- The exchange rate channel of transmission mechanism of monetary policy in Sierra Leone is effective
- The credit channel of transmission mechanism of monetary policy in Sierra Leone is effective.

The alternative hypotheses (H_1) state that each of the three channels is ineffective.

1.5 SIGNIFICANCE OF THE STUDY

Although several authors have written on monetary transmission mechanisms including one study on the same subject in Sierra Leone (Ogunkola & Tarawallie, 2008) which used time series such as real gross domestic product; short term interest rate; domestic price level-inflation rate; credit to private sector; real effective exchange rate; index of world fuel price; and U.S. Federal Fund rate. Also, in another study by Robinson and Robinson (1997) in Jamaica which included series such as treasury bills, time deposit and loans. Holistically, the series of the studies might not give a true financial condition and monetary policy stance. Unlike the previous studies, this study will use the following variables such as: real interest rate; exchange rate; private domestic credit; gross domestic product per capita; gross capital formation; and consumer

price index which will give a more distinct picture of the financial and monetary policy condition of an economy like Sierra Leone.

For monetary policy to be successful, it is essential to have a broad understanding of the channels of monetary transmission mechanisms and the associated lags. The findings of this study will be very useful in guiding monetary authorities and policy makers from the context of adopting the correct channel(s) of monetary policy to achieve their objectives. Furthermore, this study will contribute to the body of existing literature on monetary transmission mechanisms and other related monetary policy issues.

1.6 ORGANISATION OF THE STUDY

The remaining part of the work is organised as follows: Chapter Two will focus on the review of theoretical and empirical literatures on the transmission mechanisms of monetary policy. Chapter Three will take into account the methodology which includes research design; type of data and source; data analysis and econometric model specification. Chapter Four will encompass results; findings; and discussion. Finally, Chapter Five will involve conclusion of work; policy recommendations, limitations of the study and necessary areas for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This section looks at both the theoretical literature and relevant empirical studies of other scholars in the area of transmission mechanisms of monetary policy. The techniques or methods adopted by various researchers to determine the transmission channels of monetary policy in different economies.

2.2 THEORETICAL LITERATURE REVIEW

A vast number of theories have explained certain links to the main channels of monetary transmission mechanisms. The main center of attention is on the primary channels that are in line with the objectives of the study.

Interest Rate Channel

The traditional Keynesian IS-LM view of monetary transmission mechanism can be characterized by showing the impact of an expansionary monetary policy. An increase in money supply (M) leads to a fall in real interest rate (R_i) which in turn reduces the cost of capital, causing a rise in investment (I) spending thereby leading to an increase in aggregate demand and a rise in output (Y). Below is the schematic indicating the effect of expansionary monetary policy.

$$M \uparrow \rightarrow R_i \downarrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (1)$$

With nominal interest rates at a floor of zero, an expansionary monetary policy that is increase money supply (M) can increase the expected price (P^e) and follow by expected inflation (π^e) and hence reducing the real interest rate (R_i) even when the nominal interest rate is at zero. This would increase investment (I) spending follow by output (Y). The schematic is shown below.

$$M \uparrow \rightarrow P^e \uparrow \rightarrow \pi^e \uparrow \rightarrow R_i \downarrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (2)$$

This channel shows that monetary policy can still be effective even when nominal interest rates have already been driven down to zero by monetary authorities.

Taylor (1995) in his study on interest rate channels explained that there is a strong empirical evidence for substantial interest rate effects on consumer and investment spending, revealing that interest rate channel is strong. Bernanke and Gertler (1995) opposed the view by stating that empirical studies have had great difficult in identifying significant effects of interest rates through capital cost.

Thus, the relationship between nominal and real interest rates is explained by theories based on price and wage rigidities, the link between short and long term real rates follows from the expectational hypothesis of the term structure of interest rates, and the relationship between aggregate demand, on one hand, and output and prices, on the other, is explained by combining a Phillips' curve with temporary nominal price rigidities. The interest rate channel lies at the core

of the current understanding of the science of monetary policy from a new Keynesian perspective. This approach models the dynamic effects of monetary policy temporary output effects and permanent price effects in a framework based on optimising dynamic behavior, rational expectations, and temporary price rigidities (Clarida, Gali, & Gertler, 2000). Benhabib and Farmer (2000) provided an alternative model in which monetary policy also has temporary real effects but markets clear continuously. In their model, money enters the production function, and the possibility of multiple rational expectations equilibria arises.

Exchange Rate Channel

The exchange rate channel as explained by (Bryant, Hooper & Mann, 1993) and (Taylor, 1993) plays a crucial role in how monetary policy affects the domestic economy. This channel includes interest rate effects in the sense that when domestic real interest rates (R_i) fall, domestic dollar deposits become less attractive relative to deposit denomination in foreign currencies, leading to a fall in the value of dollar deposits relative to other currency deposits which means a depreciation of the dollar (E). As a result of the low value of the domestic currency, this makes domestic goods cheaper than foreign goods, thereby causing a rise in net exports (NX) and in aggregate output (Y). The schematic of the expansionary policy is illustrated below as follows:

$$M \uparrow \rightarrow R_i \downarrow \rightarrow E \downarrow \rightarrow NX \uparrow \rightarrow Y \uparrow \quad (3)$$

Asset Price Channel

The Monetarist criticised the IS-LM paradigm for analyzing monetary policy effects on the economy which they said it focuses only on one asset price, the interest rate, rather than on many asset prices. The Keynesians such as Modigliani (1971) saw asset price effects as being critical to the monetary transmission mechanism. These are two key assets apart from bonds that receive substantial attention in the literature on transmission mechanism namely foreign exchange and equities. With regards to the equity price, there are two channels that are important to the monetary transmission mechanisms, namely: the Tobin' q theory of investment and wealth effects on consumption.

Tobin (1969) propounded the Tobin's q theory and explained that is a mechanism by means of which monetary policy affects the economy through its effects on the valuation of equities. An expansionary monetary policy makes bonds less attractive relative to equities leading to an increase in the price of equities (P_e). This will lead to an increase in q (defined as the market value of firms divided by the replacement cost of capital) and hence higher investment (I) spending and an increase in output (Y). The schematic is shown below:

$$M \uparrow \rightarrow P_e \uparrow \rightarrow q \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (4)$$

The wealth effect was advocated by Modigliani (1971) in his life cycle model that consumption spending is determined by the life time resources of consumers which are composed of human capital, real capital and financial wealth. With the wealth effect, an expansionary monetary

policy can lead to a rise in stock prices (P_e), leading to an increase in wealth (W); consumption (C); and hence, output (Y). The schematic of monetary policy expansion is depicted below.

$$M \uparrow \rightarrow P_e \uparrow \rightarrow W \uparrow \rightarrow C \uparrow \rightarrow Y \uparrow \quad (5)$$

Credit Channel

Credit channel of monetary transmission mechanism constitutes two sub-channels: the bank lending channel and the balance sheet (Bernanke & Gertler, 1995; Cecchetti, 1995; and Hubbard, 1995). Commercial banks play a crucial role in most financial systems by solving the problem of asymmetric information in the financial markets. With the bank lending channel, an expansionary monetary policy increases bank reserves and bank deposits (B_d) leading to a rise in the quantity of bank loans (B_L) to borrowers. As a result, investment (I) expenditure rises and hence, an increase in output (Y). Schematically, the expansionary policy effect is illustrated as:

$$M \uparrow \rightarrow B_d \uparrow \rightarrow B_L \uparrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (6)$$

The balance sheet channel came about as a result of information asymmetry problems in the credit markets. Monetary policy can affect the balance sheet of firms. Expansionary monetary policy that is increase in the stock of money (M) may cause a rise in equity prices (P_e) which increase the net worth of firms leading (L) to higher investment (I) spending and a rise in aggregate demand (AD) due to the a fall in adverse selection (AS) and moral hazard (MH) problems. The schematic illustration is shown as:

$$M \uparrow \rightarrow P_e \uparrow \rightarrow AS \downarrow \& MH \downarrow \rightarrow L \uparrow \rightarrow I \uparrow \rightarrow AD \uparrow \quad (7)$$

The controversy regarding the channels has not only taken place from a theoretical point of view but they have also influenced empirical studies as well.

2.3 EMPIRICAL LITERATURE REVIEW

Various researchers from different economies have investigated the transmission mechanisms of monetary policy using different macroeconomic variables and employing series of estimation techniques to identify the channel(s) of monetary policy transmission of countries. Some of their findings have been proven to be useful by monetary authorities and policy makers of certain nations in maintaining economic stability.

Bernarke and Blinder (1992) conducted a study on the credit channel of the U.S, using variables such federal funds rate, unemployment rate, logarithm of Consumer Price Index (CPI), deposits, loans and securities. They adopted an assumption similar to the one implemented by Sims (1992) that monetary policy is predetermined. Their result revealed that both the conventional money demand and the credit mechanisms operate and after two years, the entire long run impact of the decline in deposits is reflected in loans. They inferred that their findings supported the operation of a credit channel.

Robinson and Robinson (1997) assessed the channels through which monetary policy is transmitted in Jamaica since economic liberalization. The authors used a Vector Autoregression (VAR) model to analyse the process where by monetary policy impulses are transmitted by both the money channel and credit channel via a method of portfolio substitution. The model was comprised of interest rates on reverse repurchases-repo, Treasury bills, time deposit, loans, logs of base money, private sector credit, M3, exchange rate, prices (consumer price index) and real GDP. The quantity variables are for domestic currency assets and transactions, while the interest rate on deposits and loans are weighted average rates of various maturities and loan types and an expenditure measure derived from consumption taxes was used as proxy for GDP. The study used monthly figures on the various variables September 1991 to August 1993. The results pointed out to the possible use of a monetary conditions index (MCI) as an intermediate target for monetary policy. In addition, the impact of monetary policy was found to be immediate and pervasive. As a result of a unit shock to the reverse repo, the inflation rate decelerated within two months by approximately 0.1 percent per month while the rate of depreciation declined significantly over a period of five months. Concurrently, there were very strong although temporary, real sector effects as real economic activity declined by approximately 2.0 % in four months. Finally, the findings showed that monetary policy impulses were transmitted by both the money channel and credit channel through a process of portfolio substitution.

Kashyap and Stein (2000) examined a large panel of US banks for a period of 20 years of quarterly data using Structural VAR macro-models. They studied the bank-lending pattern of reaction towards changes in monetary policy and found significant links between the size of a bank's lending contraction and the bank's balance sheet liquidity position as a measured by the

ratio of securities to total assets. Their results indicated a quarter of the response of lending to a monetary shock is due to banks' liquidity constraints. They concluded that the bank lending channel played a significant role in monetary transmission mechanism.

Uanguta and Ikhide (2002) examined the interest rate and credit channels of monetary transmission in the Namibian economy using a structural VAR model. They used monthly data from 1990-1999, and their variables include private investment, credit to the private sector, money supply, consumer price index and lending rate. Their findings show that a tightening of monetary policy as evidenced by an increase in the repo or bank rate causes lending rates to increase in the domestic economy causing a decrease in private investment and hence a decrease in output. The result also confirms the bank lending channel.

Abradu-Otoo, Philip, Amoah, and Bawumia (2003) studied monetary transmission in Ghana from 1969-2002 using Structural Vector Error Correction (SVEC) model with the following variables such as the inflation rate and the growth rate, as well as changes in the real exchange rate, credit to the private sector, broad money, the T-bill rate, and the international oil price. They found strong evidence of monetary policy instruments affecting inflation and output in the Ghanaian economy in the long run and that the exchange rate channel remains the main medium through which monetary policy acts.

Zaderey (2003) investigated the mechanism by which monetary policy affected the real sector in Ukraine. The study employed the variables such as: Firm's capital assets, internal funds (proxy for sales), firm's gross investment, aggregate gross investment in industry, real industrial

production (net off taxes), and seasonally adjusted index of real industrial production and the data were collected for the period 1996 to 2002. Analysis of monetary environment and financial intermediation development found some fundamentals for the broad credit channel operation in Ukraine. The author concluded that monetary policy impacted on firm's balance sheets. Also, the two-step nonlinear estimation indicated positive weak link between monetary shocks and financial constraints of firms with high agency costs, which meant that even if the broad credit channel was operative in Ukraine, it would have been weak.

Garbuza (2003) studied the exchange rate channel of monetary transmission mechanism in transition economies of Central and Eastern European region with special emphasis on investigating the response of external sector variables to monetary policy shocks. The author used Poland as a reference case and employed Vector Autoregression model in VEC form. The researcher categorized variables into four groups. The first group comprised of Euro Area industrial output and the Euro Area money market interest rate to capture the European economic and financial conditions which were exogenous to the Polish variables in the VAR model. The second set of variables included the Polish industrial production and the Polish consumer price index. The third group made up of the financial variables to capture monetary policy in an open economy included the National Bank of Poland Lombard or discount rate, the money market interest rate and real effective exchange rate. The last set consisted of nominal trade balance, import prices, export prices, and volume of export and import account for policy shocks. The study used monthly data to cover the period January 1995 to September 2002. The main findings were as follows: a contractionary monetary policy shock led to a fall in industrial production and consumer prices; the interest rate and exchange rate responded positively to monetary policy

shock and magnitude of responses were not significantly different; the responses of export and import prices to monetary policy shock suggested that policy contraction led to an improvement in the terms of trade hence nominal trade balance; and finally, the investigation of the responses of volumes of export and imports to monetary policy shock showed that initial positive reaction of real exports dominated the response of real imports and real trade balance improved.

Afandi (2005) studied monetary policy transmission mechanism and structural breaks in Indonesia using both monthly and quarterly data for a time period spanning from 1984 to 2003. The study adopted a Structural VAR technique using four monetary aggregates such as total reserves, base money, narrow money (M1) and broad money (M2) together with two measures of short term interest rates: interbank call money rate and interest rate on Bank Indonesia bills as monetary policy instruments. The findings confirmed the bank lending channel and the exchange rate channel was found to be the weakest because there were anomalies during and after the financial crisis. The results also showed that the equity price channel (asset price channel) was weaker than the bank loans channel but slightly stronger than the exchange rate channel due to the collapse of the Indonesian stock market as a result of a sharp decrease in the use of equity financing during the financial crisis period. Finally, the study confirmed the occurrence of credit crunch following the financial crisis.

A study by Agha, Ahmed, Mubarik, & Shah (2005) used vector autoregressions (VARs) to examine the monetary transmission mechanism in Pakistan. The authors estimated four models which represented four channels. The variables used in the four VAR models were as follows:

The model of credit channel used; industrial production index (IPI), consumer price index (CPI), private sector credit, and six month Treasury bill rates (TB6). The model of asset price channel used; industrial production index (IPI), consumer price index (CPI), Karachi Stock Exchange index (KSEI), and six month Treasury bill rates (TB6). The model of exchange rate channel used; industrial production index (IPI), consumer price index (CPI), real effective exchange rate (REER), and six month Treasury bill rates (TB6). The model of interest rate channel used; industrial production index (IPI), consumer price index (CPI), private sector credit, real effective exchange rate (REER), Karachi Stock Exchange index (KSEI), and six month Treasury bill rates (TB6). The estimation was done using seasonally adjusted monthly data from July-1996 to March-2004 with six lags. Their results indicated that monetary tightening led to a fall in domestic demand particularly investment demand financed by bank lending which translated into gradual reduction in price pressures that eventually reduced the overall price level with a significant lag. In addition to the traditional interest rate channel, the results showed a transmission mechanism in which banks play an important role. The authors also found an active asset price channel and the exchange rate channel was less significant.

In a study by Horvath and Maino (2006) explored monetary policy transmission in Belarus by estimating a five-variable VAR model that characterized monetary policy and looked at the impact of the exchange rate on inflation for the period 1995 to 2005. The VAR model comprised of logarithm of real GDP, consumer price index, real exchange rate, interbank rates, monetary aggregates, and the U.S. Federal Funds rate as endogenous and exogenous variables. They found a significant exchange rate pass through to prices, and interest rate policy following, rather than leading, financial market developments. Furthermore, the relatively high dollarization and an

effective fixed nominal exchange rate vis-à-vis U.S. dollar contributed to the significant pass-through effect. They concluded that dollarization, and administrative interventions hindered monetary policy transmission.

Mutoti (2006) examined the transmission of monetary policy in Zambia using a cointegrated Structural VAR model. The author used monthly data over the sample period 1992 -2003 which corresponded to monetary targeting and post liberation era. The study made use of the following variables: Consumer price as a proxy for domestic price, broad money as the money of money stock, 3-month Zambian Treasury bill rate as domestic interest rate, nominal exchange rate (calculated by using the Zambian Kwacha and South African Rand), South African consumer price index (CPI) as foreign price, and the 3-month South African Treasury bill rate was captured as foreign interest rate. The researcher suggested that the impact of money supply shocks on output was little and temporal and output volatility was mainly associated with aggregate supply and IS shocks. Money demand was relatively stable and its shock in CPI inflation was identified in the short run. CPI inflation was triggered by aggregate supply and exchange rate shocks. Monetary policy was found to dampen inflationary pressures induced by exchange rate shocks and the exchange rate channel was the transmission channel.

Cheng (2006) examined monetary transmission in Kenya using a five-variable VAR which included real output, the price level, the money stock, the central bank's policy rate, and the nominal effective exchange rate, and used two identification techniques: a recursive scheme , and a structural scheme in which real output did not respond contemporaneously to any other variables in the system, the price level responds only to real GDP, the money stock responds to

all variables but the exchange rate, the central bank policy rate responds only to the money stock and the exchange rate (on the assumption that real output and prices cannot be observed by the central bank contemporaneously), and the exchange rate responds to all the other variables in the system. Under both schemes, he found that policy-driven interest rates had a considerable impact on the price level and the foreign exchange value of the shilling, but not on real output. He concluded that monetary policy affected the price level through aggregate supply in the form of exchange rate pass-through, rather than through aggregate demand.

Lungu (2008) examined monetary transmission in Southern Africa, using a seven-variable VAR containing industrial production, prices, the monetary base (M2), central bank policy rate, supply of bank loans, and bank lending and deposit rates. He identified monetary shocks using an atheoretic Choleski decomposition with the central bank policy rate ordered first, implying that monetary policy does not react contemporaneously to any of the other variables in the system. He found mixed evidence for the bank lending channel in Botswana, Malawi, Namibia, and Zambia. The general pattern was that while bank lending and deposit rates responded to innovations in the policy rate in the expected direction, such innovations seemed to have little effect on total bank lending, on output, or on prices.

Ogunkula and Tarawalie (2008) used a Vector Error-Correction Model to analyze monetary transmission in Sierra Leone over the period from 1990 to 2006, during which the exchange rate was flexible and domestic interest rates were market-determined. They used three groups of variables. The first group comprises real GDP and domestic prices; second includes domestic short term interest rate, real effective exchange rate and private sector credit; and last an index of

world fuel prices and US Federal Fund rate. They employed a recursive identification scheme with the monetary policy variable ordered last. They found that monetary policy had effects on real GDP and bank credit in the directions predicted by the bank credit channel.

Samkharadze (2008) employed the VAR approach to investigate the role of the different channels of monetary transmission mechanisms in Georgia. The author used monthly data for the period June 2002 to May 2007. The study used five endogenous variables such as: Real domestic GDP, domestic consumer prices index, domestic lending rate, money supply, and nominal effective exchange rate. The writer constructed a monthly GDP figure from the quarterly GDP data by calculating the average monthly growth before deflating it to get the real GDP. The exogenous variables used in the model were: Consumer price indices to control for changes in external inflation, migrant remittances that might influence aggregate demand, and total remittances (foreign currency inflow). The findings showed that the exchange rate channel was still important in determining the inflation level. Further, the study revealed the significant interest rate pass-through to the real GDP and inflation. In addition, the bank lending channel was partially supported by the results. The national currency denomination bank loans had positive effect on output, while total bank loans were insignificant. Conclusively, monetary aggregates, both narrow (reserve) money and broad money were found to have positive and highly significant impact on the real output and inflation in Georgia.

Buigut (2009) explored the significance of the interest rate channel using VAR model. The author selected Kenya, Uganda and Tanzania due to the availability of data and used annual times series data covering the periods 1984 to 2006 for Kenya, 1985 to 2005 for Uganda and

1984 to 2005 for Tanzania. The variables real GDP, inflation and a short term interest rate were included for the three countries. The treasury bill rate represented short term interest rate and consumer price index (CPI) was used to estimate inflation rate (changes in prices). Missing data for Kenya was filled by averaging while for Tanzania the Treasury bill rate was only available from 1993 so instead the end of period discount rate was used to represent the interest rate. The real side of the economies was mirrored by the real GDP in logs, interest rate by the Treasury bill rate in logs while the discount rate was used for Tanzania, and the price changes that is inflation was obtained by differencing the log of the CPI. The significant finding was that the effect of a monetary contraction on output relatively similar for the three countries in terms of the pattern and timing. Also, the effect of monetary policy contraction on the inflation rate in terms of the speed and direction of response was different for the countries but with output the magnitude was small and insignificant. Finally, the implication drawn by the author from the results suggested the interest rate channel was not important at that stage for the region.

In a study by Bonga-Bonga (2010) looked at monetary policy and the long term interest rates in South Africa. The writer examined how short and long term interest rates respond to demand, supply, and monetary policy shocks. The author used quarterly time series data from 1986 first quarter to the last quarter of 2007 and employed SVAR to analyse. The study accounted for two broad monetary regimes which were characterized by aggregate monetary targets starting from 1986 and explicit inflation targeting commencing from 2000. The findings showed that after a monetary and demand shock, there was a positive correlation between the two interest rates followed by a negative correlation after a supply shock and hence the conduct of monetary transmission was not effective.

Bordon and Weber (2010) examined the transmission mechanism in Armenia. They conducted a standard Vector Autoregression (VAR). They used vector endogenous variables consisting of output as measured by real GDP, consumer price index, repo rate which is the key short-term interest rate used by the central bank of Armenia to signal its monetary stance, domestic narrow money (M1) and nominal effective exchange rate. The exogenous variables contained an index of world oil prices and the US Federal Fund Rate. The study used data for the period 2000 to 2010. Their results supported the existence of a structural break during the time when inflationary target was introduced and also reduced levels of dollarization were noticed. Furthermore, with the introduction of a threshold variable in the framework showed that reduced levels of dollarization were an important determinant of the effectiveness of monetary policy.

Tsangarides (2010) adopted the Vector Autoregression (VAR) techniques, using data from 1999-2009 with core and headline consumer price index (CPI) and two types of VAR identification schemes (recursive and structural). His findings showed that the overall monetary policy transmission channel of an unexpected temporary increase in the repo rate was weak, for both headline and core CPI models, particularly for output. In addition, there was evidence that a shock to repo rate—the Bank of Mauritius' primary policy instrument as well as shocks to the other two policy variables (exchange rate and money supply) result in statistically significant changes of the headline CPI. For output, the transmission effects were not always statistically significant. Also, the results from modeling core CPI suggested that there was a transmission of exchange rate and money supply shocks but no shocks to the repo rate on prices. Furthermore, the transmission of money supply shocks was stronger (for both output and prices) compared to

the case of headline CPI. Finally, given the transmission mechanism differences, the results suggested the possibility that different monetary policy rules could be considered depending on whether headline or core CPI is targeted: for headline CPI where the interest rate channel was stronger.

A study by Mugume (2010) examined monetary policy transmission in Uganda using Structural Vector Autoregression approach during the period when the bank was planning to adopt an inflation targeting regime over the medium term. The study used quarterly data from 1999 to 2009. The following variables were incorporated in the VAR: Real GDP, CPI inflation, broad money aggregate (M2), three months Treasury bill rate, nominal exchange rate, credit to private sector, and weighted average lending interest rate. All the variables were seasonally adjusted and expressed in logarithms, except interest rates which were expressed in percentage. An index of international commodity prices and a dummy representing a possible shift during the period of global financial turmoil (2008 -2009) were included as exogenous variables. The research findings suggested that changes in monetary policy influenced economic activity and inflation. Furthermore, the monetary policy effectiveness was limited as important channels of monetary transmission were not fully functional. The interest rate channel was weak despite the strong evidence that changes in the Treasury bill rate transmitted to lending interest rate. In addition, the results revealed that the exchange rate and credit channels were ineffective.

In a study by Ziaei and Ziaei (2012) examined monetary policy transmission in the Kingdom of Saudi Arabia. They applied Structural Vector Autoregression (SVAR) model to evaluate various channels of monetary policy using quarterly data spanning for a period of 16 years (1992-2007). The authors considered only three channels namely: Interest rate; exchange rate and credit

channel. Their findings revealed that monetary policy tightening led to a fall in domestic demand; hence there was an active interest rate channel. The transmission of monetary policy shocks to the economy was slightly influenced by the exchanged rate channel while the credit channel was more predominant as compared to the exchange rate channel.

Shepel (2012) investigated the role of exchange rate and interest rate channels in the monetary transmission mechanisms in Ukraine. Also, the responses on the domestic economy together with those of Russia were estimated employing the Vector Autoregression model with block exogeneity restriction. The study used monthly data spanning from April 1999 to August 2008 for a limited data set and the period from 1999 to 2011 for a full ranged model comprised of 168 observations. The findings revealed that the monetary transmission did not prove to be strongly effective for the estimated channels, although the exchange rate channel demonstrated the results which were more in line with the economic theory. Furthermore, the exchange rate channel showed higher and significant pass through. In addition, the relevance of the Russian shocks in fluctuations to home variables was discovered.

In a study by De Waal and Van Eyden (2012) developed a Structural Co-integrated Vector Autoregression model which was known as an augmented vector error correction model VECM. The authors incorporated quarterly domestic and time varying trade weighted foreign data for the period 1979 second quarter to last quarter of 2009. The data collected was for 33 countries which accounted for about 90% percent of the world output. They found three significant long run economic relations such as augmented purchasing power parity, the uncovered interest parity and the Fisher parity. In addition, the effective transmission of monetary policy in South Africa was between 1979 and 2009.

Ifeakachukwu and Olufemi (2012) investigated the transmission channels of monetary policy impulses on sectoral output growth in Nigeria from 1986 to 2009. The study used secondary quarterly data from the first quarter of 1986 to the last quarter of 2009, while granger causality and Vector Autoregression method of analysis were utilised. Six VAR systems for the sectors of the Nigerian economy were estimated. Each system comprises of five endogenous variables: monetary policy variables (interest rate, exchange rate and credit to private sector), asset price and consumer price index. The endogenous variable was the sectoral output. The following sectors: agriculture, mining, manufacturing, building and construction, wholesale and retail trade, and service were considered. The results showed that interest rate channel was most effective in transmitting monetary policy to agriculture and manufacturing sectors respectively, while the exchange rate channel was most effective for transmitting monetary policy to building and construction, mining, service and wholesale and retail sectors. The authors inferred that interest rate and exchange rate policies were the most effective monetary policy measures in stimulating sectoral output growth in the economy.

A study by Tahir (2012) investigated the relative importance of monetary transmission channels for Brazil, Chile and Korea. The author used monthly data from the starting point of inflation targeting regime to the last month of 2009 and employed SVAR technique. The variables used were; industrial production index because of the unavailability of monthly GDP as a proxy to economic activity, consumer price index for prices, credit to private sector from the banking system as loans, real bank lending rate, real effective exchange rate, and share price. The

empirical results indicated that exchange rate channel and share price channels had higher relative importance than the traditional interest and credit channel for industrial production. In addition, the findings were not much different in the case of inflation too, except for Korea.

Kalikeka and Sheefine (2013) analysed the monetary policy transmission of Zambia with special emphases on the interest channel. They used annual data on output (GDP), inflation and real short-term interest rates for the period 1980 to 2011 and adopted the VAR approach to estimate. The study also employed time series techniques such as unit root tests, cointegration, Granger causality test, impulse response and forecast error variance decomposition. Their results provided evidence of the functional interest rate channel in the Zambian economy.

Ndekwe (2013) analysed the monetary policy transmission mechanisms to the real economy in Nigeria by examining the process by which the interest rate policy of the Central Bank of Nigeria affected the structure of interest rates, credit, aggregate demand and output production and hence, changes in inflation rate. The study adopted vector auto regression with dynamic logarithmic form and the ordinary least squares (OLS) methods. The researcher used both quarterly and annual data from 1981 to 2006. The study found that the credit channel in the financial market for credit supply and accessibility to the private sector provided the effect of a linchpin in the process by which monetary policy transmitted to the real economy. The interest rate and exchange rate channels during the period 1981 to 2008 appeared to have had a weak effect on the real economy.

Ishioro (2013) examined the channels of monetary transmission in Nigeria. The study period was from 1970 to 2011 using interest rate, investment, per capital GDP, exchange rate, prices, and private domestic credit. The Granger causality test was adopted in the estimation of the relationship between the various channels and selected macroeconomic aggregates. The results of the study indicated that three channels were functional in Nigeria namely: Interest rate, exchange rate and credit channel. The author recommended that the exchange rate and interest channels should form a fundamental basis for inflation targeting in the Nigerian economy.

Markidou and Nikolaidou (n.d) investigated the relevance of the credit channel of monetary policy transmission in Greece. The authors employed a Structural Vector Autoregression (SVAR) on both aggregated and disaggregated data and estimating the response of bank loans to different macroeconomic shocks. The study used five endogenous variables in the SVAR models to detect the macroeconomic responses of the Greek economy which were: output, price level, money stock, credit and monetary policy variable. Two classes of models were introduced. The first class comprised the monetary policy variable (monetary base) and second class, the bank rate. In order to extricate the impact of monetary policy, three different measures of bank credit were taken into account such as household credit, credit to firms, total bank credit. There were three models in each of the classes and seasonally adjusted monthly time series for the Greece economy over the period 1995 (first month) to 2005 (last month) were used. The time series in the SVAR analysis were: industrial production index, consumer price index, monetary base, overnight interbank rate (bank rate), narrow money stock (M3), bank credit to households, bank credit to firms and total bank credit (used as three alternative measures of credit). Their findings revealed that the credit channel in Greece for the study period was inoperative, despite two

monetary policy variables such as monetary base and interest rate were used. Furthermore, the responses of the different bank credit measures to monetary policy changes did differ significantly and rendered the credit channel ineffective for both consumer and business firms.

From the various empirical studies and findings reached, it is cleared that most of the channels of monetary transmission mechanisms that have existed in many economies had a significant impact on output. Also in a good number of countries, there had been at most two channels of transmission of monetary policy that were found to exist effectively.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter will discuss the methodology of study, theoretical framework, model, estimation techniques, variables to be used, and the data type and their sources.

3.2 THEORETICAL FRAMEWORK

The theoretical framework of the study is a holistic model based on the interest rate channel, credit channel and exchange rate channels of monetary policy transmission mechanisms. The choice draws from the fact that interest rate is one of the key price variables through monetary policy impulse is transmitted. In Sierra Leone, the monetary policy rate is used to signal the stance of monetary policy. The exchange rate channel of monetary policy transmission is part of the theoretical framework. The choice is on the basis that Sierra Leone is a strong import dependent economy, which makes exchange rate a key price in the economy, with implications for exchange rate pass-through to domestic prices. The credit channel is another part of the holistic theoretical framework on the basis that the financial sector of Sierra Leone is dominated by the banking sector, making credit to the private sector important in monetary policy transmission.

Driven by the fact that the interest rate, exchange rate and credit are relevant in the process of transmitting monetary policy to the real sector and they interact, it is important for an investigation of the effectiveness of monetary policy transmission in Sierra Leone to pay attention to how these variables interact in the process of transmitting monetary policy. In this regard, the vector Autoregression (VAR) which is a system that considers all variables to be endogenous and pays attention to variable dynamic, to be applied in such investigation. Hence, the model estimation is based on the VAR system.

3.3 MODEL SPECIFICATION

This study adopts a Vector Autoregression (VAR) model based on the lessons learnt from the studies of Bordon and Weber (2010) in Armenia and Samkharade (2008) in Georgia. To investigate the effectiveness of transmission mechanisms of monetary policy, the VAR model will take the form described below.

The preliminary model is presented as: Let X_t be the vector of variables to be analyzed. These variables are: real interest rate (rir), exchange rate (er), private domestic credit (pd) and GDP per capita ($gdppc$). Given an $N \times 1$ vector of variables $X_t = (rir, er, pd, gdppc)$ in this case, at date t . The VAR model of order p (Gaussian errors), and the dynamics of X_t are presumed to be governed by a p^{th} order Gaussian vector Autoregression. Then, the VAR(p) can be written as

$$X_t = a + b_1 X_{t-1} + b_2 X_{t-2} + \dots + b_p X_{t-p} + \varepsilon_t \quad (8)$$

Where X_t is an $(n \times 1)$ vector of variables defined as above, $a = n \times 1$ vector of constants or drift terms in this case, $b_i = n \times n$ matrices of time invariant, $i = 1, \dots, p$ (lag operator) and

$\varepsilon = n \times 1$ vector of independent and identically distributed (i.i.d) errors with a positive covariance matrix. The VAR (p) defined in Equation (8) is covariance stationary iff all values of Z ,

$$\left| I_n - b_1 Z - b_2 Z^2 - \dots - b_p Z^p \right| = 0 \quad (9)$$

lie outside the unit circle. The determinant comprises an identity I , matrix of time invariant b , and Z the coefficient of b .

In order to make a distinction between stationarity by linear combinations and by differencing, a reparametrization is required. Thus, the system defined in Equation (8) in error-correction form becomes,

$$\Delta X_t = a + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-p} + \Pi X_{t-p} + \varepsilon_t \quad (10)$$

Where $\Pi = -\left(I - \sum_{i=1}^{p-1} b_i \right)$ and $\Gamma_i = -(b_{i+1} + \dots + b_i)$, $i = 1, \dots, p-1$. The only difference between

Equation (10) and a standard VAR in differences is the error-correction term ΠX_{t-p} . The system represented in Equation (10) also contains information on both the short and long run adjustments to changes in X_t , via the estimates of Γ_i and Π respectively. The non-stationary component (Π) can also be factorized to test the null hypothesis r of reduced rank or equivalently, the number of cointegrating relationships, that is,

$$H_0 : \Pi = \alpha \beta', \quad \text{rank}(\Pi) = r < n \quad (11)$$

Where β is the matrix of co-integrating vectors and α the adjustment coefficients.

Since X_t is a vector of non-stationary I(1) (at first difference) variables, all the terms in Equation (10) which involves ΔX_{t-i} are stationary or I(0) (at levels), and ΠX_{t-p} must also be stationary for $\varepsilon_t \sim I(0)$ to be stationary. More usually, Π has reduced rank, i.e., there are $r \leq (n-1)$ co-integration vectors present.

The above model although very attractive cannot completely and fully describe the dynamics of the involved VAR(p) model. Based on economic theory, a VAR with exogenous variables could better capture that dynamics. This VAR model with exogenous variables is described as,

$$X_t = A(L)X_{t-p} + B(L)Y_{t-q} + u_t \quad (12)$$

where X_t is the vector of endogenous variables, Y_t is the vector of exogenous variables, u_t is the vector of serially uncorrelated disturbances that has a zero mean and a time invariant covariance matrix, A and B are denoted as coefficient matrices, and L denotes the lag operators. The vector of exogenous has two components, consumer price index (*cpi*) and gross capital formation (*gcf*) as a proxy for investment. All the inferences described for the VAR(p) remain valid in this last case.

From the variables above, the real interest rate represents the role of the interest rate channel, exchange rate the exchange rate channel, private domestic credit to identify the credit channel and GDP per capita for output, consumer price index to control for changes in external inflation as result trade among countries and gross capital formation to capture investment since

investment is predominantly undertaken by foreigners. These channels are reflective of the financial development of our nation in which the stock market is still weak to consider the asset price channel.

3.4 ESTIMATION TECHNIQUES

In order to conduct the Vector Autoregression (VAR) analysis, the following techniques are considered necessary:

1. Test for unit root and determine the order of integration for the variables by employing the following test techniques: Augmented Dickey Fuller (ADF), Philips and Peron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS).
2. Testing for cointegration, and if there is cointegration relationship among the variables can be re-parameterised which will have both short and long-run effects. The Johansen cointegration can be adopted.
3. Granger-causality. That is if there is cointegration there should be Granger-causality in at least one direction.
4. Impulse response and variance decomposition.

3.5 DATA TYPE AND SOURCE

The study makes use of annual secondary time series data collected for the period of the study (1980 to 2012) from the Central Bank of Sierra Leone and World Bank Data Base. The data on real interest rate, exchange rate, private domestic credit, GDP per capita, and gross capital

formation were collected from the World Bank Data Bases. The data on consumer price index were collected from the Central Bank of Sierra Leone.

CHAPTER FOUR

EMPIRICAL RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

This chapter presents analysis of the empirical findings of study. It starts with a statistical description of the variables employed, as well as the diagnostic tests to validate the estimation techniques that were used. In addition, the results of the regression estimations are presented for discussion.

4.2 DESCRIPTIVE STATISTICS

Table 4.1 shows the statistical description of the time series of the study. These series are: Real Interest Rate (RIR), Gross Capital Formation (GCF), Exchange Rate (ER), Consumer Price Index (CPI), Private Domestic Credit (PDC), and Gross Domestic Product Per Capita (GDPPC). The description reports the Mean, Median, Standard Deviation, Jarque-Bera, and Probability. It is important to report on these indicators given that the country has experienced civil unrest which might have accounted for structural breaks. According to Gujarati (2004), the Jarque-Bera of normality is an asymptotic or large sample test. It is also based on the OLS residuals. Under the null hypothesis that the residuals are normally distributed, Jarque and Bera showed that asymptotically that is in large samples, the JB statistic follows the chi-square distribution with 2 degrees of freedom. If the computed p value of the JB statistic in an application is sufficiently low, which will happen if the value of the statistic is very different from 0, one can reject the

hypothesis that the residuals are normally distributed. But if the p value is reasonably high, which will happen if the value of the statistic is close to zero, we do not reject the normality assumption.

Table 4.1 Descriptive statistics of data

	CPI	ER	GCF	GDPPC	PDC	RIR
Mean	59.49472	1435.841	11.79008	286.7101	4.172236	-1.550550
Median	35.51401	920.7325	10.63641	269.9475	3.334460	3.167180
Std. Dev.	67.39575	1442.805	8.575452	111.5059	1.993556	18.79772
Jarque-Bera	7.447081	3.225683	39.68692	3.722509	4.179405	3.539678
Probability	0.024148	0.199320	0.000000	0.155477	0.123724	0.170360

Number of observations (N) = 33

4.3 UNIT ROOT TEST

This study employs the Augmented Dickey Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski Phillips Schmidt and Shin (KPSS) tests to test the time series whether or not they are stationary and determine their order of integration. Table 4.2 shows the results of the Unit Root Test in levels and first difference. The ADF and PP test results reveal that only the RIR that is stationary at level $I(0)$ while the KPSS shows that all the series are stationary at level $I(0)$. In addition, the three tests show that the following series: GCF, ER, PDC, and GDPPC are stationary at first difference $I(1)$. Whereas, the ADF and PP reveal that the RIR is stationary at $I(1)$ and the KPSS shows that the CPI is stationary at $I(1)$.

Table 4.2 Unit Root Tests

Variables	ADF level		PP level		KPSS level		ADF 1 st Diff		PP 1 st Diff		K
	τ_{μ}	τ_t	τ_{μ}	τ_t	τ_{μ}	τ_t	τ_{μ}	τ_t	τ_{μ}	τ_t	τ
GCF	-1.665	-1.921	-1.665	-1.846	0.254	0.194 ^b	-5.727 ^a	-6.107 ^a	-5.758 ^a	-7.780 ^a	0.3
ER	2.379	-2.222	4.609	-2.312	0.738 ^b	0.196 ^b	-3.822 ^a	-5.717 ^a	-3.428 ^b	-4.223 ^b	0.5
RIR	-1.448	-4.339 ^a	-3.487 ^b	-4.273 ^a	0.359 ^c	0.091	-5.948 ^a	-2.862	-9.290 ^a	-9.549 ^a	0.1
CPI	2.775	3.309	6.983	2.636	0.714 ^b	0.193 ^b	-0.958	-2.476	-0.729	-2.513	0.5
PDC	-1.655	-1.620	-1.758	-1.620	0.184	0.184 ^b	-5.516 ^a	-6.159 ^a	-5.524 ^a	-6.530 ^a	0.3
GDPPC	-1.665	-1.921	-1.665	-1.846	0.338	0.192 ^b	-4.776 ^a	-5.694 ^a	-4.784 ^a	-12.929 ^a	0.4

Note:

τ_{μ} Series with a constant, τ_t Constant and a Trend, ADF denotes the Augmented Dickey Fuller, PP - the Philips-Perron and KPSS - K Schmidt and Shin Significance at 1%, 5%, and 10% are denoted by a, b, and c respectively. Mackinnon (1996) one-sided p-values or c rejection of hypothesis of a unit root.

4.4 COINTEGRATION TESTS

To conduct a co-integration test, the use of the Johansen co-integration test is applied. According to (Johansen, 1988; Johansen & Juselius, 1990) for co-integration procedure, the VAR model order has to be determined. In this study, the Akaike Information Criterion (AIC), Hannan-Quinn Criterion (HQC), and Schwarz' Bayesian Information Criterion (BIC) have been used to get the appropriate lag length. The maximum likelihood procedures developed in Johansen (1988) and Johansen and Juselius (1990) were used for estimating cointegration relationships. In Table 4.3 the results from the co-integration tests are presented. The eigenvalues from the minimization of the product of the concentrated likelihood are reported in descending order, along with the maximum eigenvalue statistic and the cumulative form of that statistic, known as the trace statistic. Tests for the number of co-integration relationships in the data consist of the maximum eigenvalue and trace statistics, where λ_{\max} tests for at most r co-integration vectors against an alternative of exactly $r+1$ co-integration relationships, while trace tests for at most r cointegrating vectors against an alternative of at least $r+1$ vectors. The trace and maximum eigenvalue tests provide the basis for rejecting the null hypothesis that there are zero co-integrating vectors. The two tests suggest that there is a long-run relationship among the variables (real interest rate, exchange rate, private domestic credit, GDP per capita, gross capital formation, and consumer price index). In order to make the result interpretable, there is a need to normalize it based on economic theory. It appears that normalizing with GDPPC is a reasonable procedure and the outcome is:

$$GDPPC - 0.000501 ER + 0.00143 RIR - 0.17 PDC = 0 \quad (13)$$

With everything being equal, a depreciation of the domestic currency where by imports become expensive and exports cheaper, the output of a nation is anticipated to improve. Also, a fall in the real interest rate (interest earned after adjusting for inflation) is expected to lead to an increase in the national output of a country. Finally, as the quantity of bank loans to borrowers increases the output is expected to improve since investors can access the required fund for investment. Thus, one error correction term is constructed and included in the maximum likelihood estimate of the Vector Error Correction model (VECM). The detailed results of the estimated equation are reported in Table 4.3.

Table 4.3 Testing for Cointegration

Null	Alternative	Test Statistic	95% Critical Value
(1) Maximum Eigen Value Test			
$r = 0$	$r = 1$	55.429*	47.856
$r \leq 1$	$r = 2$	24.088	29.797
$r \leq 2$	$r = 3$	6.201	15.494
$r \leq 3$	$r = 4$	1.946	3.841
(2) Trace Test			
$r = 0$	$r \geq 1$	31.341*	27.584
$r \leq 1$	$r \geq 2$	17.886	21.131
$r \leq 2$	$r \geq 3$	4.254	14.264
$r \leq 3$	$r \geq 4$	1.946	3.841

Note: * denotes rejection of the null hypothesis. Critical values are taken from MacKinnon-Haug-Michelis (1999) p.value.

4.5 CAUSALITY RESULTS

After an examination of co-integration among the six variables in the previous section, certain unresolved questions emerged regarding Granger-causation. These questions are: (i) Does any Granger causality among the variables of the channels and the others? (ii) What is the direction of the causality, if any? (iii) What are the economic implications of possible Granger causality between the variables? In this section, an investigation of the short-run as well as long dynamic

interactions among the six variables (with a special emphasis on the variables depicting the channels and the other variables) are summarized in Table 4.4. The table represents the F-statistics (significance levels only) constructed under the null hypothesis of non-causality. For the variable on the right hand side, rejection of the null hypothesis implies that these variables Granger-cause the dependent variables. At the 10 % level of significance, the results show that consumer price index Granger-causes exchange rate and GDP per capita. This finding is in accordance with economic theory which implies that if all things being equal, a change in consumer price index has an effect on exchange rate and hence GDP per capita. It highlights pertinent issues regarding the exchange rate channel. CPI which represents external inflation as a result of trading activities among member states may have an impact on the exchange rate of Sierra Leone and thereby affect the exchange rate channel. Furthermore, it may also have a spill-over effect on the output of the economy.

On the other hand, the results from the same Table 4.4 indicates that gross capital formation which is a proxy for investment (predominantly owned and undertaken by foreigners) Granger causes exchange rate at 1% level of significance and it also Granger causes real interest rate at 10% significance level. This finding is again in accordance with economic theory wherein issues relating to the inflows and outflows of remittances may be raised. Assuming that all things equal, an increase or decrease in foreign investment has an effect on the exchange rate of an economy and hence real interest rate. This may affect both the exchange rate and interest rate channels of monetary policy in country.

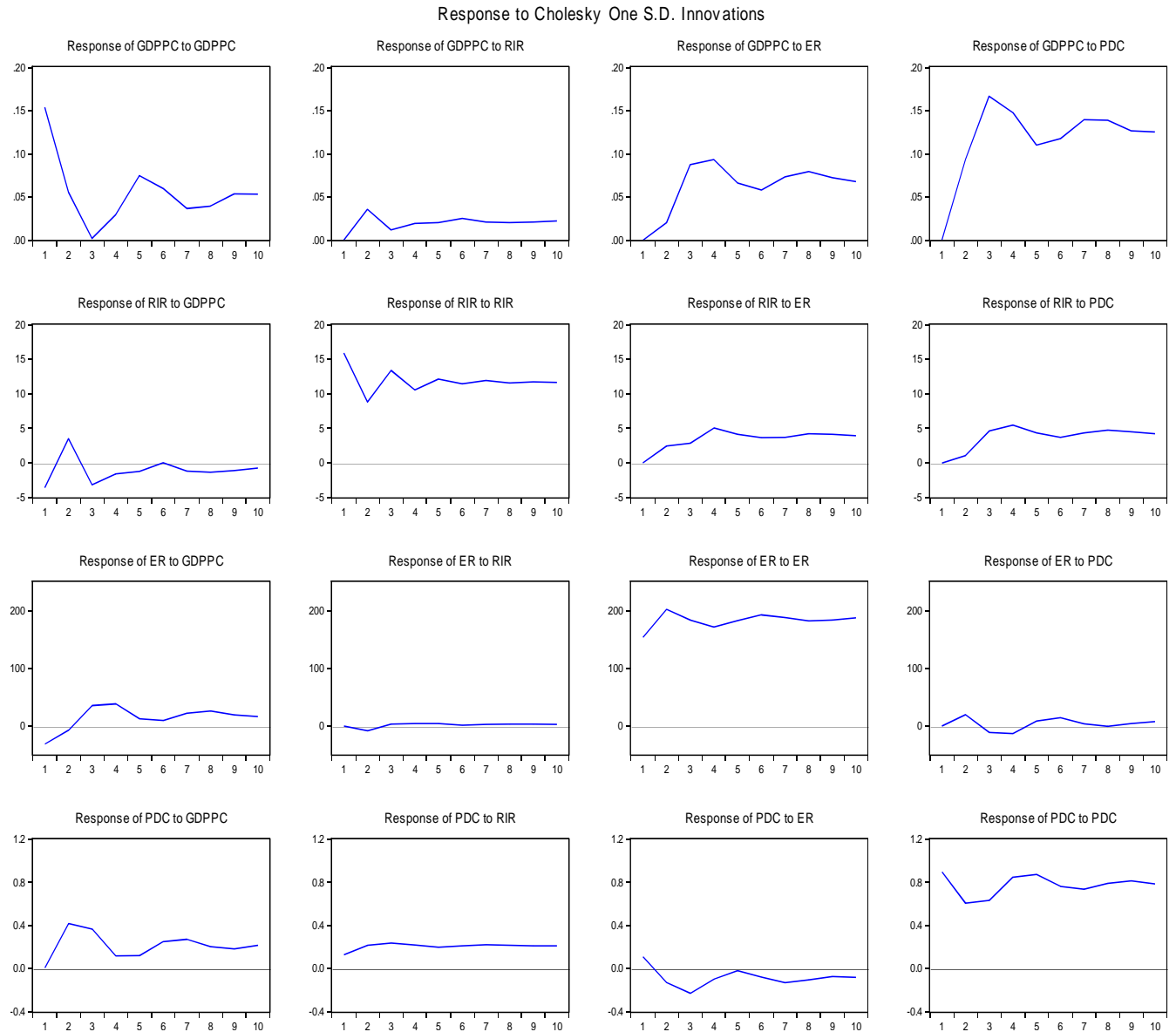
Table 4.4 Temporal causality results

Model	Δer	$\Delta gdppc$	Δpdc	Δrir	Δcpi	Δgcf	$\varepsilon_{1t} (\psi_{t-1})$
Dependent							
Variables	F- Statistics (significance levels)						t- statistics
Δer	-	1.565	0.203	0.685	2.806 ^c	7.292 ^a	0.028
$\Delta gdppc$	1.565	-	0.051	0.389	3.021 ^c	0.047	-3.489 ^a
Δpdc	0.203	0.051	-	0.955	0.115	0.003	0.356
Δrir	0.685	0.389	0.955	-	0.616	3.691 ^c	-0.686

Note: All variables are in first differences except the error-correction term obtained from the Johansen order of co-integration tests reported in Table 4.4. a, b and c indicate significance at the 1%, 5% and 10% levels respectively.

4.6 DYNAMIC SIMULATIONS

This section employs dynamic simulations to give an impending idea about the economic significance of the VECM variables particularly the endogenous variables. The simulations are adopted to compute the impulse response functions (IRF) and variance decompositions (VDC).

Figure 4.1: Impulse responses of GDPPC, ER, RIR and PDC

The IRF of GDPPC to innovations in the real interest rate, exchange rate, and private domestic credit are presented in Figure 4.1. The impulse response functions reflect responses of GDPPC (output) to one standard deviation shock to policy variables. The GDPPC responds positively to monetary shocks, as real interest rate (RIR) increases, GDPPC increases for a short period and

then declined. But in the long run, it becomes constant which is not in line with economic theory (it is expected to have a constant inverse relationship with real interest rate). This may be attributed to the period when economy was disrupted by civil unrest or political turmoil. The impulse response function of GDPPC to exchange rate (ER) and private domestic credit (PDC) shows that even in the long run, the effects of the shocks might not be transitory in order to converge towards a steady state. In this regard, the channels of monetary policy are proving to be ineffective in transmitting effects to output.

Table 4.5 Point estimates (standard deviations) of variance decomposition for the VECM model

Dependent Variables	Relative variation in period	Explained by innovations in			
		GDPPC	RIR	ER	PDC
GDPPC	1	100 *	0	0	0
	5	26.11 *	1.72 *	16.70 *	55.45 *
	10	18.07 *	1.82 *	18.42 *	61.67 *
RIR	1	4.90	95.09 *	0	0
	5	4.23	82.09 *	6.08	7.58
	10	2.50	80.82	7.50	9.16
ER	1	3.98	0.00018	96.01	0
	5	2.36	0.07	97.10	0.45
	10	1.69	0.04	97.95	0.30
PDC	1	0.007	1.96 *	1.46	96.56 *
	5	9.19 *	5.56 *	2.45	82.78 *
	10	8.23 *	5.98 *	1.85	83.91 *

Table 4.5 indicates the variance decomposition results of the model. The asterisk is used to point out that an estimate is at least twice its standard error and hence statistically significant. To allow the system dynamic to function well, a 10-period horizon is employed. The results of three different time periods are reported to transmit a notion of the system dynamics.

The results from Table 4.5 show that fluctuations in forecasting GDPPC in the first year period are explained by itself. Over the following period, the fluctuations dwindle drastically with a significant contribution of 61.6% by PDC, while RIR and ER contribute 1.8% and 18.4% respectively. The error forecast of RIR in the first period is greatly dominated by itself with an insignificant contribution of GDPPC and none by ER and PDC. The error forecast trend of RIR continues with an insignificant contribution of the same variables. Fluctuations in forecasting ER in the first period were greatly attributed to itself but in the successive period, the forecasting trend of ER increases with a trivial contribution by the GDPPC, RIR, and PDC. Finally, the error forecast of PDC in the first period is greatly dominated by itself. As the trend falls, there is a slight increase in the contribution of GDPPC, RIR, and ER. It is evident that from the three channels (interest rate, exchange rate, and credit) are ineffective in transmitting significant shocks to output.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

The main objective of the study was to investigate the efficacy of transmission mechanisms of monetary policy in relation to the applicable channels. This chapter draws conclusions and makes policy recommendations arising from the findings. Finally, the chapter considers the limitations of the study and area for future research.

5.2 CONCLUSION

In order to determine the effectiveness of transmission mechanisms of monetary policy in Sierra Leone, the study focused on three channels namely interest rate, exchange rate, and credit channels that may be applicable to most developing countries where stock exchange markets are not fully established or not operating. The study made use of the following variables: real interest rate (RIR), exchange rate (ER), private domestic credit (PDC), consumer price index (CPI), gross capital formation (GCF), and gross domestic product per capita (GDPPC). An unrestrictive Vector autoregressive (VAR) model was adopted but a Vector Error Correction Model (VECM) was used because the variables were found to be cointegrated with the series spanning from 1980 to 2012. The study used the Granger Causality test and it revealed that consumer price index Granger-causes exchange rate and GDP per capita. Also, gross capital formation Granger causes exchange rate and real interest rate.

The forecast error variance decompositions show the following: The fluctuations in forecasting GDPPC were explained by itself but in the long run, the fluctuations dwindled drastically with a significant contribution by PDC. In forecasting RIR, the fluctuations were greatly dominated by itself and in the long run the trend continued with an insignificant contribution of the three variables. Fluctuations in forecasting ER were greatly attributed to itself but in the long run, a trivial contribution by the other variables. Finally, the error forecast of PDC was greatly dominated by itself but in the long run, there was a slight increase in the contribution of the other variables.

In general, the results show that all the channels of monetary policy were ineffective since real interest rate, exchange rate, and private domestic credit as monetary policy tool were unable to transmit significant shocks to output. The study is partially or completely in line with some of the early findings such as a study in South Africa by Bonga-Bonga (2010) which showed that the conduct of monetary was not effective. Also, another study in Uganda by Mugume (2010) revealed that the interest rate channel was weak while both the exchange rate and credit channels were ineffective.

5.3 POLICY RECOMMENDATIONS

The results discussed in chapter four reveal that all the variables in the model are important in determining the effect of transmission mechanisms of monetary policy and the results obtained in this study have significant implications for monetary policy formulations and implementations. As a matter of policy consideration, the following should be considered:

- Even though the results show that the channels are ineffective, but the Private domestic credit (PDC) which represents the credit channel is able to transmit the highest shocks to output as compared to the interest rate and exchange rate channels despite its transmission being insignificant. Against this back drop, the monetary authorities should put a mechanism in place to enhance this channel which stands out to be effective in the long run. This can be done through banking supervision by the central bank or monetary authorities and coupled with increased competition among commercial banks.
- The development of the financial sector will be essential to augmenting the effectiveness of the transmission channels. In addition, the central Bank of Sierra Leone should improve the stock exchange market to enhance the asset price channel.

The country will experience rapid economic transformation which will foster sustainable economic growth if these policies are implemented. In view of the benefits, there are lot of challenges face with such as lack of trained and competent workers to carry out effective banking supervision, corrupt practices of workers, inadequate funds and logistics for the central bank to function properly, and political inference by government officials in the operations of the central bank.

5.4 LIMITATIONS OF THE STUDY

The major limitation of the study is the exclusion of the asset price channel because of the nature of the financial system in the country, whereby capital markets are not fully developed to provide sufficient data for a study to be undertaken in such area.

5.5 AREAS FOR FURTHER RESEACRH

The aim of this study was to investigate the effectiveness of transmission mechanisms of monetary policy in Sierra Leone by taking into consideration of all the channels of monetary policy and how they impact on output. As a result of the nature of the financial sector in Sierra Leone, three key channels were considered. With the establishment of a stock exchange market by the monetary authorities in Sierra Leone and plans to develop the financial sector, the future area of research is to include the asset price channel together with the other three channels and investigate how they will impact on the economy.

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