The Effectiveness Of Transmission Mechanisms Of Monetary Policy In Sierra Leone.

ABSTRACT

Studies on the effectiveness on the effectiveness of transmission mechanisms of monetary policy are crucial for an economy. Even in this case, it is essential to understand how effective are the channels of monetary transmission in directing economic activities in Sierra Leone. In this case, particular focus is on the interest rate, exchange rate, and credit channels. The analytical methods used are unit root tests, cointegration, Granger causality test, impulse responses and variance decomposition. Central to this investigation is the use of the Vector Autoregression (VAR) approach to estimate time series annual data from 1980 to 2012. 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.

Keywords: Impulse response function, variance decomposition, reparametrization; and private domestic credit.

1. INTRODUCTION

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. In order to attain such, it 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 Centrals Banks that have been successful at controlling inflation and stabilizing output within their domestic economies have done so largely through an understanding of these mechanisms [1].

A useful way to understand monetary policy is to focus patently 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 [2].

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 [3].

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 [4].

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 [5].

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 (6). According to (7), 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. (8) 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 (8) which only focused on the civil war period (1991 to 2001) and used three groups of variables. The first group comprised of real GDP and domestic prices; the second domestic short term interest rate, real effective exchange rate, and private sector credit; and the last 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

119 domestic product per capita which give a clearer financial and monetary policy stance of a
120 country like Sierra Leone as compared to those used by previous study.

121

122 **2. LITERATURE REVIEW**

123 **2.1 Theoretical Literature**

124 A vast number of theories have explained certain links to the main channels of monetary
125 transmission mechanisms. With the interest rate channel, the traditional Keynesian IS-LM
126 view of monetary transmission mechanism can be characterized by showing the impact of an
127 expansionary monetary policy. An increase in money supply (M) leads to a fall in real
128 interest rate (R_i) which in turn reduces the cost of capital, causing a rise in investment (I)
129 spending thereby leading to an increase in aggregate demand and a rise in output (Y). Below
130 is the schematic indicating the effect of expansionary monetary policy.

131

132 $$M \uparrow \rightarrow R_i \downarrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (1)$$

133

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

139 $$M \uparrow \rightarrow P^e \uparrow \rightarrow \pi^e \uparrow \rightarrow R_i \downarrow \rightarrow I \uparrow \rightarrow Y \uparrow \quad (2)$$

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.

The exchange rate channel 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) [9, 10]. The schematic of the expansionary policy is illustrated below as follows:

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

The Keynesians such as Modigliani 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 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) [11, 12]. 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 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 of monetary transmission mechanism constitutes two sub-channels: the bank lending channel and the balance sheet. 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) [13,14,15]. 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 [13]. The schematic illustration is shown as:

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

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.

2.2 Empirical Literature

Various studies 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. In a study in the U.S. [16] on the credit channel which used federal funds rate, unemployment rate, logarithm of Consumer Price Index (CPI), deposits, loans and securities. 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.

In another study in Jamaica [17] which 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 whereby monetary policy impulses are

transmitted by both the money channel and credit channel via a method of portfolio substitution. 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. Finally, the findings showed that monetary policy impulses were transmitted by both the money channel and credit channel through a process of portfolio substitution.

Also, a study in Pakistan [18] used Vector Autoregression (VAR) to examine the monetary transmission mechanism. The study estimated four models which represented four channels. The 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.

Furthermore, [19] 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 Autoregression with dynamic logarithmic form and the ordinary least squares (OLS) methods. 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.

From the various empirical studies and findings reached, it is cleared that most of the channels of monetary transmission mechanisms that have existed in economies had a significant impact on output.

3. MATERIALS AND METHODS

3.1 Model Specification and Econometric Framework

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 (pdc) and GDP per capita $(gdppc)$. Given an $N \times 1$ vector of variables $X_t = (rir, er, pdc, gdppc)$ 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

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

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, $i = 1, \cdots, p$ (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,

$$\left|I_n - b_1 Z - b_2 Z^2 - \cdots - b_p Z^p\right| = 0 \tag{9}$$

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,

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

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

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

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

$\varepsilon_t \sqcup I(0)$ 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,

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

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.

In order to conduct the Vector Autoregression (VAR) analysis, the following techniques are considered necessary: 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). 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. Granger-causality; that is if there is cointegration there should be Granger-causality in at least one direction. Impulse response and variance decomposition.

3.2 Data and Sources

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.

4. RESULTS AND DISCUSSION

4.1 Unit Root Tests

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 1 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).

4.2 Cointegration Tests

To conduct a co-integration test, the use of the Johansen co-integration test is applied. According to (20, 21) 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 [20, 21] were used for estimating cointegration relationships. In Table 2, 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 $\lambda_{\max}$ 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:

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

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 2.

4.3 Causality Tests

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 3. 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.

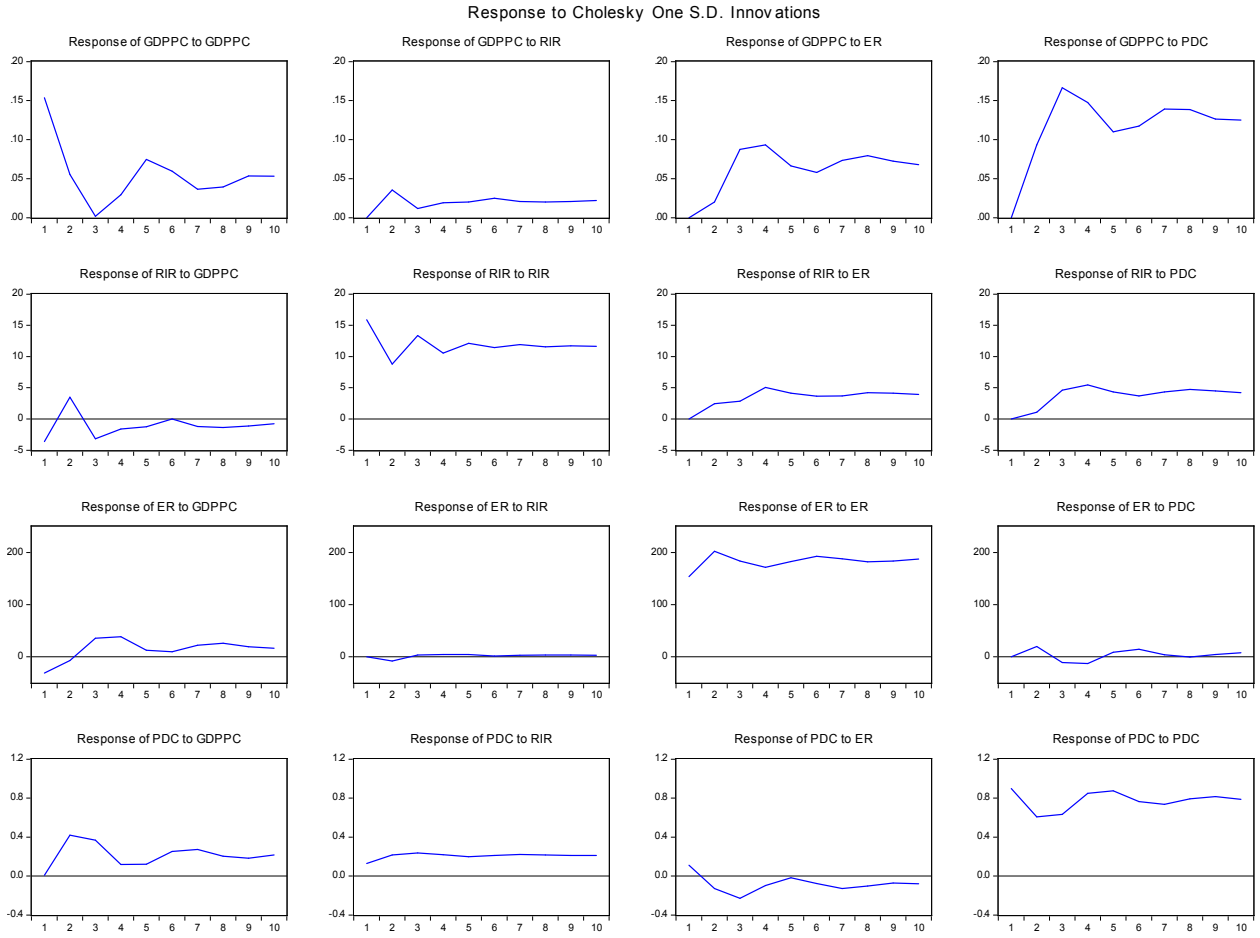
On the other hand, the results from the same Table 3 indicates that gross capital formation which is a proxy for investment (predominantly owned and undertaken by foreigners) Granger causes exchange rate at 1% level of significance and it also Granger causes real interest rate at 10% significance level. 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.

4.4 Dynamic Simulation

The simulations are adopted to compute the impulse response functions (IRF) and variance decompositions (VDC). The IRF of GDPPC to innovations in the real interest rate, exchange rate, and private domestic credit are presented in Figure 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 the 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 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 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.

Figure 1. Impulse responses of GDPPC, ER, RIR and PDC



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410

411 **Table 1. Unit Root Tests**

Variables	ADF level		PP level		KPSS level		ADF 1st Diff		PP 1st Diff		KPSS 1st Diff	
	τ_μ	τ_t	τ_μ	τ_t	τ_μ	τ_t	τ_μ	τ_t	τ_μ	τ_t	τ_μ	τ_t
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]	0.319	0.272 [a]
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]	0.574 [b]	0.435 [a]
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]	0.141	0.113
CPI	2.775	3.309	6.983	2.636	0.714 [b]	0.193 [b]	-0.958	-2.476	-0.729	-2.513	0.599 [b]	0.142 [c]
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]	0.364 [c]	0.070
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]	0.417 [c]	0.500 [a]

412 **Note:** τ_μ Series with a constant, τ_t Constant and a Trend, ADF denotes the Augmented Dickey
413 Fuller, PP - the Philips-Perron and KPSS - Kwiatkowski Phillips Schmidt and Shin Significance at
414 1%, 5%, and 10% are denoted by a, b, and c respectively. Mackinnon (1996) one-sided p-values or
415 critical values are used for rejection of hypothesis of a unit root.
416

417 Table 2. Tests 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

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

420

421 Table 3. Causality Results

Model	Δer	Δgdppc	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
Δgdppc	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.

Table 4. 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 *

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. As a matter of policy consideration, the following should be considered: First, 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. Second, 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. Third, 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.

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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.

REFERENCES

1. Abradu-Otoo, P., Amoah, B., & Bawumia, M. (2003). An investigation of the transmission mechanisms of monetary policy in Ghana: A Structural Vector Error Correction Analysis. *Bank of Ghana Working Paper, WP/BOG-2003/02*.

2. Loayza, N., & Schmidt-Hebbel, K. (2002). *Monetary policy functions and transmission mechanisms*: *An overview*. Santiago, Chile: Central Bank of Chile.

3. Kamin, S. B., Turner, P., & Van 't dack, J. (1998). The transmission of monetary policy in emerging market economies: An overview. *Bank for International Settlements Policy Paper,(*3).

4. Mansaray, M. & Swarray, S. (2012). Financial liberalisation, monetary policy and money demand in Sierra Leone. *Journal of Monetary and Economic Integration, 12*(2), 67-68.

5. Mishra, P., Montiel, P., & Spilimbergo, A. (2011). How effective is monetary transmission in developing countries? A survey of the empirical evidence. *International Monetary Fund Draft Working Paper.*

6. Ndekwu, E. C. (2013). An analysis of the monetary policy transmission mechanism and the real economy in Nigeria. *Central Bank of Nigeria Occasional Paper*, (43).

7. Mishkin, F. S. (1996). The channels of monetary transmission: Lessons for monetary policy *NBER Working Paper Series*.

8. Olawale- Ogunkula, E. & Tarawalie, A.B. (2008). Monetary policy transmission mechanism in Sierra Leone: A Vector Error Correction (VEC) Approach. *Journal of Political Economy*, 207-37.

9. Bryant, R., Hooper, P., & Mann, C. (1993). *Evaluating policy regimes: New empirical research in empirical Macroeconomics*. Washington. D.C.: Brookings Institution.

10. Taylor, J. B. (1993). *Macroeconomic policy in a world economy: From econometric design to practical operation*. Norton, NY: W.W. Norton.

11. Modigliani, F. (1971). *Monetary policy and consumption, in consumer spending and monetary policy: The linkages*. Boston, NY: Federal Reserve Bank of Boston.

12. Tobin, J. (1969). A general equilibrium approach to monetary theory. *Journal of Money, Credit Banking, 1*(1), 15-29.

13. Bernanke, B. S., & Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perpectives, 9*(4), 27-48.

14. Cecchetti, S. G. (1995). Distinguishing theories of the monetary transmission mechanism. *Federal Reserve Bank of St. Louis Review, 77*, 83-97.

15. Hubbard, R. G. (1995). Is there a credit channel for monetary policy? *Federal Reserve Bank of St. Louis Review, 77*, 63-74.

16. Bernanke, B. S., & Blinder, A. S. (1992). The Federal Fund Rate and the channels of monetary transmission. *American Economic Review*, *8*(2), 901-921.

17. Robinson, W., & Robinson, J. W. (1997). The transmission mechanism of monetary policy in the Jamaican economy. *Caribbean Center for Monetary Studies*.

18. Agha, A. I., Ahmed, N., Mubarik, Y. A., & Shah, H. (2005). Transmission mechanism of monetary policy in Pakistan. *SBP-Research Bulletin, 1*(1), 1-23.

19. Ndekwu, E. C. (2013). An analysis of the monetary policy transmission mechanism and the real economy in Nigeria. *Central Bank of Nigeria Occasional Paper*, (43).

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

21. Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on co-integration with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210.