Effectiveness of the Interest Rate Channel of Monetary Policy Transmission Mechanism in Sierra Leone

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Abstract

The study investigated the effectiveness of the interest rate channel of monetary policy transmission to domestic price level in Sierra Leone using data from February 2011 to June 2022. Two VAR models are employed to analyze the relationship between the lending rate and credit to the private sector, exchange rate, money supply, and consumer price index. The results indicate that a one standard deviation shock to lending rates does not significantly affect credit to the private sector, suggesting that the lending rate channel has minimal impact. The impact of the lending rate on the exchange rate is also insignificant. However, the impact of the monetary policy rate on the lending rate is significant. Thus, while monetary policy rate is effectively transmitted to the lending rate, the lending rate does not effectively transmit to other monetary variables of interest, including credit to the private sector and the price level, implying that the role of the monetary policy rate in Sierra Leone is quite limited. Thus, there is a need for structural changes, including building financial inclusion to reduce the role of cash transactions.

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1. Introduction

Price stability is key to monetary policy operations. It is a core objective of central banks, and it is sought through monetary policy. In a forward-looking framework, the monetary policy is set with the idea that it can affect other important interest rates and bank lending, with the ultimate effect on the price level. Where its impact on the price level is significant then the interest rate channel is considered effective but where its effect is weak, the interest rate channel is considered weak. While there are various channels of monetary policy transmission mechanism, including credit channel, the exchange rate channel and the asset price channel, the interest rate channel is the channel associated with the use of monetary policy rate to implement monetary policy.

The Bank of Sierra Leone (BSL) has a crucial role in stabilizing macroeconomic conditions in the country as enshrined in Section 4(1&2) of the BSL Act 2019, which grants the bank autonomous status. This also enables the bank to monitor price and financial stability, as specified in Section 5 (1b&1c) of the BSL Act 2019. To support its autonomous status, the central bank, through the Monetary Policy Committee (MPC), uses monetary targeting with reserve money as the operational target. This places a significant responsibility on the BSL to monitor the demand and supply of money. Also, through the Monetary Policy Committee meetings the Bank sets the monetary policy rate on a quarterly basis following a review of macroeconomic conditions and observation of forecast for inflation rate.

The MPC ensures that its quarterly meetings determine the Monetary Policy Rate (MPR) through the outcome of technical presentations from relevant policy departments. These technical inputs, which typically take the form of empirical forecast outputs from staff, provide a guide for decisive voting by MPC members. Once the rate is set by the MPC through its quarterly deliberations, the outcome is communicated through a published Monetary Policy Statement. The rate at a particular point in time is based on three decisions: increase, reduce, or stay-put. The expectation is that the information conveyed in the quarterly MPRs will be efficiently transmitted to the banking system, supporting the BSL's objectives of ensuring price stability.

Several attempts have been made to examine the transmission of monetary policy to domestic price level, through the banking system. In Sierra Leone, Bangura et al. (2021) used a Dynamic Panel Data approach. Given the increasing interest in ensuring price and financial stability, particularly in the face of shocks from the Russia-Ukraine war, this study aims to fill the gap by

providing a more in-depth understanding of the interest rate channels of the Bank of Sierra Leone's (BSL) efforts to achieve and maintain price stability by addressing two main research questions – How *effective is the Bank of Sierra Leone's Monetary Policy Rate (MPR) in fulfilling its role of monitoring price stability in Sierra Leone?* and *What is the nature and pace of the transmission of MPR signals to interest rates, exchange rate and the price level in Sierra Leone?*

The rest of the paper is structured as follows: Section 2 provides a review of the literature. Section 3 provides the methodology, including the estimation technique and a description of the data and sources. Section 4 provides an analysis of the results, and Section 5 is the conclusion.

2. Literature Review

2.1 Theoretical Literature

There are various channels of monetary policy transmission. However, as the focus of this paper is on the interest rate channel of monetary policy transmission, given the importance of this channel in the transmission of changes in monetary policy rate to the real sector, our focus is on the interest rate channel.

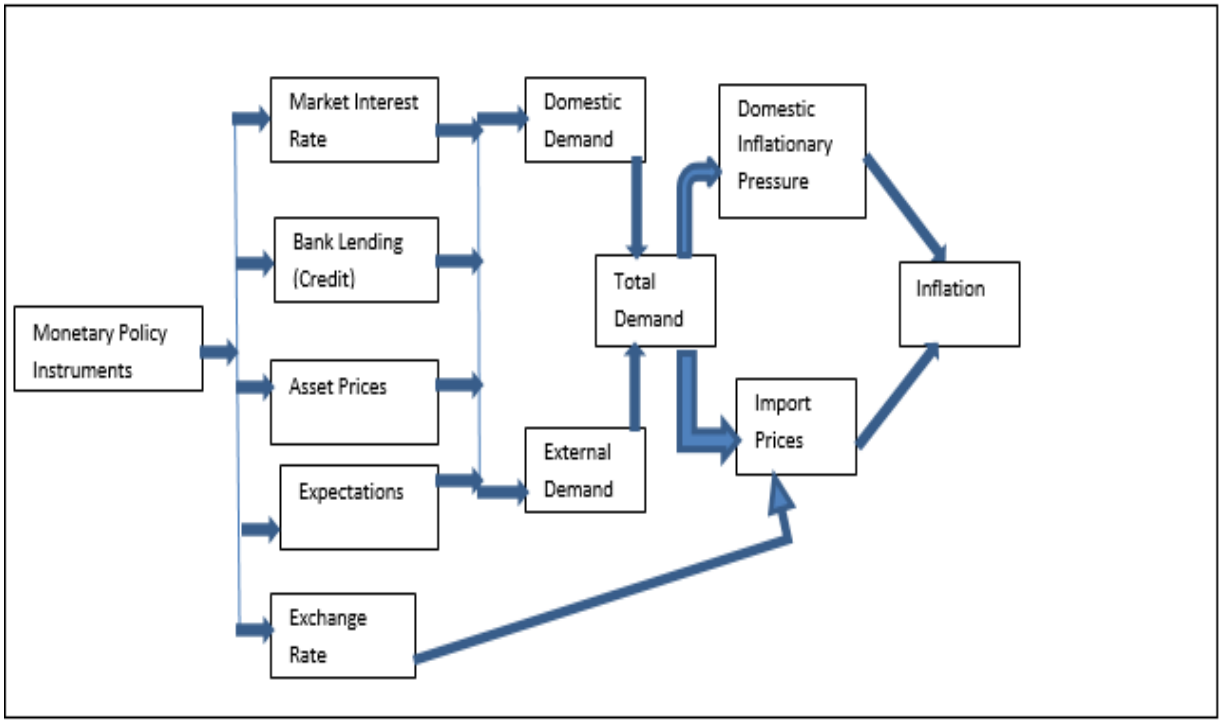
The interest rate channel is the traditional channel which is put forward by Keynes in terms of how monetary policy affects the economy. In addition, in a system where the central bank signals its policy stance using its rate, for example the monetary policy rate, this is expected to transmit to the interbank rate. The change in the interbank rate is expected to translate into the lending rate, which also affect bank lending and investment as well as consumption. Thus, aggregate demand is affected, and the price level is consequently affected, depending on the degree of excess demand created for goods.

Thus, the interest rate channel allows central banks to impact price changes by adjusting rates, either upward or downward. An upward adjustment of the MPR is expected to result in higher costs for economic agents, leading to reduced spending and causing prices to decrease.

As presented in Figure 1 (adapted from Mishkin, 2010), an adjustment of the MPR is likely to influence one or more of the following: market interest rate, bank lending (Credit), expectations, asset prices, including the exchange rate. Figure 1 shows that the effects of a channel can be significant, as illustrated by the exchange rate channel, which is especially critical for import-dependent economies such as Sierra Leone. The figure demonstrates that exchange rate changes

directly impact import prices, thereby contributing to inflationary pressures in the economy (Campa and Goldberg, 2005).

Figure 1: Monetary Policy Transmission Channels



Source: Bank of England (1999) and Loayza et al (2002)

Research indicates that in Sierra Leone, an increase in interest rates often results in currency depreciation due to a disparity between the demand and supply of foreign currencies, such as the US dollar (Kargbo, 2014). However, higher interest rates can attract foreign investment inflows, provided inflation remains under control. Typically, the announcement of the monetary policy rate (MPR) in Sierra Leone is transmitted through the interbank lending channel and the market lending rate established by domestic commercial banks (Kamara et al., 2020). Nevertheless, the weak performance of the real sector in Sierra Leone may hinder the transmission of higher rates through the market, potentially causing some challenges. One such challenge is the possibility of reduced productivity resulting from high pass-through costs to consumers and their financing, which can arise when commercial banks charge elevated interest rates to their customers (World Bank, 2018). Also, where there is high preference for transactions in cash, the response of the banking sector may be weak when there is a change in the interest rate.

2.2 Empirical Literature

There is a plethora of studies on monetary policy transmission mechanism in general and there are also numerous studies on the interest rate channel. For example, a recent study by Ojaghlou and Kaya Söztanacı (2022) analyzed how changes in the official interest rate set by the Central Bank of Turkey (CBRT) affect market interest rates in the Turkish economy. The used data on six market interest rates, including bank rate, lending rate, deposit rate, money market rate, treasury bill rate, and government bond yield. It determined the correlation and possible cointegration of these series and then applied Bayesian Vector Auto-regression (BVAR) to estimate the response of interest rates to the bank rate. The results indicated a long-term relationship among the interest rates, with a strong correlation between the bank rate and other rates such as the money market rate, deposit rate, and lending rate. Ojaghlou and Kaya Söztanacı (2022) found a full pass-through effect between the bank rate and lending rate, money market rate, treasury bill rate, and deposit rate. However, no pass-through was found between the government bond yield and bank rate.

Kotlele, Edoun, and Naidoo (2021) employed three quantitative, secondary, independent, annual time-series data sources, including interest rates, spanning from 1998 to 2018 for South Africa.. The study used correlation and linear regression methods to determine the impact of interest rates on household behavior for the observed variables, including personal transport, household credit, and the consumption of durable goods at the household level. The results show a negative relationship between real interest rates, adjusted for inflation, and overall household consumption of goods. Additionally, the study found that an increase in interest rates leads to a decrease in spending, while a lowering of interest rates results in a better-off disposable income bracket for households in all the observed variables, implying an effect interest rate channel.

The work by Gregor, Melecký, and Melecký (2020), examined an empirical assessment on interest rate pass-through and analyzing them through meta-analysis and meta-regression. The results, which used corporate lending rates as the baseline for the pass-through outcome, showed systematically lower pass-through estimation coefficients for studies that focused on the pass-through to consumer lending rates and long-term lending loan rates. The study also revealed that averaging lending rates into a single category produced lower pass-through results. Additionally, the study found that the interest rate pass-through is highly influenced by a country's macro-

financial environment, with estimated outcomes from pass-through being significantly strong for countries with deepening stock market dynamics. However, the study showed that the pass-through effect weakened generally due to increased levels of trade openness and supply-chain financing, high volatility, stock market risks, and the diminishing role of central bank independence.

According to an empirical study by Obafemi and Ifere (2015), the results of the precise channel of monetary policy transmission are unclear. The study used a Factor Augmented Vector Autoregression (FAVAR) model, with 53 observations and 6 observed variables, and compared it with a conventional Vector Autoregression (VAR) model. The results of the two models showed that, although both models produced similar outcomes, the FAVAR model was preferable to the VAR model because it was more effective at identifying monetary policy shocks. Furthermore, the FAVAR model allowed for the calculation of impulse responses for many of the chosen variables, unlike the conventional VAR, which exhibits the "prize puzzle problem." The outcomes of both models indicate that credit channels in Nigeria are the most important and effective means of transmitting monetary policy. The results also showed that money conduits and exchange rates were not significant or effectively pronounced.

Safeguard (2006) examined the pattern of excess liquidity in sub-Saharan Africa and its impact on the effectiveness of monetary policy. Using a non-linear Structural Vector Autoregression (SVAR) model, the study argues that understanding the consequences of excess liquidity holdings by commercial banks for precautionary purposes is crucial. The study data and methodology were set up for selected economies, including the CEMAC region, Nigeria, and Uganda. The results show that excess liquidity weakens the monetary policy transmission mechanism and the ability of monetary authorities to impact demand conditions in the respective economies.

Chiaraah (2003) evaluated the efficacy of Ghana's monetary policy by taking into account the effectiveness of trade policy and openness to trade. The study used quarterly data from 2002 to 2016 and analyzed the relationship between trade openness and the efficiency of monetary policy in stabilizing inflation and output using the co-integration approach. The empirical outcome showed that as trade openness increases, monetary policy becomes less successful in reducing inflation, leading to a fall in domestic output in the long term. The outcome also showed that an increase in monetary policy rate limits the potential of trade openness to lower Ghana's inflation

rate. The findings suggest that trade openness makes it difficult for Ghana's monetary policy to control inflation, resulting in a consequential fall in output.

Akosa (2015) attempted to evaluate the efficiency of channels used to transmit monetary policy using data from 1970 to 2013 for Ghana. The study applied both the Factor Augmented Vector Autoregression (FAVAR) and traditional Vector Autoregression (VAR) models. The results showed that in Nigeria, the transmission mechanism for monetary policy is greatly influenced by interest rate and credit channels.

Ogunkula and Tarawalie (2008) examined the efficiency of transmission routes for monetary policy, focusing on interest rates and bank lending. The study used a non-recursive Structural Vector Autoregression (SVAR) technique and analyzed quarterly data from 1990Q1 to 2006Q2. The results showed that the interest rate channel was proven to be minimal, whereas the bank lending channel was found to be highly relevant. Additionally, the exchange rate channel of monetary policy had a greater impact on inflation, while its impact on output was found to be minimal.

A recent empirical study on monetary policy transmission in Sierra Leone is by Bangura et al (2021) explored bank lending channels of monetary policy in Sierra Leone using Dynamic Panel Data model estimation, and specifically Generalized Method of Moments (GMM) with quarterly data spanning 2014-2018. This study explored the effectiveness of MPR influence and other bank-level characteristics (size, liquidity and capital) in determining banks' lending behaviour in Sierra Leone. The study's results showed that the Monetary Policy Rate (MPR) significantly and negatively impacts banks' loan supply. Additionally, the study found that the interaction between MPR and bank size is significantly positive, consistent with the theory that lending volume of large banks is less sensitive to monetary policy conditions compared to smaller banks. However, how monetary policies rate affects various rate was not considered and this is a common problem across previous studies.

In spite of the existence of a plethora of studies on the effectiveness of the interest rate channel, including studies on Sierra Leone, we are not aware of any study that explicitly the effect of monetary policy rate on various interest rates and how these rates affect the price level. This is important because investigating whether the monetary policy rate is effect requires determining where the cut off is, if the channel is found to be in effective and this can provide a clear guide to

policy makers. Over time, the focus of this study has shifted towards using two models, Price and Interest VAR models, in order to be more robust in assessing the situation in Sierra Leone.

3. Methodology

3.1 The Estimation Strategy

The Vector Autoregression (VAR) model is used to determine the effectiveness of the interest rate channel of the interest rate channel of monetary policy transmission in Sierra Leone. This approach is highly favored because it allows for all variables to be entered into the model endogenously. In addition, considering the inter-linkage between various interest rates is deemed important in the investigation of interest rate channels, a structural single equation model may not be suitable because including all the rates in a single equation can result in correlation and inflate the standard errors of the estimated parameters. The VAR model can also be used to measure the impact of interest rate changes on a variable of interest over a long period, such as up to twelve months using monthly data. Several studies, such as Davoodi et al. (2013), Mishra and Montiel (2013), and Cheng (2006), have resorted to using the VAR methodology in their investigation of the relative effectiveness of monetary policy transmission channels. A simplified expression of the VAR model is as follows:

$$Y = B_1(L)Y + B_2(L^2)Y + \ldots . B_k(L^q)Y + \eta_t \qquad (3.1)$$

Where:

Y is a kx1 matrix of the variables of model.

Bi is a kxk matrix of the coefficients of $(L^i)Y$, which are the lags of the variables in Y and

$\boldsymbol{\eta}t$ is the disturbance assumed to be iid with zero mean and constant variance.

The formulation in (3.1) is a standard VAR. In a structural VAR, the equations in (3.1) also has the contemporaneous form of each variable in the model and the model is as in (3.2).

$$AY_t = B_1(L)Y + B_2(L^2)Y + \ldots . B_k(L^q)Y + \eta_t \qquad (3.2)$$

Where: A is a kxk matrix.

However, instead of using the Cholesky decomposition in the standard VAR, identification conditions are normally imposed on some of the structural parameters to allow the invertibility of the A matrix in (3.2), which is necessary for a solution to be obtained. This leads to the estimation

of what is known as SVAR (structural VAR). This requires setting some elements of A matrix to be assigned a priori values and normalizing the diagonal elements of A matrix to unity. Economic theory is used to impose these additional restrictions, which is $\frac{n(n-1)}{2}$ in number, where n is the number of (endogenous) variables in the VAR. However, most of the restrictions are normally zeros, indicating that the contemporaneous form of a variable has no impact on the contemporaneous form of another variable. In this regard, the restrictions may be imposed to have an invertible A matrix even where the restriction may not be valid.

The main advantage of the Structural Vector Autoregression (SVAR) model is that it can provide coefficients for the contemporaneous impact even before conducting the conventional impulse response function. However, these coefficients are obtained by imposing restrictions which may not be valid, in order to have an invertible A matrix. Furthermore, when the variables are not stationary and are cointegrated, using the structural VAR for vector error correction estimation is not applicable. Therefore, in this study, we applied the standard Vector Autoregression (VAR) and tested for unit roots in each variable. If some variables are stationary and others were not, the non-stationary variables are differenced to make them stationary, and are combined with the stationary variables to estimate a VAR model with stationary variables. We also chose the appropriate lag lengths and conducted various VAR diagnostic tests, including tests for serial correlation, residual normality, and VAR stability.

3.2 The Selected Variables of the VAR

In an economic model, variables entering a VAR system are typically based on economic phenomenon. Hence, it is those variables that considered are useful in determining monetary policy effectiveness that should enter a VAR for investigating the effectiveness of the interest rate channel of monetary policy.

In investigating the effectiveness of the interest rate channel and the monetary policy transmission mechanism in general, the target variable of interest should be clearly identified. The impact of a policy on one variable may vary from its impact on another variable. Conventional or ultimate target variables of interest are those that reflect economic growth and price stability. This is because monetary policy aims for price stability as its primary objective, and economic growth is also a secondary objective. In Sierra Leone, price stability is the core objective of monetary

policy, although the Bank of Sierra Leone also pursues growth-enhancing policies as needed. In line with this, the VAR variables are selected based on the price stability objective.

In order to investigate the effectiveness of the interest rate channel of monetary policy transmission in Sierra Leone, we estimated two types of VARs: an interest rate VAR and a price VAR. The interest rate VAR captures the transmission of changes in monetary policy rates to changes in lending rates through the standing lending facility. In this VAR, the response of the interbank rate, nominal exchange rate, and Treasury bill rate to changes in monetary policy rates are captured. Thus, the variables in the lending rate VAR model are as follows:

$$Y = (\mathrm{LR}, \mathrm{SLF}, \mathrm{IBR}, \mathrm{EXR}, \mathrm{TBR\ and\ MPR}) \quad (3.3)$$

Where: LR is the lending rate, SLF is the standing lending facility, IBR is the interbank rate, EXR is the exchange rate, defined as the monthly average of domestic currency per US dollar, TBR is the Treasury bill rate, specifically the three-month Treasury bill rate, and MPR is the monetary policy rate. The variables in the VAR are ordered as follows: LR, SLF, IBR, EXR, TBR, and MPR. In the absence of a savings rate, we utilized the deposit rate (DPR).

The price VAR model captures the role of the lending rate in price dynamics and accounts for the impact of the exchange rate on price formation. It also captures the independent effect of credit to the private sector on the price level through an increase in expenditure and the overall effect of changes in the broad money supply on inflation. Hence, the variables of the price VAR model are specified as follows:

$$Y = (\mathrm{CPI}, \mathrm{MS}, \mathrm{CPS}, \mathrm{EXR\ and\ LR}) \quad (3.4)$$

Where CPI is the consumer price index, MS is the money supply, defined as currency plus demand deposits plus quasi-money, and CPS is credit to the private sector. EXR is the exchange rate and LR is the lending rate.

Typically, real GDP is included in structural models of inflation and in VARs with annual data. In some cases, it is included in price VARs with quarterly data where the country has quarterly data on real GDP. In other cases, it is used in monthly VARs with interpolation of quarterly or annual data into monthly data. Real GDP is absent in the price VAR model for this study because there is no monthly data on real GDP and interpolating existing annual GDP figures into monthly

GDP does not guarantee that the generated data would accurately reflect what happened in the real sectors of the economy every month. However, while an increase in credit to the private sector may be inflationary, it may also be disinflationary, in which case, it would imply that more credit would translate into growth in the real sector, with the ensuing growth resulting in reduced inflationary pressures.

3.3 The Data

For this study, we have used monthly data ranging from 2011M02 to 2022M06. In the case of Sierra Leone, the formal process of setting the monetary policy rate started after 2011M02. The use of monthly data is justified by the need to effectively assess the interest rate channel of monetary policy. This is because it is considered a factor in the dynamics of monetary impact every month rather than annually. This is because many policy or structural changes and shocks may occur within a few months, compared to a few years.

Therefore, monthly data analysis of monetary impulses is considered more robust compared to yearly or quarterly data. However, the drawback is the unavailability of monthly and quarterly data on the real sector in Sierra Leone. Some researchers have addressed this issue by converting annual GDP series into quarterly or monthly series (see Vinayagathasan, 2013). However, we did not use this approach because we wanted the study outcomes to be based on the available data from the Bank of Sierra Leone to avoid significant interpolation of the GDP series.

4. Empirical Results

4.1 Trend Graphs, Summary Statistics and Unit Root Tests

Table Appendix Figure 1 shows graph of model variables, which was useful to guide the approach to the unit root test, in terms of using trend or trend and constant in the auxilliary regression for the tests. Appendix Table 1 shows the summary statistics of variables and Appendix Table Tables 2 to 5 shows the results of the unit root tests. summarizes the unit root test results for each of the variables and provides a summary of the statistics. All model variables are found to be stationary based on the combined tests. Thus, the standard Vector Autoregression (VAR) can be used and there is no need for testing for cointegration or transforming the variables by differencing.

The unit root test results affirm the joint findings from the three tests: Dickey-Fuller GLS, Perron-Vogelsang, and Clemente-Montanes-Reyes. The reason for conducting three separate tests is to account for single and double structural breaks and outliers in the data, which also confirms the correct stationarity condition.

4.2 Monetary Policy Impact and Price Response to Various Rates and Other Factors.

(i) The Effects of Monetary Policy Rate

Tables 1 and 2 show the impulse response of Lending Rates, Exchange Rates, Treasury Bill Rates, Interbank Rates, and Standing Lending Facility Rates to a positive one-standard deviation innovation shock to the monetary policy rate of the Bank of Sierra Leone.

From Table 2, the six-month average response to a one standard deviation innovation shock to MPR on the standing lending facility is 0.118, while the impact on the interbank rate is 0.044. There is a decline in Treasury bill rate by -0.736, an appreciation in exchange rate by 2.929, and finally an increase in lending rates by 0.021. We also observe that the impact of the monetary policy shock on the standing lending facility rate, interbank rate, Treasury bill rate, exchange rate, and lending rates maintains its initial direction after the shock, but the magnitudes dissipate after the 12th and 24th months, as shown in Table 6 above.

However, the impact of MPR on the Standing Lending Facility (SLF) is only significant until the 6th month, while the accumulated impact is only significant up to the 8th month as shown in Figure 4, panel A. Furthermore, the accumulated response of lending rates was significant only in the 6th month and remains so until the 20th month and thereafter becomes insignificant. As shown in figure 4, the impact on the interbank rate, Treasury bill rate, and exchange rate was found to be statistically insignificant after a one standard deviation shock to the MPR.

These results imply that the interbank rate, lending rate, and Treasury bill rate in Sierra Leone have a weak response to changes in the monetary policy rate. The weak response of the interbank rate and lending rate suggests a weak transmission of the monetary policy rate to the key rate that is expected to directly affect the price level (i.e., the lending rate).

Raising the MPR by a one standard deviation shock shows no significant impact on the exchange rate. The domestic currency (the Leone) does not react to an increase in the monetary policy rate. The monthly average response standard deviation of the nominal exchange rate to a

one standard deviation innovation shock to the monetary policy rate in a year is negative but insignificant. This response remains inconsequential throughout the 6th, 12th and 24th months. This implies that changes in monetary policy rates in Sierra Leone have little or no impact on the nominal exchange rate.

Table 1: Cholesky Ordering: D(LR) D(EXR) TBR IBR SLF MPR (Standard Errors Analytic)

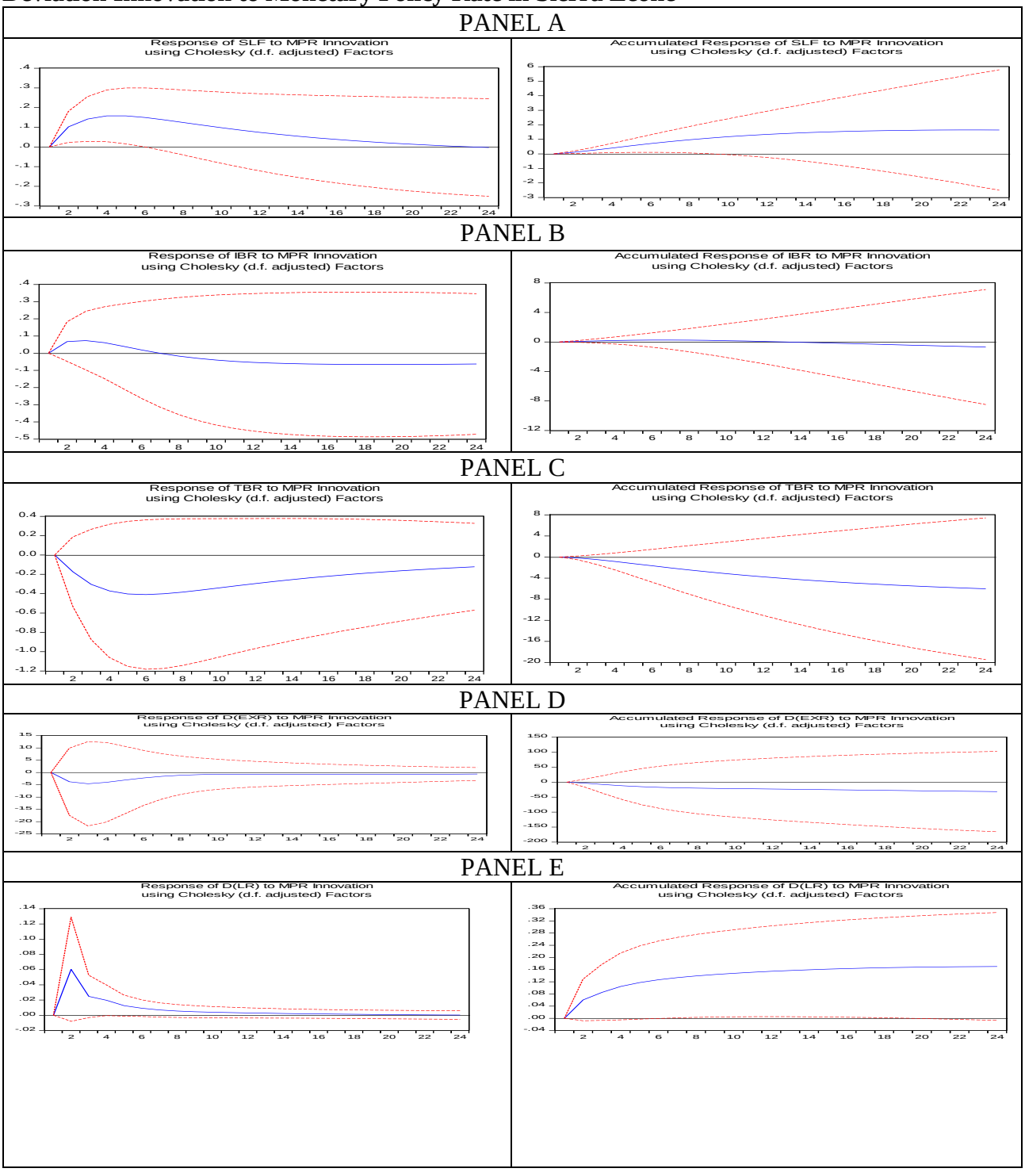
Period	D(LR)	D(EXR)	TBR	IBR	SLF
6 months	0.021	-2.929	-0.277	0.044	0.118
12 Months	0.013	-1.931	-0.314	0.006	0.112
24 Months	0.007	-1.321	-0.251	-0.029	0.068

Table 2: Accumulated Cholesky Ordering: D(LR) D(EXR) TBR IBR SLF MPR (Standard Errors Analytic)

Period	D(LR)	D(EXR)	TBR	IBR	SLF
6 months	0.082	-9.555	-0.736	0.152	0.336
12 Months	0.114	-15.441	-1.844	0.167	0.725
24 Months	0.140	-21.659	-3.498	-0.084	1.150

Figure 2 summarizes the results of the impulse response functions. The results show that a positive one-standard deviation innovation shock to the monetary policy rate in Sierra Leone has a significant positive impact on the standing lending facility immediately, which continues for up to six months but no impact on interbank rate, exchange rate, and Treasury bill rate. However, for lending rate, while there is no immediate or later impact, there is evidence of positive cumulative impact.

Figure 2: Impulse Response of Various Interest Rates and Exchange Rate to One Standard Deviation Innovation to Monetary Policy Rate in Sierra Leone



(ii) The Response of Price Level

Tables 3 and 4 below summarize the results of the impulse response functions, showing the impulse response of credit to the private sector, money supply, exchange rate, and consumer price index to changes in the lending rate. The outcomes indicate that a positive one standard deviation innovation shock to the lending rate in Sierra Leone has an insignificant impact on credit to the private sector, money supply, exchange rate, and consumer price index.

Table 3: Cholesky Ordering: D(LCPI) D(LEXR) D(LMS) LCPS D(LR)(Standard Errors Analytic)

Period	D(LCPI)	D(LEXR)	D(LMS)	LCPS
6 months	-0.0000595	-0.0001020	0.0000046	-0.0006569
12 Months	-0.0001124	-0.0001954	0.0000122	-0.0006261
24 Months	-0.0002111	-0.0003328	0.0000264	-0.0005593

Table 4: Accumulated Cholesky Ordering: D(LCPI) D(LEXR) D(LMS) LCPS D(LR)(Standard Errors Analytic)

Period	D(LCPI)	D(LEXR)	D(LMS)	LCPS
6 months	-0.00126	-0.002071917	0.000116	-0.00786
12 Months	-0.00113	-0.001734	0.000105	-0.00372
24 Months	-0.00094	-0.001212	5.68E-05	-0.00167

Figure 3 shows that a one standard deviation shock to the lending rates resulted in a decrease in credit to the private sector, but the result is not statistically significant. The shock decreases credit to the private sector by -0.0006569, -0.0006261, and -0.0005593 in the 6^{th}, 12^{th}, and 24^{th} months, respectively, but the result is found to be statistically insignificant. These suggest that lending rates have a negligible impact on credit to the private sector. The results in the accumulated impulse response outcome also mirror the aforementioned outcomes.

Furthermore, Figure 3 shows that a one standard deviation shock to the lending rate decreases consumer prices, although the result is not statistically significant. Specifically, the lending rate shock reduces consumer prices by -0.0000595, -0.0001124, and -0.0002111 in the 6^{th}, 12^{th}, and 24^{th} months, respectively. These findings suggest that the lending rate has a weak impact on consumer prices. The results in the accumulated impulse response outcome also mirror the aforementioned findings.

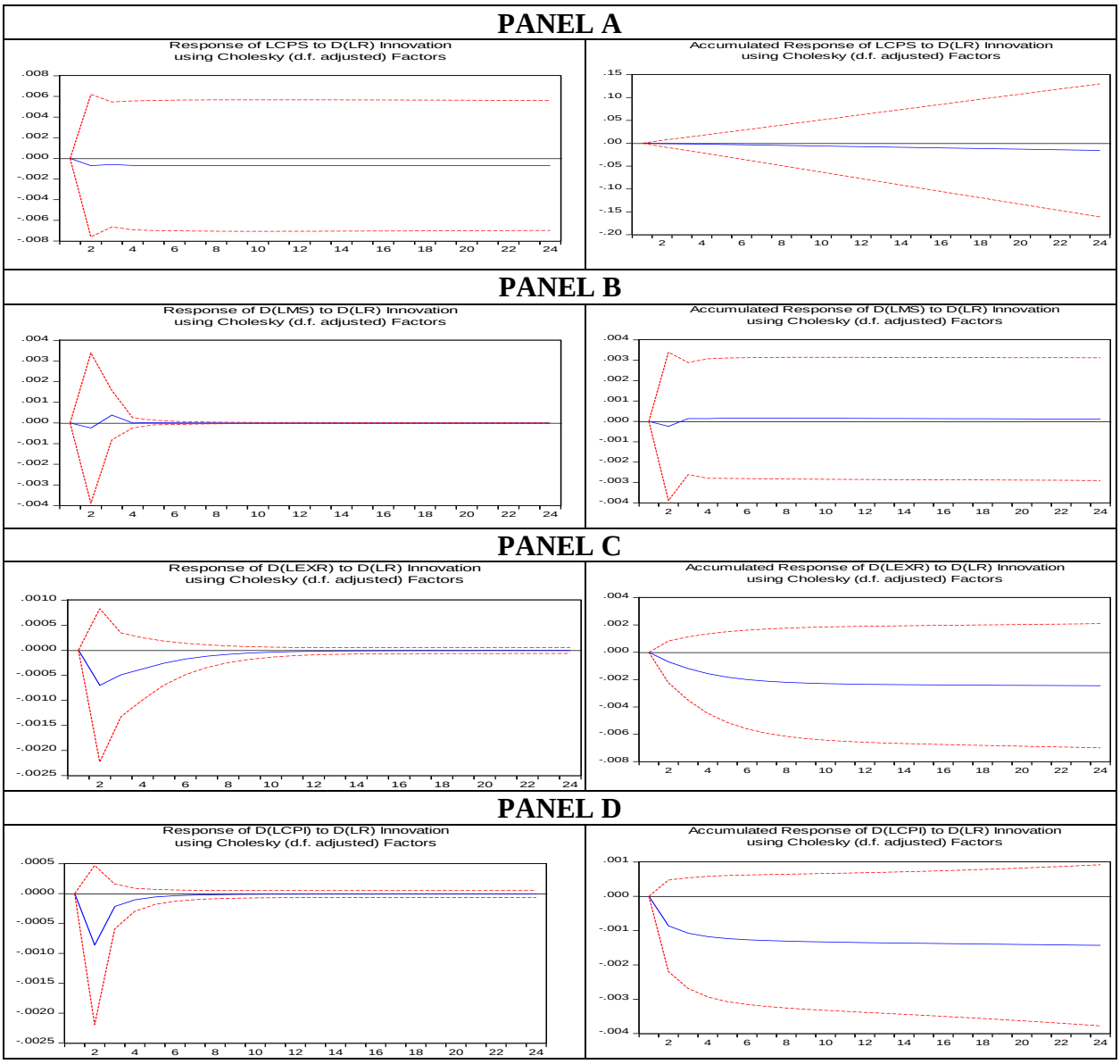
A one standard deviation shock to the lending rates shows that the Leone appreciates against the US dollar, with an average monthly appreciation of 0.0001020, 0.0001954, and

0.0003328 to the Leone currency in the 6th, 12th, and 24th months, respectively. However, the result is found to be statistically insignificant, suggesting that the lending rate has an insignificant impact on the exchange rate. The results in the accumulated impulse response outcome also mirror the aforementioned outcomes (see Tables 8 and 9 and Appendices 3 and 4). This implies that as the lending rate rises, the Leone appreciates against the US dollar, while the price level in Sierra Leone decreases but with a weak impact within a month. The accumulated impulse response is shown in Figure 3, which shows that while the impact of exchange rate change on the price level is weakly negative on a monthly basis.

A one standard deviation shock on lending rates shows that the money supply increases at an average monthly rate of 0.0000046, 0.0000122, and 0.0000264 in the 6th, 12th, and 24th months, respectively, but the result is found to be statistically insignificant, which suggests that the lending rate has an insignificant impact on the money supply.

These responses to a one-time standard deviation shock to price level, credit to the private sector, exchange rate, and money supply show that the lending rate has a weak and insignificant impact on these variables, implying that the transmission mechanism to prices is ineffective in supporting the mandate of price stability in Sierra Leone.

Figure 3: Impulse Response of Price Level to One Standard Deviation Innovation to Lending Rate and Other Variables in Sierra Leone.



5. Conclusion

The paper investigated the effectiveness of the interest rate channel of monetary policy transmission in Sierra Leone using monthly data February 2011 to June 2022. A VAR examining effect of MPR on lending through standing lending facility, interbank rate and exchange rate was estimated in addition to a VAR examining the effect of lending rate on domestic price level through credit to the private sector, money supply and the exchange rate. Unit root test were done, and impulse response functions were obtained.

The results show that in Sierra Leone, the link from the monetary policy rate to the standing lending facility is effective, and the link from the monetary policy rate to the interbank rate is also moderate. In addition, the response of the Treasury Bill rate to changes in the monetary policy rate is negative but statistically insignificant. Moreover, the response of the exchange rate to the monetary policy rate is negative, implying that an increase in the monetary policy rate causes the Leone to appreciate against the dollar, but the result is found to be statistically insignificant. Finally, we found that the response of the lending rate to changes in the monetary policy is effective and partially significant.

However, the impact of the MPR on the Standing Lending Facility (SLF) is only significant until the 6th month, while the accumulated impact is only significant until the 8th month. Furthermore, the accumulated response of lending rates becomes significant only in the 6th month and remains so until the 20th month, and thereafter becomes insignificant. The impact on the interbank rate, Treasury bill rate, and exchange rate was found to be statistically insignificant after a one-time standard deviation shock to the monetary policy rate, even after the accumulation of the impact.
The results imply that the standing lending facility, interbank rate, lending rate, and Treasury bill rate in Sierra Leone are moderately effective in response to changes in the monetary policy rate. The moderate response of the standing lending facility, interbank rate, and lending rate suggests a moderately effective transmission from the monetary policy rate to the key rate that should directly affect the price level, which is the lending rate.

The price VAR model shows that changes to the lending rate reduce the consumer price index, but the result is not statistically significant. The results in the accumulated impulse response outcome

also confirm that the impact of changes in the lending rate on the consumer price index is statistically insignificant. On the other hand, an increase in lending rates increases money supply, but the result is not statistically significant. This suggests that the lending rate has an insignificant impact on money supply.

The result shows that a one standard deviation shock to the lending rates decreases credit to the private sector, but the result is not statistically significant. This suggests that the lending rate has a negligible impact on credit to the private sector. A one standard deviation shock to the lending rates shows that the Leone appreciates against the US dollar, but the result is found to be statistically insignificant, suggesting that the lending rate has weak negative impact on the exchange rate.

In conclusion, the study results indicate that the monetary policy rate effectively transmits to the lending rate through the standing lending facility and interbank rate, but the lending rate channel does not effectively transmit to the credit to the private sector, money supply, exchange rate, and consumer price index. To make the transmission from the lending rate to the price impactful, some structural issues are important in Sierra Leone, including the need to build financial inclusion and reduced role of cash transactions and strong use of the banking system.

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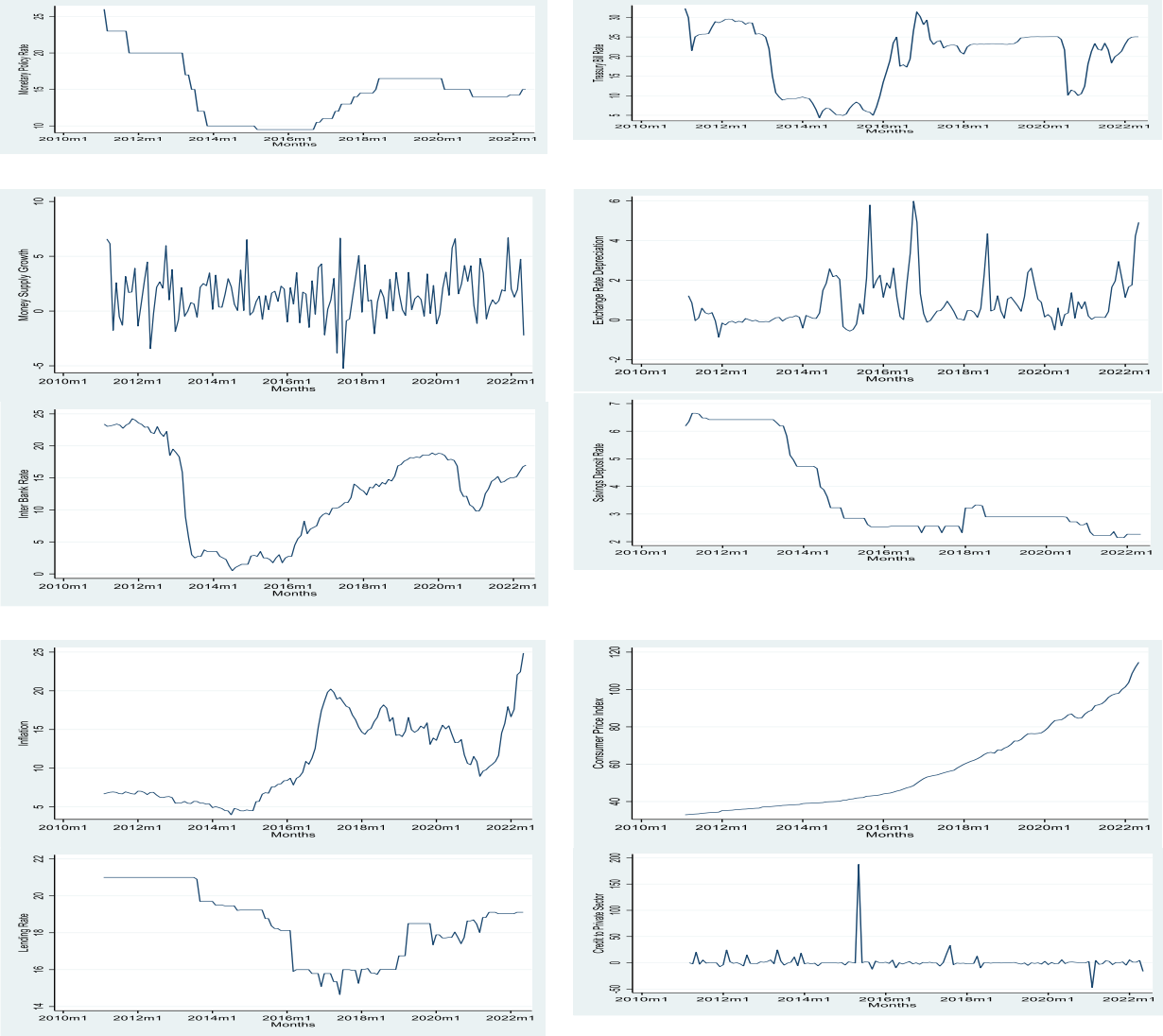
Appendices

Appendix Figure 1: Plot of the Various Variables



Appendix Table 1: Summary Statistics

	MPR	MS	SLF	TBR	LR	IBR	EXR	CPI	CPS
Mean	14.57299	6521316.	15.58824	19.65247	18.48745	12.44051	6940.653	57.61650	1158837.
Median	14.50000	5636882.	17.00000	23.08750	18.77000	13.52758	6809.150	48.60000	968510.5
Maximum	26.00000	15881401	20.50000	32.28000	21.00000	24.25000	13120.30	118.1600	2278647.
Minimum	9.500000	2229259.	10.50000	4.360000	14.65000	0.500000	4254.590	32.90000	537508.5
Std. Dev.	4.029323	3512407.	3.998089	7.889154	1.882007	7.211527	2485.115	22.55496	502611.0
Skewness	0.486150	0.998540	-0.14825	-0.62742	-0.2056	-0.11106	0.465796	0.787353	0.822913
Kurtosis	2.510996	3.123957	1.339446	1.989248	1.877454	1.788957	1.954368	2.462483	2.355273
Jarque-Bera	6.761475	22.85440	12.09276	14.82027	8.158291	8.653618	11.19523	15.80424	17.83520
Probability	0.034022	0.000011	0.002366	0.000605	0.016922	0.013210	0.003707	0.000370	0.000134
Sum	1996.500	8.93E+08	1590.000	2692.389	2532.780	1704.350	950869.4	7893.460	1.59E+08
Sum Sq. Dev.	2208.020	1.68E+15	1614.456	8464.471	481.7054	7072.832	8.40E+08	69186.75	3.44E+13
Obs	137	137	102	137	137	137	137	137	137

Appendix Table 2: Dickey-Generalized Least Squares (DF-GLS) Unit Root Test Results

Variable		Deterministic Component	Lag	Test Statistics	Conclusion
Monetary Policy Rate	L	Constant	2	-0.245	I(k)
	1D	Constant	3	-0.328	
	2D	Constant	4	-0.332	
Treasury Bill Rate	L	Constant	1	-1.356	I(1)
	1D	Constant	1	-4.564a	
	2D				
Standing Lending Facility	L	Constant	1	0.494	I(1)
	1D	Constant	2	-2.693a	
	2D				
Inter Bank Rate	L	Constant	2	-1.005	I(1)
	1D	Constant	1	-4.915a	
	2D				
Lending Rate	L	Constant	1	-0.656	I(1)
	1D	Constant	1	-8.438a	
	2D				
Consumer Price Index	L	Trend	1	0.763	I(1)
	1D	Trend	1	-5.528a	
	2D				
Exchange Rate	L	Trend	1	-0.046	I(1)
	1D	Trend	1	-3.344a	
	2D				
Money Supply	L	Trend	12	-1.147	I(k)
	1D	Trend	11	-0.749	
	2D	Trend	12	1.205	
Credit to Private Sector	L	Trend	1	-1.183	I(1)
	1D	Trend	1	-7.670a	
	2D				
Critical Values					
Constant 1%: -2.595 5%: -2.072				Constant and Trend 1% : -3.538 5%: -2.985	

.**Note:** 1. L = level, 1D = 1st Difference and 2D =2nd difference
2. I(K) means series is not stationary after second differencing
3. “a” Stationary at 5%
4. ‘***’ and ‘**’ mean the break is significant at 1% and 5% levels respectively

Appendix Table 3: Perron-Vogelsang Single Break Unit Root Test Result

Variable		Additive Outlier (Immediate Break)			Innovative Outlier (Gradual Break)			Conclusion
		Breakpoint	P-Value for Break	Test Statistics	Breakpoint	P-Value for Break	Test Statistics	
Monetary Policy Rate	L	2018M4	0.094	-2.638	2017M2	0.098	-3.001	I(K)
	1D	2013M6	0.003	-3.222	2013M7	0.012	-4.171	
	2D	2013M2	0.513	-3.237	2013M3	0.912	-9.546	
Treasury Bill Rate	L	2016M6	0.000	-2.669	2015M9	0.034	-2.968	I(k)
	1D	2020M6	0.848	-3.773	2020M7	0.113	-10.165	
	2D	2020M6	0.981	-8.613	2020M7	0.087	-9.321	
Standing Lending Facility	L	2014M3	0.000	-3.539	2013M6	0.000	-5.376	I(0)
	1D							
	2D							
Inter Bank Rate	L	2016M5	0.009	-2.089	2016M6	0.115	-2.588	I(k)
	1D	2013M2	0.418	-6.803	2013M3	0.113	-7.350	
	2D	2013M2	0.941	-6.710	2013M3	0.096	-7.556	
Lending Rate	L	2015M3	0.000	-1.363	2013M7	0.089	-2.446	I(K)
	1D	2016M1	0.347	-4.567	2016M2	0.072	-4.624	
	2D	2016M1	1.000	-5.067	2016M2	0.505	-7.924	
Consumer Price Index	L	2020M10	0.000	-1.566	2016M8	0.321	1.377	I(k)
	1D	2019M9	0.000	-0.771	2016M5	0.517	1.497	
	2D	2020M11	0.272	-8.036	202M12	0.001	-7.186	
Exchange Rate	L	2020M1	0.000	-2.382	2015M6	0.768	1.173	I(2)
	1D	2021M10	0.000	-3.441	2016M9	0.271	-3.231	
	2D	2021M6	0.015	-6.341	2016M9	0.886	-7.890	
Money Supply	L	2021M2	0.000	-1.555	2020M2	0.000	2.093	I(1)
	1D	2020M4	0.000	-3.928	2020M1	0.000	-5.310	
	2D							
Credit to Private Sector	L	2015M2	0.000	-1.394	2015M3	0.002	-3.551	I(K)
	1D	2015M3	0.931	-10.917	2015M4	0.423	-15.986	
	2D	2015M3	0.952	-8.316	2015M4	0.559	-10.156	
5% Critical Values: **Additive Outlier: -3.560** **Innovative Outlier: -4.270**								

Note: 1. L = level, 1D = 1st Difference and 2D =2nd difference
2. I(K) means series is not stationary after second differencing
3. "a" Stationary at 5%
4. '***' and '**' mean the break is significant at 1% and 5% levels respectively

Appendix Table 4: Clemente-Montanes-Reyes (double break) Unit Root Test Results

Panel A: Additive Outlier (Immediate Break) Results

Variable		First Break			Second Break			Conclusion
		Breakpoint	P-Value for Break	Test Statistics	Breakpoint	P-Value for Break	Test Statistics	
Monetary Policy Rate	L	2013M5	0.000	-1.978	2017M7	0.000	-1.978	I(K)
	1D	2013M1	0.008	-1.410	2013M10	0.000	-1.410	
	2D	2013M2	0.541	-3.028	2018M4	1.000	-3.028	
Treasury Bill Rate	L	2013M6	0.000	-6.037	2016M6	0.000	-6.037	I(0)
	1D							
	2D							
Standing Lending Facility	L	2013M10	0.000	-1.658	2014M10	0.000	-1.658	I(k)
	1D	2013M7	0.048	-2.226	2017M11	0.030	-2.226	
	2D	2014M4	0.926	-6.159	2017M11	1.000	-6.159	
Inter Bank Rate	L	2013M7	0.000	-2.795	2016M7	0.000	-2.795	I(2)
	1D	2012M12	0.000	-5.196	2013M6	0.000	-5.196	
	2D	2013M2	0.950	-6.666	2020M6	0.962	-6.666	
Lending Rate	L	2015M12	0.000	-2.816	2019M1	0.000	-2.816	I(k)
	1D	2016M1	0.882	-3.870	2019M2	0.263	-3.870	
	2D	2016M1	1.000	-6.730	2017M5	1.000	-6.730	
Consumer Price Index	L	2017M3	0.000	-2.773	2019M9	0.000	-2.773	I(k)
	1D	2016M5	0.000	-2.697	2021M2	0.000	-2.697	
	2D	2020M6	0.571	-8.090	2020M11	0.299	-8.090	
Exchange Rate	L	2017M1	0.000	-4.244	2020M1	0.000	-4.244	I(k)
	1D	2015M7	0.002	-1.987	2016M8	0.851	-1.987	
	2D	2016M8	0.819	-6.371	2018M6	0.415	-6.371	
Money Supply	L	2017M5	0.000	-2.400	2021M2	0.000	-2.400	I(1)
	1D	2020M3	0.000	-5.970	2020M10	0.104	-5.970	
	2D							
Credit To Private Sector	L	2015M2	0.000	-1.602	2020M11	0.000	-1.602	I(k)
	1D	2015M3	0.662	-14.692	2020M12	0.071	-14.692	
	2D	2015M3	0.996	-5.967	2020M12	0.852	-5.967	

Additive Outlier 5% Critical Values : -5.490

Panel B: Innovative Outlier (Gradual Break) Results

Variable		First Break			Second Break			Conclusion
		Breakpoint	P-Value for Break	Test Statistics	Breakpoint	P-Value for Break	Test	
Monetary Policy Rate	L	2013M2	0.000	-8.676	2017M2	0.000	-8.676	I(0)
	1D							
	2D							
Treasury Bill Rate	L	2013M1	0.000	-6.042	2015M9	0.000	-6.042	I(0)
	1D							
	2D							
Standing Lending Facility	L	2013M6	0.000	-6.958	2014M4	0.000	-6.958	I(0)
	1D							
	2D							
Inter Bank Rate	L	2013M1	0.000	-5.622	2016M1	0.000	-5.622	I(0)
	1D							

	2D							
Lending Rate	L	2015M4	0.000	-3.978	2018M11	0.000	-3.978	I(k)
	1D	2016M2	0.251	-5.406	2019M3	0.446	-5.406	
	2D	2016M2	0.236	-5.659	2017M6	0.247	-5.659	
Consumer Price Index	L	2016M8	0.921	-1.509	2020M11	0.001	-1.509	I(k)
	1D	2016M2	0.930	0.086	2020M10	0.001	0.086	
	2D	2020M7	0.003	-7.800	2020M12	0.000	-7.800	
	1D	2015M6	0.093	-3.587	2016M9	0.516	-3.587	
	2D	2016M9	0.378	-8.400	2018M7	0.247	-8.400	
Money Supply	L	2017M9	0.152	0.018	2020M2	0.000	0.018	I(k)
	1D	2020M4	0.000	-4.314	2020M11	0.254	-4.314	
	2D	2020M6	0.238	-6.300	2021M1	0.238	-6.300	
Credit To Private Sector	L	2015M3	0.000	-8.651	2020M12	0.000	-8.651	I(0)
	1D							
	2D							
Innovative Outlier 5% Critical Values : -5.490								

Note:1. L = level, 1D = 1st Difference and 2D =2nd difference.

2. I(K) means series is not stationary after second differencing

Note: 1. I(K) means series is not stationary after second differencing

Appendix Table 5: Combination of the Unit Root Test Results

Variable	Order of Integration from DF-GLS	Order of Integration from PV	Order of Integration from CMR	Conclusion from all the three results
Monetary Policy Rate	I(k)	I(k)	I(0)	I(0)
Treasury Bill Rate	I(1)	I(k)	I(0)	I(0)
Inter Bank Rate	I(1)	I(k)	I(0)	I(0)
Lending Rate	I(1)	I(k)	I(k)	I(1)
Consumer Price Index	I(1)	I(k)	I(k)	I(1)
Exchange Rate	I(1)	I(2)	I(k)	I(1)
Money Supply	I(k)	I(1)	I(1)	I(1)
Credit To Private Sector	I(1)	I(k)	I(0)	I(0)
Standing Lending Facility	I(k)	I(k)	I(0)	I(0)