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An Empirical Analysis of the Monetary Policy Transmission Channels in Sierra Leone

Alhassan Kallon

Monetary Policy Department, Bank of Sierra Leone, Freetown, Western Area, Sierra Leone
https://orcid.org/0009-0003-3470-9819
e-mail: akallon@bsl.gov.sl

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Abstract: *This empirical study investigates Sierra Leone's monetary policy transmission channels using a VAR model from 2011Q1 to 2021Q4, emphasising the interest rate, exchange rate, and credit channels. Rigorous pre-estimation tests and variable transformations were applied to enhance result robustness and credibility. The research evaluates the impact of recent monetary policy and financial sector reforms in Sierra Leone and unveils insights into the dynamics of each of the three transmission channels. Notably, the interest rate channel revealed a delayed and transitory impact of policy rate changes on inflation and economic activity. The exchange rate channel underscored the importance of exchange rate stability in managing inflation, particularly in an import-dependent economy. Furthermore, the credit channel highlighted the challenges of private sector credit expansion amidst substantial government borrowing, urging a balanced approach. Overall, the study contributes to a better understanding of Sierra Leone's monetary policy transmission channels, emphasizing the positive influence of recent institutional, operational, and legal reforms adopted by the Bank of Sierra Leone. More precisely, it presents the need to strengthen the interest rate, credit and exchange rate channels for more effective policy transmission. A key policy recommendation is for the Bank of Sierra Leone to continue its reform agenda, with a focus on enhancing these channels to better achieve its policy objectives.*

Keywords: *Transmission Channels; Vector Autoregressive (VAR); Impulse Response; Granger Causality; Bank of Sierra Leone.*

Introduction

Central banks and monetary authorities across the globe bear the crucial responsibility of formulating and implementing effective monetary policies aimed at achieving macroeconomic stability. This pivotal role involves the central bank's meticulous management of the money supply, credit availability, and cost in accordance with the prevailing economic conditions. The overarching objectives of monetary policy encompass the attainment of price stability, economic growth, balance of payments equilibrium, and full employment. However, the effective execution of these objectives hinges on the utilization of various monetary policy instruments, such as bank rates, even though these instruments are not inherently aligned with the desired policy goals. Consequently, policymakers must possess a comprehensive understanding of the monetary transmission mechanism operating within their respective economies. Central banks are thus confronted with the crucial task of identifying and comprehending the primary channels through which their policy actions influence economic

activities, ultimately leading to the achievement of their policy objectives. This imperative is underscored by Mishkin's seminal work in 1995.

The monetary transmission mechanism has emerged as a focal point in global policy discussions, sparking substantial empirical research in both developed and developing nations. The Global Financial Crisis (GFC) of 2008-2009 prompted a reevaluation of how monetary policy impacts economies, leading to a refined understanding of the monetary transmission mechanism. In Sierra Leone, the Bank of Sierra Leone (BSL) has undertaken significant monetary policy and financial sector reforms in recent years. These reforms include transitioning from monetary targeting to a "hybrid" operational framework, introducing the Standing Lending and Standing Deposit Facility Rates (the "corridor system") to enhance policy signaling and transmission, establishing a financial inclusion unit and launching a financial inclusion strategy, creating a financial stability department, and commencing inflation forecasting. Additionally, the BSL's mandate was expanded in the new BSL Act of 2019 to encompass both financial system development and stability, in addition to price stability, leading to the establishment of a second deputy governor position dedicated to financial sector matters in 2020.

Given these reforms, it becomes imperative to reassess the monetary policy transmission mechanism in Sierra Leone. This paper thus endeavors to empirically examine the monetary policy transmission channels in Sierra Leone from 2011q1 to 2021q4, with a specific focus on assessing whether recent monetary policy reforms have strengthened the effectiveness of these channels in achieving the objectives of price stability and economic growth. As a preliminary expectation, these reforms are likely to have bolstered the transmission of monetary policy through the three channels, thereby impacting the policy objectives to some extent.

Literature Review

Theoretical Literature

The literature identifies various monetary policy transmission channels, including the interest rate channel, money supply channel, exchange rate channel, credit channel, asset price channel, and expectations channel. These channels serve as mechanisms through which adjustments in consumption and investment occur, ultimately influencing aggregate demand and inflation.

The interest rate channel

The interest rate channel, rooted in the Keynesian IS-LM framework, has long been recognized in the literature as a primary monetary transmission mechanism. Keynes described this channel's dynamics as follows: $M\uparrow \Rightarrow r\downarrow \Rightarrow I\uparrow \Rightarrow Y\uparrow$

This demonstrates that an increase in the money supply (M) leads to a decline in the real interest rate (r), thereby encouraging investment (I) and subsequently boosting aggregate output (Y). However, in Sierra Leone, where the financial sector remains underdeveloped and private sector credit is quite limited, the effectiveness of the interest rate channel tends to be diminished. The central bank has primarily influenced the 91-day T-bill rate, while the Monetary Policy Rate (MPR) has predominantly served as a signaling instrument. Nevertheless, the Central Bank's recent efforts to bolster the financial sector, the MPR is now anticipated to play a more influential role in shaping the decisions of economic agents and assisting the Bank of Sierra Leone (BSL) in achieving its objectives. Consequently, this study employs the MPR instead of the T-bill rate to investigate this shift. Nonetheless, as part of the preliminary analysis, the T-bill rate is also examined to assess its impact on inflation and real GDP before the MPR is employed.

The credit channels

The credit channel encompasses the dual impact of changes in the supply of reserves within the banking system on aggregate demand, operating through alterations in the terms under which bank customers can access loans (the bank lending channel) and shifts in the external finance premium (the balance sheet channel) (IMF WP/12/143). To elaborate, when the central bank chooses to reduce the policy rate, it triggers adjustments in short-term money market rates. This, in turn, leads to a reduction in the debt obligations of businesses, thereby bolstering their balance sheets (the balance sheet channel). Consequently, financial institutions become more inclined to extend loans to businesses due to reduced risks and the banks' access to more affordable loanable funds. Consequently, investment surges, fostering economic growth. However, the tradeoff for such policy action is a higher price level. It is also anticipated that this channel has improved in Sierra Leone for reasons analogous to those discussed within the interest rate channel.

The exchange rate channel

When a central bank opts to raise the policy rate, it triggers adjustments in short-term money market rates, leading to increased returns on domestic investments compared to foreign investments, consequently attracting capital inflows. This, in turn, causes the exchange rate to appreciate, leading to an uptick in imports. Conversely, the appreciation of the exchange rate makes domestic goods relatively more expensive, thereby dampening exports and reducing net exports, ultimately leading to a decrease in aggregate demand and a subsequent alleviation of inflationary pressures. Given Sierra Leone's heavy reliance on imports, it is expected that the exchange rate channel will exhibit a robust pass-through effect on prices and exert an impact on aggregate demand.

The money supply channel

This channel operates by increasing the supply of money, thereby augmenting the reserves of banks, and enabling them to extend more credit. The effect of this mechanism is manifested through the reduction of short-term interest rates, subsequently leading to a decrease in the real interest rate through the lens of rational expectations. However, in the Sierra Leone financial market, this channel does not exhibit significant strength, primarily due to the prevalence of a substantial number of foreign banks that tend to source liquidity from their headquarters abroad.

Assets price channel

The asset price channel, as recognized in the literature, plays a crucial role in the transmission mechanism. For instance, when the central bank chooses to lower the policy rate, it influences short-term money market rates, prompting economic agents to redirect their savings towards non-interest-bearing assets such as real estate, equities, and bonds, thereby driving up their prices. This increase in asset values leads to enhanced wealth, which, in turn, stimulates higher levels of consumption. Furthermore, the elevation of equity prices amplifies the market value of firms, generating stronger incentives for investment (referred to as Tobin’s “q” theory). Consequently, this expansion in domestic demand contributes to accelerated economic growth. However, it's worth noting that the asset price channel is not applicable in Sierra Leone due to the absence of a developed capital market, which results in the lack of a real estate market in the economy.

The expectations channel

The expectations of economic agents regarding future changes in the central bank's policy rate can swiftly impact medium and long-term interest rates, with long-term rates partially

contingent on market anticipations of short-term rate trends. Through effective communication and signaling of future monetary policy directions, central banks can shape market expectations concerning future inflation, consequently influencing the overall price level. The central bank's capacity to steer expectations and signal future non-standard measures, such as forward guidance, holds significant importance for the efficacy of these policies (ECB Occasional Paper Series No. 191). The ineffectiveness of monetary policy in influencing the expectations of economic agents renders this channel ineffective.

However, given Sierra Leone's underdeveloped financial sector and economic structure, the interest rate channel, the exchange rate channel, and the credit channels have been the most pertinent over the years, and as such, are the primary focus of this paper.

Empirical Literature

This section provides a comprehensive review of previous empirical studies aimed at forming the basis for exploring the research gap concerning the study's objectives. Since the focus of this paper is on the monetary policy transmission channels in a small open economy like Sierra Leone, it reviews related empirical studies in countries that share similar macroeconomic characteristics.

Swaray (2023) assessed the transmission channels of monetary policy to Sierra Leone's real economy spanning from 2002 to 2018, employing a non-recursive SVAR methodology. The author incorporated reserve money, credit to the private sector, 91-day T-bills, and the nominal exchange rate as indicators of the respective monetary policy channels. The findings pointed to the exchange rate channel as the primary conduit through which monetary policy effects permeate domestic prices in Sierra Leone.

M.A. Mwamkonko (2023) investigated the relative effectiveness of monetary policy transmission channels in Tanzania. Employing cointegration and error correction modeling approaches, the results revealed that while both the interest rate and asset price channels exhibited limited effectiveness, the exchange rate and expectations channels dominated the transmission process in Tanzania. The paper concluded by advocating for increased access to financial services and a revision of lending procedures to the private sector, aiming to bolster monetary policy transmission in Tanzania.

In another study, Bangura Ngombu, Pessima & Kargbo (2021) delved into the bank lending channel of monetary policy transmission using dynamic panel data encompassing Sierra Leone from 2014 to 2018. Their findings confirmed the existence and importance of the bank lending channel as a narrower aspect of the credit channel in Sierra Leone. This channel emerged as a vital conduit through which monetary policy shocks influence the national economy.

Similarly, M. O. Jallow (2021) employed a structural VAR model to scrutinize the transmission of monetary policy shocks to various sectors of the Gambian economy, including agriculture, building & construction, consumer credit, and trade. The findings highlighted the heterogeneous nature of monetary policy transmission to these economic sectors. Given this heterogeneity, the author cautioned against the practice of aggregating all sectors while evaluating the potential impact of monetary policy on the economy.

Taking a broader perspective, Mishra and Montiel (2013) conducted a survey of VAR literature concerning low-income countries, using identification strategies to gauge the impact of monetary policy shocks on inflation and output. Their conclusions suggested that in most low-income countries, studies tend to report weak and statistically insignificant effects of monetary shocks on both inflation and output. This weak monetary policy transmission was attributed, in part, to the underdeveloped financial markets in these economies.

In contrast, Buigut (2009) explored monetary transmission in East African countries, namely Kenya, Tanzania, and Uganda, employing a three-variable VAR model that featured real output,

inflation, and a policy interest rate as endogenous variables. The study adopted the Bernanke-Blinder approach to identify structural shocks and concluded that changes in policy interest rates had limited and statistically insignificant effects on both output and inflation. This implied a weak monetary transmission mechanism in these nations.

Abradu-Otoo, Philip, Amoah, and Bawumia (2003) carried out an investigation of monetary transmission in Ghana, utilizing a seven-variable vector-error-correction (VEC) model that encompassed factors such as inflation rate, growth rate, real exchange rate changes, credit to the private sector, broad money, the T-bill rate, and international oil prices. However, their analysis failed to detect statistically significant effects of monetary policy shocks, whether originating from M2 or the T-bill rate. Moreover, their findings indicated a short-term anomaly in the behavior of the T-bill rate and their impulse response functions (IRFs), with a T-bill rate shock seemingly leading to increased inflation and a depreciating exchange rate, in contrast to economic theory.

In summary, the body of empirical research examined here provides a nuanced perspective on the mechanisms through which monetary policy influences economies, both globally and within the specific context of low-income countries. It is evident that there exists a considerable diversity in the significance and effectiveness of different transmission channels. Some studies underscore the pivotal roles played by channels such as the exchange rate and bank lending, highlighting their potency in transmitting monetary policy effects to real economic variables. Conversely, other investigations reveal the inherent complexities of monetary policy transmission, often exposing the weakness or insignificance of its impact on inflation and output, particularly in economies characterized by limited financial market development.

The collective insights from these empirical reviews paints a rich tapestry of challenges and opportunities in the area of monetary policy, reinforcing the need for continued exploration of this intricate landscape. This body of work acts as a vital backdrop for the research endeavour at hand – “An Empirical Analysis of the Monetary Policy Transmission Channels in Sierra Leone”. By acknowledging the multifaceted nature of monetary policy transmission and the distinctive attributes of Sierra Leone's economy, this study aims to bridge the existing research gap and contribute a tailored understanding of how monetary policy operates within this specific context. The goal is to inform more effective policy formulation and implementation strategies that are attuned to Sierra Leone's unique economic dynamics, thus enhancing the nation's monetary policy strategy.

Methodology

In this study, we employ the Vector Autoregressive (VAR) model, a widely adopted econometric model in related research. The VAR model offers the advantage of a non-structural approach to modeling the relationships among the variables under examination. This allows for the treatment of each variable as endogenous within the system, bypassing the need for structural modeling.

The Bank of Sierra Leone (BSL) utilizes a combination of traditional monetary targeting and a forward-looking monetary policy framework in its operations. The BSL manages the growth of monetary aggregates (money supply) to influence both the price level and economic growth. The forward-looking aspect involves the establishment of the Monetary Policy Rate (MPR) as a signaling mechanism, which also governs credit allocation to the private sector through the money market. It's essential to note that Sierra Leone's economy is heavily reliant on imports, and fluctuations in the exchange rate often result in a pass-through effect on prices.

The Model

The paper's primary focus centers on the interest rate, money supply, exchange rate, and credit channels. To do so, it employs a five-variable time series VAR model, representative of the monetary transmission channels discussed in the preceding section. These variables encompass Real GDP (RGDP), Consumer Price Index (CPI), Monetary Policy Rate (MPR), Exchange Rate (EXC), and Bank Credit to the Private Sector (CPS). All variables undergo a transformation into log differences, except for the MPR, which is expressed in first differences. The specifications for these variables are outlined as follows:

$$MPR_t = \alpha_{10} + \alpha_{11} MPR_{t-1} + \alpha_{12} MPR_{t-2} + \cdots \delta_p MPR_{t-p} + \mathcal{E}_{t1} \quad (1)$$

$$EXC_t = \alpha_{20} + \alpha_{21} EXC_{t-1} + \alpha_{22} EXC_{t-2} + \cdots \theta_p EXC_{t-p} + \mathcal{E}_{t2} \quad (2)$$

$$CPS_t = \alpha_{30} + \alpha_{31} CPS_{t-1} + \alpha_{32} CPS_{t-2} + \cdots \lambda_p CPS_{t-p} + \mathcal{E}_{t3} \quad (3)$$

$$RGDP_t = \alpha_{40} + \alpha_{41} RGDP_{t-1} + \alpha_{42} RGDP_{t-2} + \cdots \varphi_p RGDP_{t-p} + \mathcal{E}_{t4} \quad (4)$$

$$CPI_t = \alpha_{50} + \alpha_{51} CPI_{t-1} + \alpha_{52} CPI_{t-2} + \cdots \rho_p CPI_{t-p} + \mathcal{E}_{t5} \quad (5)$$

Combining them into a vector yields:

$$\begin{pmatrix} MPR_t \\ EXC_t \\ CPS_t \\ RGDP_t \\ CPI_t \end{pmatrix} = \begin{pmatrix} \alpha_{10} \\ \alpha_{20} \\ \alpha_{30} \\ \alpha_{40} \\ \alpha_{50_t} \end{pmatrix} + \begin{pmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51_t} & \alpha_{52} \end{pmatrix} \begin{pmatrix} MPR_{t-1} \\ EXC_{t-1} \\ CPS_{t-1} \\ RGDP_{t-1} \\ CPI_{t-1} \end{pmatrix} + \begin{pmatrix} \mathcal{E}_{t1} \\ \mathcal{E}_{t2} \\ \mathcal{E}_{t3} \\ \mathcal{E}_{t4} \\ \mathcal{E}_{t5} \end{pmatrix}$$

The above systems of equations are expressed in a VAR(1) model as follows:

$$Y_t = A_0 + A_1 Y_{t-p} + \mathcal{E}_t \quad (6)$$

Where: Y_t represents the variable vector as indicated above, A_0 is the constant vector, A_1 represents the matrix of the parameters, Y_{t-p} is the lag of the variable vector, and $\varepsilon_!$ being the error vector.

To enhance the utility of the VAR methodology, this paper conducts stationarity checks on the series through unit root tests, including the Dickey Fuller (ADF) and the Phillips Perron (PP) tests. Assessing the stationarity of a series is critical, as it can significantly influence its behavior and characteristics. Moreover, when the variables incorporated in a regression model lack stationarity, it becomes evident that the standard assumptions required for asymptotic analysis do not hold. Consequently, utilizing non-stationary data can lead to spurious regression results. Additionally, in the realm of time series data, a cointegration test is employed to examine the presence of a cointegrating relationship, utilizing the Johansen cointegration test.

Impulse Response Function (IRF)

Like many studies on monetary transmission, this paper employs an Impulse Response Function (IRF) to examine how monetary policy impulses are transmitted to the economy and assess their effects. The IRF effectively illustrates the dynamic behavior of the model, depicting the impact of a one standard deviation innovation on the orthogonalized innovation in the current and future values of each endogenous variable, both individually and in relation to one another.

In the autoregressive form of the model, we can identify each **innovation,** *vmt*, with a particular variable in **y***t* , say *ymt* . Consider then the effect of a one-time shock to the system, *dvmt*. As compared with the equilibrium, we will have, in the current period,

$$y_{mt} - \bar{y}_m = dv_{mt} = \delta_{mn}(0) dv_t \quad (7)$$

One period later, we will have:

$$y_{m,t+1} - \bar{y}_m = (\lambda)_{mm} dv_{mt} = \delta_{mm}(1)\, dv_t \quad (8)$$

Two periods later:

$$y_{m,t+2} - \bar{y}_m = (\lambda^2)_{mm} dv_{mt} = \delta_{mm}(2)\, dv_t \quad (9)$$

and so on. The function, $\delta_{mm(i)}$, for instance in equation (7), gives the impulse response characteristics of variable y_m to innovations in v_m. A useful way to characterize the system is to plot the impulse response functions. The preceding traces through the effect on variable *m* of a one-time innovation in v_m.

It is essential to remember that when estimating the impulse response, the ordering of variables holds significance. This importance arises because the impulse responses pertain to a unit shock affecting the errors of just one VAR equation, while keeping the error terms of all other equations in the VAR system constant. However, this assumption is not entirely realistic, as error terms are likely to exhibit some degree of correlation across equations. Assuming complete independence would result in a misrepresentation of the system dynamics. In practice, these errors tend to have a shared component that cannot be attributed to a single variable alone. To address this challenge, the standard approach is to compute orthogonalized impulse responses.

Following this, the study proceeds to conduct a Granger causality test to evaluate the causal relationships among the variables, with a particular focus on the causal relationships within the three channels of interest.

Results and Analysis

Unit Root Tests

The Dickey Fuller unit root test was employed to examine the presence of unit roots in the series. The test results revealed that all the variables exhibited unit roots at their initial levels, rendering them non-stationary. However, their non-stationarity was rectified after applying logarithmic differences, and in the case of MPR, after implementing the first differences. Consequently, all the variables utilized in the model are integrated of order one (I (1)). This determination was based on the statistical significance of all the variables at the 1% level, except for the LRDGP variable, which exhibited significance at the 5% level, as indicated in Table 1.

Table 1. Unit root test

Variable	At Levels; I(0)	At First Difference; I(1)	5% Critical Values	1% Critical values
DLRGDP	-2.214	-3.152**	-2.952	-3.634
DLCPI	-0.176	-6.507***	-3.532	-4.224
DMPR	-2.139	-4.102***	-2.851	-3.540
DLEXC	2.198	-4.132 ***	-2.952	-3.634
DLCPS	3.265	-6.373 ***	-2.952	-3.634

Note: ** 5% significance, ***1% significance.

Source: Author's computation using STATA 17.

Lag Length Selection

Lag length selection criteria are employed to inform the decision regarding the optimal lag, with reliance placed on both Akaike's Information Criteria (AIC) and Bayesian Information Criteria (BIC). The outcomes of the lag length selection criteria are presented in Table 2.

Table 2. Lag order selection criteria

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-448.766				8784.17*	23.27	23.3466*	23.4833*
1	-425.697	46.138	25	0.006	9818.27	23.3691	23.8282	24.6487
2	-409.39	32.613	25	0.141	16384.4	23.8149	24.6566	26.1609
3	-394	30.781	25	0.196	32045.7	24.3077	25.532	27.7201
4	-346.769	94.461*	25	0.00	14965.5	23.1676*	24.7746	27.6465

Sample: 2012q2 thru 2021q4;
Number of obs = 39;
* optimal lag;
Endogenous: dlrgdp dlcpi D.mpr dlexc dlcps;
Exogenous: _cons.

Source: Author's computation using STATA 17.

The results of lag length selection criteria, including the BIC, Final Prediction Error (FPE), and Hannan-Quinn (HQ), suggested lag 0, while the AIC and Likelihood Ratio (LR) leaned towards lag 4. Diagnostic tests conducted on the recommended lags indicated that neither the models at lag 0 nor at lag 4 were Best Linear Unbiased Estimators (BLUE). In response, the researcher utilized a combination of economic intuition, knowledge of the policy environment, and opted for lag 3. This choice was informed by the institutional arrangement, where the Monetary Policy Committee of the Bank of Sierra Leone convenes every three months to assess domestic economic and financial conditions, guiding their decisions on monetary policy stance. Consequently, lag 3 was selected, proving to be a more suitable lag length, as affirmed by diagnostic tests. Before estimating the VAR model, the Johansen cointegration test was conducted, revealing no cointegrating relationship, further justifying the need for a VAR model. The results of the VAR model are available in the appendix section.

Diagnostic Test on the Baseline Model

Several diagnostic tests were conducted on the VAR model, encompassing stability, normality, and autocorrelation tests, adhering to econometric norms to evaluate the model's robustness and facilitate inferences from the results. Overall, the test outcomes affirmed the robustness of the model. The stability test results are displayed in Figure 1.

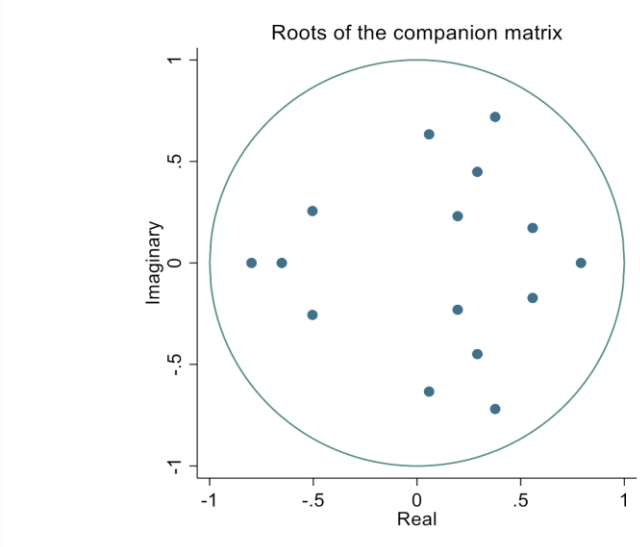

Fig.1. AR roots graph

Source: Author's computation using STATA 17.

The stability assessment presented above indicates that all eigenvalues fall within the unit circle, affirming the satisfaction of the stability condition in the VAR model. To evaluate the

model's normality, the Jarque-Bera test was employed. Despite data limitations, the test results suggest that the errors exhibit a degree of normal distribution. Detailed results of the normality test are provided in Appendix 2. Furthermore, an autocorrelation test was conducted, revealing that, at least at lags 1 and 2, there is no basis to reject the null hypothesis of no autocorrelation. In other words, the test indicates that the residuals do not display any signs of serial correlation as shown in Table 3.

Table 3. LM Autocorrelation test

Lag	chi2	df	Prob>chi2
1	38.1054	25	0.04518
2	30.8820	25	0.19296

H0: no autocorrelation at lag order.

Source: Author's computation using STATA 17.

Analysis of Impulse Response Functions (IRFs)

After confirming the model's robustness, Impulse Response Functions (IRFs) were generated to visually illustrate the dynamic impact or response of the endogenous variables within the model when subjected to an unanticipated structural shock, as viewed through the relevant channels under study.

The interest rate channel

The first crucial channel examined in this paper, the interest rate channel, is analyzed using the first difference of the MPR as the impulse variable, while the log differences of CPI, RGDP, and CPS serve as the response variables. The graphical representation illustrates that a one-standard deviation shock in the monetary policy rate (MPR) initially has no discernible impact on the Consumer Price Index (CPI) during the first and second quarters. However, CPI begins to rise in the third quarter, resulting in an approximate 0.4 percentage point increase in the CPI. This suggests that an increase in the central bank's policy rate yields an opposite effect on the aggregate price level, reflecting the unique policy environment within which the Bank of Sierra Leone operates. Furthermore, the graph indicates that a one-standard deviation shock in the MPR leads to a gradual decline in RGDP by about 0.25 percentage points, beginning in the second quarter and becoming statistically insignificant thereafter. This implies that the central bank's decision to raise the MPR tends to moderately affect domestic economic activities in the second quarter following the policy action but loses significance by the fourth quarter. Additionally, the impact of a one-standard deviation shock in the MPR is found to contract credit to the private sector (CPS) by at least 1 percentage point in the very short run, although this impact diminishes in significance starting from the second quarter onwards. Figure 2 presents the impulse response function (IRF) for the interest rate channel.

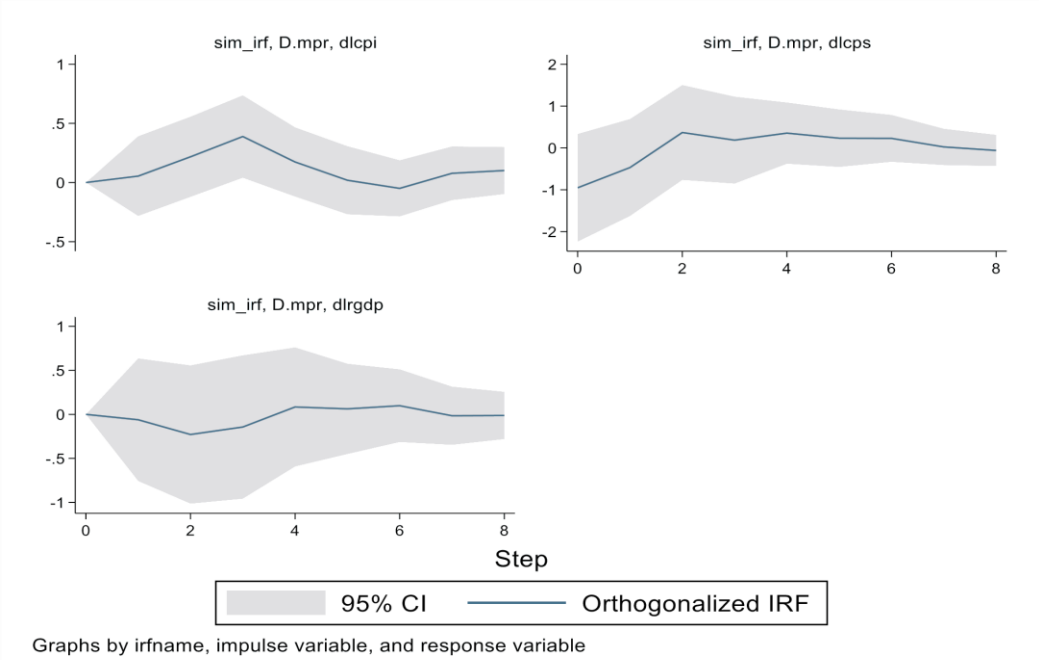

Fig. 2. IRF for the interest rate channel

Source: Author's computation using STATA 17.

The credit channel

The examination of the credit channel aims to determine whether recent financial sector reforms have effectively influenced credit conditions within the financial market. The IRF chart illustrates that a one standard deviation shock in CPS results in an approximately 0.38 percentage point increase in the MPR during the second quarter, but this impact diminishes in subsequent quarters. Similarly, a one standard deviation shock in CPS leads to a 0.4 percentage point increase in prices, which is observable only in the second quarter but quickly loses significance in the third quarter and beyond. Furthermore, a one standard deviation shock in credit to the private sector initially causes a 0.7 percentage point decline in RGDP during the first quarter, becoming insignificant in the second quarter, but impacting RGDP negatively again in the third quarter. This effect gradually diminishes starting in the fourth quarter and extending into the future. The IRF for the credit channel is presented in Figure 3 for reference.

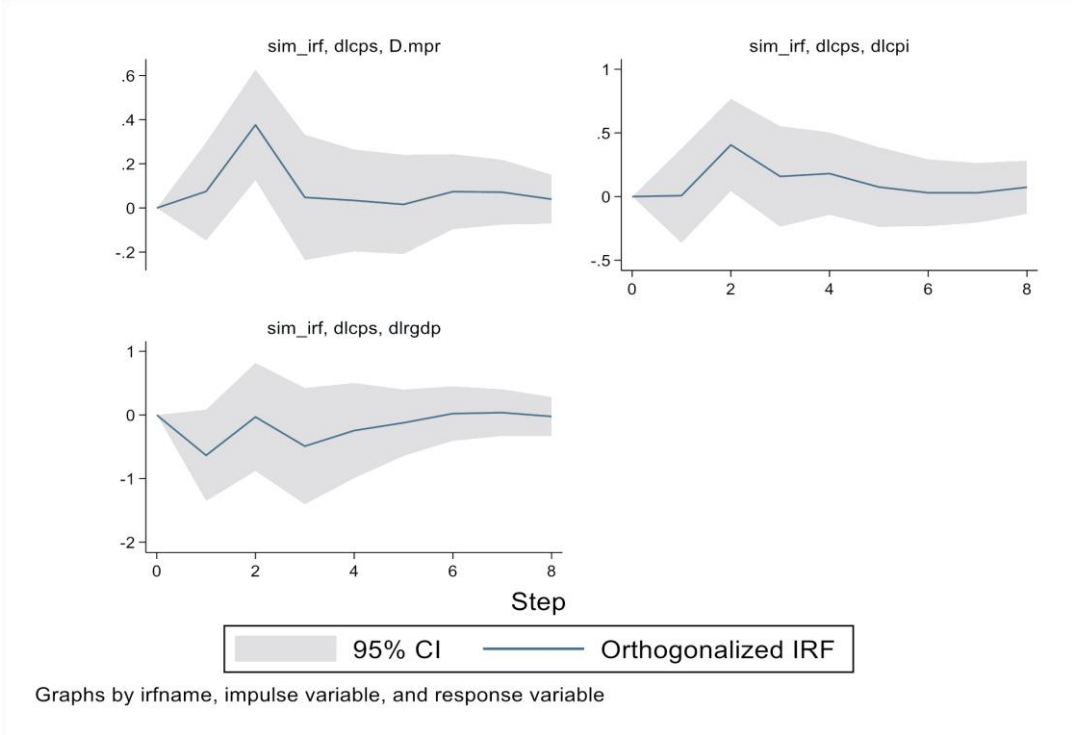

Fig. 3. IRF for the credit channel

Source: Author's computation using STATA 17.

The exchange rate channel

The evaluation of the exchange rate channel reveals that a one standard deviation shock in the exchange rate (EXC) triggers a 0.25 percentage point increase in prices, commencing in the first quarter and persisting until the third quarter. Subsequently, it stabilizes between the fourth and sixth quarters, before once again raising prices in the seventh quarter, ultimately fading by the eighth quarter. This finding aligns with the a-priori expectation, signifying that a depreciation of the domestic currency stemming from an expansionary monetary stance renders exports relatively affordable and imports more expensive. In an import-dependent economy like this one, greater amounts of domestic currency are required in exchange for foreign currency to meet the high costs of imports, resulting in a depreciation of the domestic currency and subsequent exchange rate-induced inflation. Concerning RGDP, the surge in imports reduces net exports, dampening aggregate output and leading to a contraction in RGDP, as illustrated in the IRF in Figure 4.

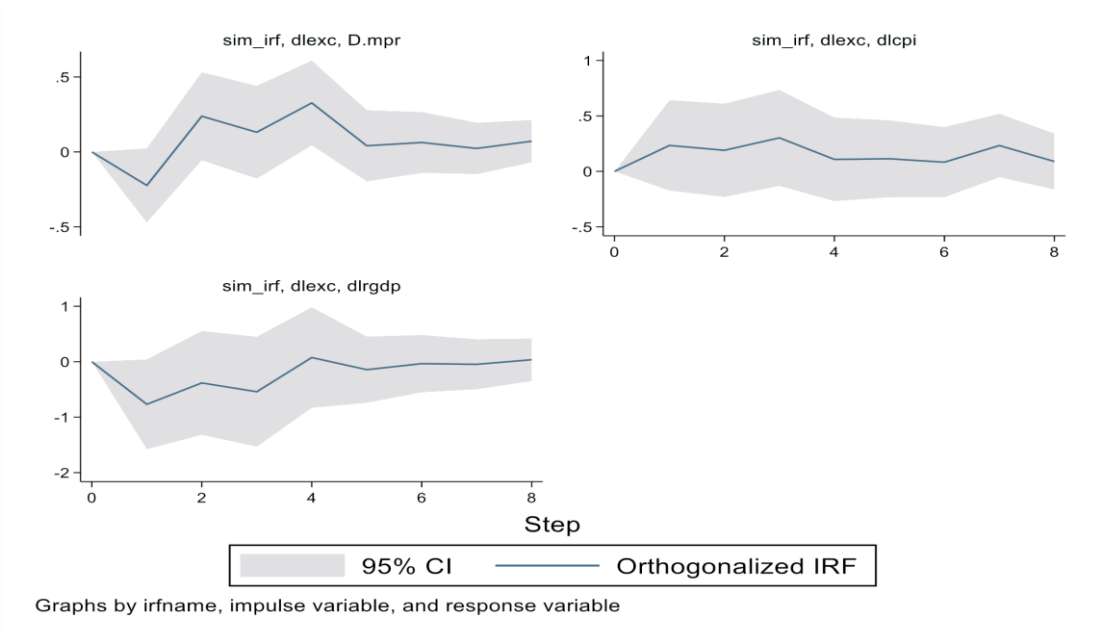

Fig. 4. IRF for the Exchange rate channel

Source: Author's computation using STATA 17.

Granger Causality Test

The Granger causality Wald test was conducted among the variables, specifically examining them through the lens of the three channels. In the context of the interest rate channel, it was observed that the first difference of MPR significantly enhances the predictive power of the log difference of CPI at the 5% significance level, indicating that MPR Granger causes CPI. However, the result indicates that the first difference of MPR does not Granger cause RGDP, implying that, at least in the short-run, monetary policy influences CPI through the interest rate channel. In the exchange rate channel, the outcome suggests that the log difference of EXC tends to increase the predictive power of the log difference of CPI at the 10% significance level, aligning with economic theory regarding exchange rate depreciation and its impact on inflation in a highly import-dependent economy. However, the log difference of EXC does not Granger cause RGDP. Concerning the credit channel, the result reveals that the log difference of CPS does not Granger cause either CPI or RGDP, corroborating the notion of the crowding out of private sector credit due to substantial government borrowing from the banking system. The detailed results of the Granger causality test are presented in Table 4.

Table 4. Granger causality wald test

Equation	Excluded	chi2	df	Prob > chi2
D_mpr	dlrgdp	3.9466	3	0.267
D_mpr	dlcpi	6.6312	3	0.085
D_mpr	dlexc	6.5929	3	0.086
D_mpr	dlcps	16.146	3	0.001
D_mpr	ALL	33.539	12	0.001
dlexc	dlrgdp	4.0216	3	0.259
dlexc	dlcpi	0.15334	3	0.985
dlexc	D.mpr	0.49652	3	0.92
dlexc	dlcps	2.1301	3	0.546

Table 4 (cont.)

dlexc	ALL	7.0099	12	0.857
dlcps	dlrgdp	1.7623	3	0.623
dlcps	dlcpi	1.8205	3	0.61
dlcps	D.mpr	0.35271	3	0.95
dlcps	dlexc	4.2386	3	0.237
dlcps	ALL	11.023	12	0.527
dlrgdp	dlcpi	3.2333	3	0.357
dlrgdp	D.mpr	0.22647	3	0.973
dlrgdp	dlexc	3.1556	3	0.368
dlrgdp	dlcps	6.2519	3	0.1
dlrgdp	ALL	10.756	12	0.55
dlcpi	dlrgdp	2.5945	3	0.458
dlcpi	D.mpr	9.2134	3	0.027
dlcpi	dlexc	6.4328	3	0.092
dlcpi	dlcps	5.338	3	0.149
dlcpi	ALL	24.641	12	0.017

Source: Author's computation using STATA 17.

Conclusion and Policy Implications

In addressing the research gap, this paper employed an empirical investigation into Sierra Leone's monetary policy transmission channels using the VAR model. Pre-estimation tests were conducted to ensure robust results, and variables were appropriately transformed to mitigate the risk of spurious regression. These steps not only contribute to the existing body of literature but also enhance the credibility of the findings.

The research aimed to evaluate the effectiveness of recent monetary policy and financial sector reforms in Sierra Leone and their impact on the monetary policy transmission channels. Specifically, it focused on the interest rate, exchange rate, and credit channels, which are particularly relevant in the Sierra Leonean context. By empirically assessing these channels, this study bridges the gap in understanding how the reforms have influenced monetary policy transmission in a developing economy like Sierra Leone.

The results of the study shed light on the dynamics of each transmission channel. In the interest rate channel, it was observed that changes in the monetary policy rate had a delayed and transitory impact on inflation and economic activity, emphasizing the need for policymakers to consider longer time horizons when assessing the effectiveness of interest rate adjustments.

The exchange rate channel analysis provided insights into the inflationary consequences of currency depreciation in an import-dependent economy, highlighting the importance of exchange rate stability in managing price levels.

Furthermore, the credit channel findings pointed to the challenges of private sector credit expansion in the presence of substantial government borrowing, suggesting a need for a balanced approach to government borrowing to ensure the availability of credit for the private sector.

In conclusion, this research contributes to a better understanding of the monetary policy transmission mechanism in Sierra Leone, especially in the context of recent reforms. It

underscores the gradual positive impact of these reforms while identifying areas that require further attention, such as strengthening the interest rate and exchange rate channels. As a policy recommendation, the Bank of Sierra Leone should continue its reform agenda, focusing on enhancing these channels to facilitate more effective monetary policy transmission, ultimately supporting the achievement of its policy objectives.

Disclaimer

The views expressed in this paper are those of the author and do not necessarily reflect those of the Bank of Sierra Leone, its Executive Board or its Management.

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Appendices

Appendix 1: VAR output

Vector autoregression

Sample: 2012q1 thru 2021q4		Number of obs	= 40
Log likelihood = -405.4423		AIC	= 24.27212
FPE = 30309.63		HQIC	= 25.49341
Det(Sigma_ml) = 438.2245		SBIC	= 27.64988

Equation	Parms	RMSE	R-sq	chi2	P>chi2
dlrgdp	16	3.11242	0.5046	40.73734	0.0004
dlcpi	16	1.64106	0.4729	35.87992	0.0018
D_mpr	16	.980127	0.5544	49.75866	0.0000
dlexc	16	2.97473	0.2955	16.77898	0.3322
dlcps	16	5.64823	0.2251	11.61636	0.7078

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
dlrgdp						
dlrgdp						
L1.	.6219632	.1507075	4.13	0.000	.3265819	.9173445
L2.	.1167464	.1756542	0.66	0.506	-.2275294	.4610222
L3.	-.1970157	.1575295	-1.25	0.211	-.5057678	.1117364
dlcpi						
L1.	.3605286	.2616595	1.38	0.168	-.1523145	.8733718
L2.	-.0451904	.2674683	-0.17	0.866	-.5694186	.4790379
L3.	.2514395	.260356	0.97	0.334	-.2588489	.761728
mpr						
LD.	-.1005539	.4440625	-0.23	0.821	-.9709003	.7697925
L2D.	-.1374498	.3981312	-0.35	0.730	-.9177726	.6428731
L3D.	-.0101072	.3719548	-0.03	0.978	-.7391252	.7189108
dlexc						
L1.	-.2905438	.1751582	-1.66	0.097	-.6338476	.05276
L2.	.0069285	.1906244	0.04	0.971	-.3666885	.3805454
L3.	.0077715	.1886333	0.04	0.967	-.3619429	.377486
dlcps						
L1.	-.1573034	.0892191	-1.76	0.078	-.3321695	.0175628
L2.	.1201741	.0846324	1.42	0.156	-.0457022	.2860505
L3.	-.1097186	.1012207	-1.08	0.278	-.3081075	.0886703
_cons	-.169124	1.150701	-0.15	0.883	-2.424457	2.086209
dlcpi						
dlrgdp						
L1.	.0691865	.0794626	0.87	0.384	-.0865573	.2249302
L2.	-.0432255	.092616	-0.47	0.641	-.2247496	.1382985
L3.	.0871031	.0830595	1.05	0.294	-.0756906	.2498968
dlcpi						
L1.	-.0363212	.1379635	-0.26	0.792	-.3067246	.2340822
L2.	.0640623	.1410263	0.45	0.650	-.2123441	.3404687
L3.	-.3155034	.1372762	-2.30	0.022	-.5845598	-.046447
mpr						
LD.	.0104592	.2341379	0.04	0.964	-.4484427	.469361
L2D.	.3748039	.20992	1.79	0.074	-.0366318	.7862396
L3D.	.384949	.1961182	1.96	0.050	.0005644	.7693335

Appendix 1 (cont.)

dlexc						
L1.	.1034069	.0923545	1.12	0.263	-.0776046	.2844185
L2.	.0448942	.1005093	0.45	0.655	-.1521003	.2418888
L3.	.1835019	.0994594	1.84	0.065	-.0114349	.3784388
dlcps						
L1.	.0017977	.047042	0.04	0.970	-.0904029	.0939982
L2.	.1025297	.0446235	2.30	0.022	.0150692	.1899902
L3.	.0122858	.05337	0.23	0.82180	-.0923174	.116889
_cons	2.402423	.6067226	3.96	0.000	1.213268	3.591577
D_mpr						
dlrgdp						
L1.	-.004466	.0474591	-0.09	0.925	-.0974841	.0885521
L2.	-.0793463	.055315	-1.43	0.151	-.1877616	.0290691
L3.	.0138224	.0496074	0.28	0.781	-.0834063	.111051
dlcpi						
L1.	.1763039	.0823988	2.14	0.032	.0148052	.3378025
L2.	-.0311463	.0842281	-0.37	0.712	-.1962302	.1339377
L3.	.0916975	.0819883	1.12	0.263	-.0689967	.2523917
mpr						
LD.	.3577417	.1398391	2.56	0.011	.0836622	.6318212
L2D.	.1373462	.1253749	1.10	0.273	-.1083841	.3830765
L3D.	-.2830476	.1171317	-2.42	0.016	-.5126216	-.0534736
dlexc						
L1.	-.1052813	.0551588	-1.91	0.056	-.2133906	.0028279
L2.	.133656	.0600293	2.23	0.026	.0160008	.2513112
L3.	-.0207934	.0594022	-0.35	0.726	-.1372197	.0956328
dlcps						
L1.	.0186034	.0280958	0.66	0.508	-.0364635	.0736702
L2.	.0940216	.0266514	3.53	0.000	.0417857	.1462575
L3.	-.0570395	.0318753	-1.79	0.074	-.1195139	.0054348
_cons	-.8387872	.3623656	-2.31	0.021	-1.549011	-.1285637
dlexc						
dlrgdp						
L1.	.1410177	.1440405	0.98	0.328	-.1412966	.4233319
L2.	-.2953254	.1678836	-1.76	0.079	-.6243711	.0337204
L3.	.0167873	.1505607	0.11	0.911	-.2783062	.3118809
dlcpi						
L1.	.0481568	.2500842	0.19	0.847	-.4419991	.5383128
L2.	.0650319	.2556361	0.25	0.799	-.4360056	.5660694
L3.	.0485267	.2488384	0.20	0.845	-.4391876	.5362411
mpr						
LD.	.1340173	.424418	0.32	0.752	-.6978267	.9658614
L2D.	.2144957	.3805187	0.56	0.573	-.5313073	.9602987
L3D.	-.0677733	.3555003	-0.19	0.849	-.7645411	.6289944
dlexc						
L1.	.3187031	.1674096	1.90	0.057	-.0094136	.6468199
L2.	-.1271479	.1821916	-0.70	0.485	-.4842369	.229941
L3.	.0491294	.1802885	0.27	0.785	-.3042296	.4024885

Appendix 1 (cont.)

dlcps						
L1.	.0846822	.0852722	0.99	0.321	-.0824483	.2518127
L2.	.08427	.0808884	1.04	0.298	-.0742683	.2428083
L3.	-.0159479	.0967429	-0.16	0.869	-.2055604	.1736646
_cons	1.087036	1.099796	0.99	0.323	-1.068525	3.242598
dlcps						
dlrgdp						
L1.	.3368169	.2734949	1.23	0.218	-.1992232	.872857
L2.	-.3233243	.3187665	-1.01	0.310	-.9480953	.3014466
L3.	.0220649	.285875	0.08	0.938	-.5382398	.5823695
dlcpi						
L1.	.1009686	.4748438	0.21	0.832	-.8297081	1.031645
L2.	.576787	.4853853	1.19	0.235	-.3745508	1.528125
L3.	.263149	.4724784	0.56	0.578	-.6628916	1.18919
mpr						
LD.	-.3854763	.8058577	-0.48	0.632	-1.964928	1.193976
L2D.	.2955849	.7225045	0.41	0.682	-1.120498	1.711668
L3D.	.0844961	.6750011	0.13	0.900	-1.238482	1.407474
dlexc						
L1.	-.3256762	.3178665	-1.02	0.306	-.9486832	.2973307
L2.	.7012811	.3459336	2.03	0.043	.0232637	1.379299
L3.	-.3139172	.3423203	-0.92	0.359	-.9848525	.3570182
dlcps						
L1.	.0276638	.1619094	0.17	0.864	-.2896728	.3450004
L2.	.0190708	.1535857	0.12	0.901	-.2819516	.3200932
L3.	-.171592	.1836891	-0.93	0.350	-.5316161	.1884321
_cons	.7291018	2.088223	0.35	0.727	-3.363739	4.821943

Source: Author's computation using STATA 17.

Appendix 2: Eigenvalue stability condition

Eigenvalue			Modulus
.3768574	+	.7194186*i*	.812148
.3768574	-	.7194186*i*	.812148
-.7982029			.798203
.7907831			.790783
-.6525565			.652556
.05808786	+	.6336286*i*	.636286
.05808786	-	.6336286*i*	.636286
.5574994	+	.1724615*i*	.583565
.5574994	-	.1724615*i*	.583565
-.5044286	+	.2559702*i*	.565658
-.5044286	-	.2559702*i*	.565658
.2908333	+	.4488593*i*	.534845
.2908333	-	.4488593*i*	.534845
.1960142	+	.2304725*i*	.302554
.1960142	-	.2304725*i*	.302554

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.

Source: Author's computation using STATA 17.

Appendix 3: Normality test result

Equation	chi2	df	Prob > chi2
dlrgdp	89.708	2	0.00000
dlcpi	0.745	2	0.68909
D_mpr	43.691	2	0.00000
dlexc	41.749	2	0.00000
dlcps	8.724	2	0.01275
ALL	184.617	10	0.00000

Source: Author's computation using STATA 17.