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Monetary policy, credit growth, and economic activity in Rwanda

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Abstract

The successful conduct of monetary policy requires a thorough assessment of how changes in policy actions are propagated to the real economy. We employ the Vector Autoregression (VAR) type of models to examine the effect of monetary policy on goal variables, namely, credit, output, and inflation in Rwanda. The empirical findings from standard VAR models show that the effect of the interbank rate on goal variables is consistent with theoretical propositions and empirical applications. A positive shock to the interbank rate causes inflation to fall by about five percentage points over eight quarters, and credit to fall by about four percentage points in the first four quarters. Consequently, economic growth falls by about one percentage point. The Vector Error Correction (VEC) model shows that the previous quarter's deviation from long-run equilibrium is corrected for in the current quarter at an adjustment speed of 0.1%. These findings remain robust when we apply a Structural Vector Autogressive (SVAR) model, and these models capture the essential macroeconomic relations between a monetary policy indicator and goal variables, following the recent improvement in financial markets.

KeyWords: Interest rate pass-through, Monetary Policy, VAR Model, Impulse response.

JEL Classification Numbers: C32, E51, E52, E58, E60.

1. Introduction

The main mandate of monetary policy is to ensure price stability and the soundness of the financial system, and its ability to influence credit and the real economy remains the central concern for both monetary policymakers and academics (Bernanke et al., 1988). The conventional wisdom in monetary economics considers credit as a very important engine of a transmission channel of monetary policy in modern economies from small-scale credit to big credit that allows a firm to invest (Bernanke et al., 1988). However, credit may have an inflationary impact on the economy, which might hamper the attainment of the Central Banks' main objective of price stability (Saiki and Frost, 2014).

The voluminous literature on the relationship between monetary policy and credit (Berkelmans, 2005; Bernanke et al., 1988) highlights theoretical assumptions and empirical findings such as those of Aiyar et al. (2016), Bowman et al. (2015), Giannone et al. (2012) , Kuttner (2018) that expansionary monetary policy leads to an increase in credit supply or a monetary policy tightening lowers credit.

The bulk of the literature and the mass of empirical findings have focused on the traditional interest rate channel of the monetary policy, and the majority of these studies cover the most advanced economies with well-functioning financial systems (Mishra et al., 2010). Even though the empirical studies established that changes in monetary policy decisions are eventually followed by changes in the real economy, they are largely silent about what happens in between, and thus the studies on the effects of monetary policy have treated the monetary policy transmission mechanism itself as a "black box."

For developing economies, the channels of monetary policy are impeded by financial underdevelopment and weak institutions (Beck and Levine, 2002). This is in line with views indicating that the interbank markets are still underdeveloped, and, even though some central banks use policy rates, changes to these policy rates have only limited effect on other interest rates and on the economy more generally (Fischer, 2015). These findings emphasize the role of financial development in shaping the impact of monetary policy on the economy, supporting the source of finance as a crucial input to capital accumulation, economic growth and price stabilization (Beck et al., 2009).

The empirical fronts, particularly in the specific case of Rwanda, like studies of Kigabo and Kamanzi (2018), have provided optimistic evidence about the performance of the monetary policy transmission mechanism, but the interest rate pass-through generally is not very active in Rwanda, and the lending rate remains very weak, which limits the impact of monetary policy actions on the cost of bank loans. Generally, the empirical findings for the case of Rwanda, as given by Irankunda (2014) and Dempere (2022), show that the changes in the interest rate do not significantly affect the banks' lending behavior. These findings are consistent with those for other developing economies which cite the underdevelopment of the financial sector and the presence of weak institutions as the key impediments to the efficient monetary policy transmission mechanism (Beck et al., 2009).

The limited number of studies that have investigated Rwanda's monetary policy transmission mechanism typically found evidence of a relatively weak transmission process, and the extended analysis of monetary policy, credit growth, and economic activity has not been subjected to profound analysis, and very few studies rely upon the classic VAR models with mixed findings. Furthermore, since the shift of the National Bank of Rwanda to the Price Based Monetary Policy framework, there is a greater need for critical analysis to uncover clarity on the potential effects of policy decisions on the real economy, including specific information on magnitudes, time lags, and the relevant monetary policy transmission channel.

Unlike several other studies in this area, this study seeks to conduct a deeper analysis of the effect of monetary policy on target variables, notably credit, output, and inflation in Rwanda. A prime result of our paper is that the transmission of a positive interest rate shock to credit conditions and to the real economy depends on financial sector development.

The paper adds to the body of empirical works by providing a critical review of the existing stock of knowledge by identifying the important gaps and providing explicit analysis that might be useful for the National Bank of Rwanda to contribute to the current policy in central banking. First, it adds to the scarce literature that examines the effect of monetary policy on credit, output, and inflation in Rwanda.

Secondly, we believe that monetary policy cannot be a static and stable function in time. This implies that the conduct of monetary policy cannot be the repetition of strategies deemed useful in the past. The present investigation becomes essential to accommodate for the effect of structural changes, such as technological, institutional, or policy-related changes, specifically following the recent move from quantity-based to price-based monetary policy.

Lastly, from an econometric perspective, the standard VAR applied by Kigabo (2018) in the specific case of Rwanda is not exhaustive; even though the VAR model has good properties when applied to covariance-stationary time series, most of the economic variables exhibit unit roots and such non-stationary variables may create the so-called problem of spurious relationships. To avoid this problem, the VEC model is used to specify both short-run and long-run relationships among variables of interest. We also check whether the pre-observed relationships are imprecise in the so-called ''price puzzle" that is commonly observed in the current body of literature that is not previously investigated, especially in the case of Rwanda. As a robustness check, we depart from the previously specified models, given that they arbitrarily select lags but do not tolerate contemporaneous relationships among variables, which is particularly important when the frequency of the data is relatively long (i.e., quarterly). Furthermore, the deficiency in the standard VAR is that its error terms will, in general, be correlated, and the model does not also allow for one to impose several highly specific restrictions on the coefficient and residual covariance matrices. Thus, we apply the SVAR approach, which derives identifying restrictions for the structural shocks and imposes them on the reduced form of the model. To the best of our knowledge, there is no existing work assessing monetary policy, credit growth, and economic activity using those two improved techniques in Rwanda.

The rest of the paper is organized as follows: Section 2 describes the literature review; Section 3 describes the institutional and macroeconomic context; Section 4 summarizes the methodology and data; Section 5 discusses the empirical analysis, while Section 6 concludes.

2. Literature review

The central objective of monetary policy is to ensure price stability and the soundness of the financial system, and its ability to influence credit and the real economy remains the central concern of both monetary policymakers and academics (Bernanke et al., 1988). Every Central Bank around the world selects the monetary policy framework allowing it to anchor inflation expectations. So far, three main monetary policy frameworks are used by the central banks, namely, monetary targeting, inflation targeting, and exchange rate targeting (Mishkin, 1998).

The channels through which the monetary policy can influence output and, ultimately, prices are the interest rate channel, the exchange rate channel, the asset prices channel, and the bank-lending channel (Mishkin, 1995). The majority of the literature and the mass of empirical findings have focused on the traditional interest rate channel of the monetary policy, and a big number of these studies analyzed the interest rate pass-through in the most advanced economies with well-functioning financial systems (Mishra et al., 2010).

The bank-lending channel, which is the topic of interest in this paper, is a better way to understand the link between monetary policy, credit growth, economic activity, and eventually inflation. The bank-lending channel gives a wider view of the role of credit in economics, namely the credit channel of monetary policy. According to theory, the credit view of monetary policy works through the balance sheet channel and the bank-lending channel. The balance sheet channel mainly focuses on how monetary policy affects the value of assets of borrowers and, finally, their net worth by ultimately affecting their eligibility to obtain new loans given the changes in their collateral. The bank-lending channel concerns the impact of monetary policy on the supply of loans provided by banks (Bedikanli, 2020).

Some macroeconomists use the IS/LM model to organize their thinking about how various events affect aggregate demand. However, this model is too simple. An example is the IS/LM model's asymmetric treatment of money and credit. This approach makes bank liabilities essential to the monetary transmission mechanism while ignoring the role of bank assets despite much theoretical literature which shows the importance of intermediaries in the provision of credit. According to this theory, if financial intermediation is reduced, either by regulating credit granted to different economic sectors or by increasing or decreasing the interest rate, aggregate supply and demand may be affected (Bernanke and Blinder, 1988; Angeloni et al., 2009). This view states that some borrowers whose non-bank finances are not substituted for bank loans, meaning that those borrowers heavily rely on financing from the banking sector, will be affected by the monetary policy implemented by the central bank. For example, a tight monetary policy contracts the size of the banking sector and decreases the overall supply of loans to these dependent borrowers. Consequently, investment and aggregate demand reduce by more than they could have reduced under the conventional money channel (Kashyap et al., 1992; Bernanke et al., 1988).

Empirically, numerous authors worked on the nexus between monetary policy, credit market, and economic activities around the world using different methodologies in different periods. Generally, the studies on developed countries focused on the non-linearity between credit markets and economic activities, estimating the models with the Threshold Auto-Regression (TVAR), while a few of them used VAR (Holtemöller, 2002; Angeloni et al., 2009; Avdjiev and Zeng, 2014). However, most of the studies in emerging and developing countries focused on linear models (i.e., VAR, SVAR, or VEC models) to test the link between monetary policy, credit, and economic activity. The variables of interest in different papers are largely the ones that well signal the stance of monetary policy, either the policy rate, short-term interest rates, or monetary aggregates; the proxies of credit market developments and economic activity, mainly credit to the private sector and real GDP respectively; and, inflation.

For instance, a study done in the US by Avdjiev and Zeng (2014) examined the nonlinear nature of the interactions among credit market conditions, monetary policy, and economic activity using the Threshold Vector Auto-regression (TVAR). The selected variables were real GDP growth, inflation, the federal funds rate, real credit growth, and the spread between Baa-rated corporate bonds and 10-year Treasury bonds. Their findings showed that the interactions among credit market conditions, monetary policy, and economic activity change significantly as the economy moves from one stage of the business cycle to another. The shocks to output growth and credit growth have the biggest impact when economic growth is in a recession. However, real output growth is most sensitive to credit shocks when the economy is booming. Li and St-Amant (2010), conducted the same study and used the same method on Canadian data, namely Canadian real output growth, inflation, the real overnight rate, and a financial stress index. In addition to the above findings, these authors found that monetary policy contraction appears to have more powerful effects, in general, than monetary policy easing. Moreover, the effects of tight monetary policy are particularly large in regimes of high financial stress. Other papers on developed economies that used TVAR include Calza and Sousa (2005), Atanasova (2003), and Balke (2000), among others.

The studies on monetary policy and credit in Australia and ASEAN-5 economies (Indonesia, Malaysia, Philippines, Singapore, and Thailand) were done by Berkelmans (2005) and Tnga et al. (2015), respectively, and used SVAR models. Berkelmans (2005) used real Australian GDP, quarterly inflation, real credit (nominal credit deflated by the CPI), the cash rate, and the real trade-weighted exchange rate index for the 1983Q4-2003Q4 period. In addition to these domestic variables, he added foreign variables such as commodity prices in US dollars deflated by the US CPI and real US GDP to capture the openness of Australia's economy. His findings showed that shocks to the exchange rate, interest rate, and past shocks to credit are found to be significant for credit growth in the short run, whereas shocks to inflation, output, and commodity prices play a greater role in the long- run. The response of credit to changes in monetary policy is relatively slow, similar to that of inflation and slower than that of output.

Tnga et al. (2015) introduced the financial stress variable in the domestic variables, excluding the real trade-weighted exchange rate index, to show the impact of monetary policy. Their results suggested that an increase in financial stress leads to tighter credit conditions and lower economic activity in all five countries. The estimated impact on the real economy showed an initial rapid decline followed by a gradual dissipation. In Malaysia, the Philippines, and Thailand, the central banks tend to decrease policy interest rates when financial stress increases, though there is substantial cross-country variation in the magnitude and time dynamics. The accommodative monetary policy is found to have a little significant effect in reducing financial stress but is still important in stimulating economic activity through other channels.

A study done by Dempere (2022) on Sub-Saharan Africa (SSA) using the dynamic system-generalized method of moments (GMM) and the one carried out by Allybokus et al. (2010) in Mauritius using a vector autoregressive (VAR) model revealed the presence of the lending channel in the studied SSA countries. Employing quarterly data on Gross Domestic Product (GDP), price level, money supply, and credit to the private sector from 1985Q1 to 2006Q4, a study for Mauritius revealed the effectiveness and relevance of a credit channel and monetary policy in the short-run. Changes in the monetary policy variable (M2) affected the credit variable (CPS) in the short run. GDP rose temporarily, while the increase in monetary variables increased prices. However, a study done by Mugume (2011), which used SVAR for Uganda data, showed a weak bank-lending channel. The weakness in the bank-lending channel in Uganda resulted from the credit market frictions, which made the deposits at the central bank, government bonds, and foreign securities much closer substitutes among themselves than these alternative assets are with private sector credit. Furthermore, a high amount of remittances and trade credit constituted the non-negligible alternative sources of finance for many Ugandan economic agents.

Concerning the studies on Rwanda, numerous papers on monetary policy transmission mechanisms worked on the interest rate channel (Kamanzi and Kimenyi, 2020; Kigabo and Kamanzi, 2018; Rutayisire, 2020; Bernanke et al., 1988; Balke, 2000; Mwenese et al., 2016). Their findings revealed a weak interest rate channel. A study done by Hitayezu and Nyalihama (2019) showed a weak exchange rate channel with some noticeable improvement arising from the introduction of a more flexible exchange rate regime. To the best of our knowledge, only the Kamanzi et al. (2019) study covered the bank-lending channel in Rwanda, limiting its analysis to the impact of monetary policy on the supply of loans. Their results revealed the presence of a lending channel in Rwanda, though still very weak. Regarding the effect of bank characteristics, big banks respond less to monetary policy change, while well-capitalized banks and more liquid banks react more to monetary policy changes compared with lower capitalized banks and less liquid banks.

In addition to the analysis of how monetary policy affects the supply of loans as covered in Kamanzi et al. (2019), this paper goes beyond to examine the nexus between monetary policy, GDP, and inflation in Rwanda.

3. Institutional and macroeconomic context

A steady macroeconomic environment is good for business and can reduce banks' risk aversion and the price mark-up. The macroeconomic environment in Rwanda has been healthy, stable, and sound over the past fifteen years, with high real economic growth of 7.1 percent on average, stable inflation of 5.6 percent, and a stable exchange rate as the country runs a relatively flexible exchange rate regime (depreciation of 3.8 percent against the US dollar for the last fifteen years).

3.1. Monetary policy frameworks in Rwanda

NBR is an independent central bank with the following missions: ensuring and maintaining price stability, enhancing and maintaining a stable and competitive financial system without any exclusion, and supporting the government's general economic policies without prejudicing its other missions (BNR law 48/2017, article 6).

From 1995 to 2018, the National bank of Rwanda conducted its monetary policy under the monetary targeting framework, with the broad monetary aggregate as the intermediate target and reserve money as the operating target. While the macroeconomic and price stability achieved under the monetary targeting regime was estimable, the continuing economic transformation in both financial and real sectors posed new challenges that weakened the relationship between inflation and broad monetary aggregates.

In addition, the NBR observed a tendency among economic agents to gradually focus on interest rates in their saving and consumption decisions as a result of the developments in the domestic financial system, such as the avenue of modern payment systems and new financial products. These trends were revealed by the surge in term deposits and investments as well as in government securities by retail businesses and institutional investors. Under those conditions, a more forward-looking monetary policy that applies the interest rate as an operating target to direct market expectations became the most relevant framework.

The price-based monetary policy presents several benefits over the quantity-based monetary policy. First, a price-based monetary policy has the benefit that a stable link between money and inflation is not necessary for the success of the monetary policy. Second, prices of money (interest rate) and goods and services (as measured by inflation) can be easily observed by the general public and market players, which enables more effective communication, greater transparency, and increased accountability of NBR. In view of this, the National Bank of Rwanda shifted from the quantity-based monetary policy framework to a price-based approach in January 2019.

During the period of analysis, the interbank market remained stable with an upward trend in the amount exchanged. Therefore, the interbank market plays a critical role in the domestic financial system by providing a liquidity price-discovery mechanism in the money market and being a channel of monetary policy transmission.

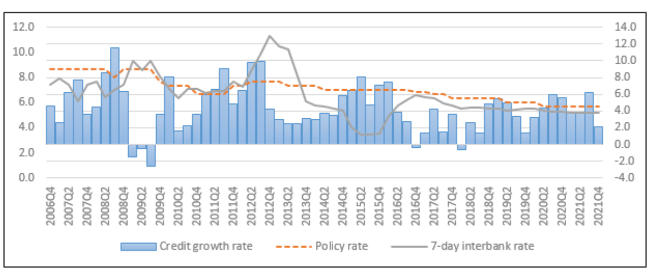

Figure 1: Monetary conditions and bank credit

Figure 1 shows that monetary conditions represented by the interbank rate affect the credit growth rate, with the two variables inversely related: hikes in the interbank rate correspond to low credit growth and vice-versa. The introduction of FMOC in 2016 has improved the interbank market and also contributed to the stabilization of the growth of credit to the private sector of 3.4% on an average quarterly basis.

Figure 2 illustrates the development of credit, real GDP growth, and inflation. It reveals that credit growth has a positive effect on real GDP growth despite the shocks of the covid-19 period. Real GDP growth has the same pattern over the sample period. However, the effect of credit growth on inflation depends on the sensitivity of the latter to supply shocks.

Figure 3 reveals that monetary policy actions represented here by the interbank rate have limited

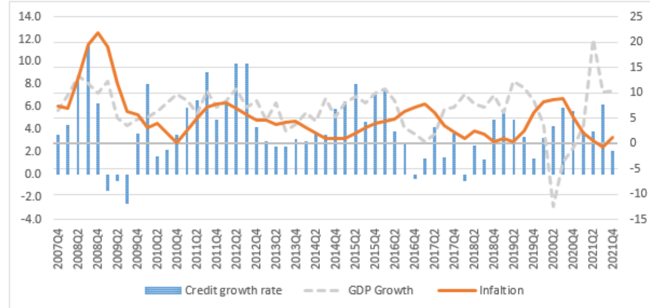

Figure 2: Credit growth, Real GDP growth, and inflation rate

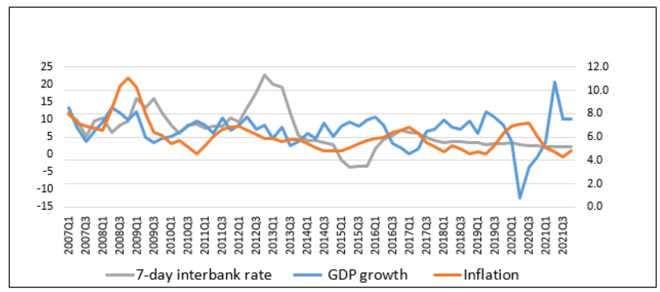

Figure 3: Monetary conditions, real GDP growth, and inflation

influence on real GDP growth; however, inflation and real GDP growth have a direct relationship, although this relationship has been hampered by the Covid-19 effects since 2020.

3.2. *Financial sector development in Rwanda*

The financial sector continued to grow throughout the period under study; by 2021, total assets of the financial sector expanded by 19.0 percent, to FRW 7,531 billion in December 2021, higher than the 14.3 percent average growth registered over the five years prior to the pandemic. In 2021, financial sector assets stood at 68.8 percent of GDP (Dempere, 2022).

The banking sector remains the largest component of the financial sector, accounting for about 67.2 percent of total financial sector assets. Because of its size and interconnectedness with the other subsectors, the health of the banking sector underpins the overall soundness of the financial sector (Dempere, 2022) .

The sector is comprised of 16 banks (of which eleven is commercial banks, three microfinance banks, one development bank, and one cooperative bank). A large number of competitors and a range of products and services in the banking sector has tremendously improved over the past fifteen years as a result of the strong economic growth of the country, good and improving conditions for doing business, and an appropriate regulatory environment. The benefit of this competition is expanded outreach through bringing people that were previously excluded into the banking market, enhancement such as accounts with no fee, and product innovation such as the introduction of credit and debit cards. The entry of foreign-owned banking institutions has expanded the new business model, strategy, and capability to the market (Dempere, 2022).

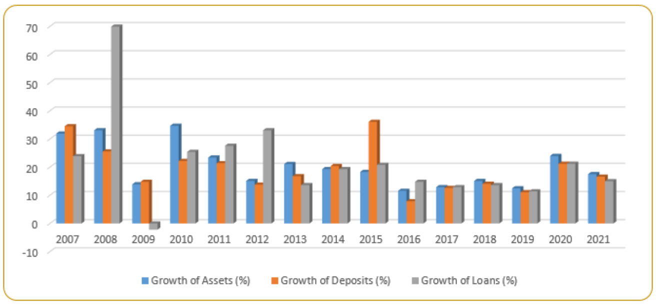

Figure 4: Development in Banking Sector indicators (%)

4. Methodology and data

4.1. Benchmark Models

In line with Sims (1980), most of the empirical studies in monetary economics are based on VAR methods (Brüggemann and Lütkepohl, 2000). The VAR models often succeed in capturing the dynamic relationships among macroeconomic variables since they can be applied to simulate the dynamic response over a horizon of any indicator to either an own disturbance or a disturbance to any other indicator in the framework (Bernanke et al., 1988). The coefficients of a VAR model are estimated by OLS, and the regressors are the lagged values of all the indicators included in the system. In a general representation, a VAR model of the following order:

$$y_t = A_1 + y_{t-1} + ...A_k y_{t-k} + \varepsilon_t \tag{1}$$

$$\pounds(\varepsilon_t \varepsilon_t^{'}) = \sum \tag{2}$$

Where y_t is a vector of the dimension of the exogenous variables k that include the stationary variables, $A_1, ..., A_k$ are the coefficients' matrices to be estimated, ε is a vector of error terms, and $\sum$ is the covariance matrix of the errors that may be contemporaneously correlated but are uncorrelated with their own lagged indicators and uncorrelated with the exogenous indicators and the lagged stationary variables.

In this VAR modeling procedure, we make two basic model-selection choices. First, we choose which variables to include in the VAR, typically motivated by the research question and guided by theory. Second, we choose the lag length, once the lag length has been determined, we proceed to Estimation, and the parameters of the VAR are estimated, and we can perform post-estimation procedures to assess the model fit. Hence, the VAR to estimate is:

$$\begin{bmatrix} Inf_t \\ Gdpg_t \\ Credit_t \\ Intgerb_t \end{bmatrix} = \alpha_0 + A_1 \begin{bmatrix} Inf_{t-1} \\ Gdpg_{t-1} \\ Credit_{t-1} \\ Intgerb_{t-1} \end{bmatrix} + ... + A_k \begin{bmatrix} Inf_{t-k} \\ Gdpg_{t-k} \\ Credit_{t-k} \\ Intgerb_{t-k} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix}$$

We depart from the previously specified model to implement the VEC model (VECM). Since most economic time series appear to be first difference stationary with their levels exhibiting unit root, the conventional regression estimators, including VARs, have good properties when applied to covariance-stationary time series but encounter difficulties when applied to processes. These difficulties were illustrated by Granger and Newbold (1974) when they introduced the concept of spurious regressions. The VECM is specified as follows:

$$\triangle y_t = \varnothing + \pi y_{t-1} + \sum_{i=1}^{\rho-1} \psi_i \triangle y_{t-i} + \varepsilon_t \tag{3}$$

Where $\sum_{j=1}^{j=\rho} A_j - I_k$and $\psi_i = \sum_{j=i+1}^{j=\rho} A_j$

If all variables y_t are $I(1)$ the matrix π has a rank $0 \leq r < k$ where r is the number of linearly independent cointegrating vectors. If the identified variables are cointegrated ($r \ > 0$), the VAR in the first differences is misspecified as it excludes the error correction term. If the rank of$\pi = 0$, there is no cointegration among the non-stationary variables, and a VAR in their first differences is consistent.
If the rank of $\pi =$ k all of the variables in y_t are $I(0)$ and a VAR in their levels is consistent. If the rank of π is $r \ > 0$, it may be expressed as $\pi = \alpha B^{'}$ were α and B are $(r \times K)$ matrices of rank r. We must place restrictions on these matrices' elements to identify the system. We will also present suitable models for dynamic forecasts.

4.2. Alternative Model

Although VAR has been the standard tool for empirical macroeconomic analysis, it cannot address some fundamental research questions that might be unsatisfactory for two reasons. First, it allows for arbitrary lags but does not allow for contemporaneous relationships among its variables. The economic theory often links variables contemporaneously, and if we apply VAR to test those theories, it must be modified to allow for contemporaneous relationships among the model variables. A VAR that does allow for contemporaneous relationships among its variables, known as the SVAR model, may be written as:

$$Ay_t = C_t y_{t-1} + ... + C_k y_{t-k} + \varepsilon_t \quad (4)$$

And we introduce new notation (the C_i) because when $A \neq I$ the C_i will generally differ from the A_i in the reduced-form VAR. The A matrix describes the contemporaneous relationships among the variables in the VAR system.

The second deficiency of the reduced VAR is that its error terms, in general, are correlated. We want to decompose these error terms into mutually orthogonal shocks to be able to better examine the effect of a particular shock in one equation, holding all other shocks constant. This helps to keep other shocks constant when conducting impulse response analysis. Nevertheless, if the error terms are correlated, then a shock to one equation is linked with shocks to other equations; the assumed experiment of holding all other shocks fixed could not be performed. The solution is to denote the errors as a linear combination of "structural" shocks:

$$\varepsilon_t = Bu_t \quad (5)$$

Without loss of generality, we can impose $£(u_t u_t^{'}) = I$, so our duty, then, is to estimate the parameters of a VAR model that has been extended to include correlation among the endogenous variables and exclude correlation among the error terms. Combine (4) and (5) to obtain the structural VAR model,

$$Ay_t = C_t y_{t-1} + ... + C_k y_{t-1} + Bu_t \quad (6)$$

So the goal is to estimate A, B and C_i Unfortunately, there is little more we can demonstrate at this stage because, at this level of generality, the model's parameters are not identified. The main method of identification is to set $A = I$ and require B to be a lower-triangular matrix, putting zeros on all entries above the diagonal. This identification scheme places n^2 restrictions on B and places restrictions on B the order condition is satisfied. The mapping resulting from structure to reduced form is:

$$BB^{'} = \sum$$

Along with the requirement that B it be lower triangular, there is a unique lower-triangular matrix B that satisfies (7); hence, we uniquely recover the structure from the reduced form.

For the restrictions on the contemporaneous matrix of structural parameters, we follow the original paper by Sims (1980), whereby Cholesky decomposition is applied to the contemporaneous parameter matrix. Equation (8) summarizes the non-recursive identification approach based on equation (7), the ordering of the newly obtained triangular matrix is written as follows:

$$\begin{bmatrix} u_{Inf} \\ u_{Gdpg} \\ u_{Credit} \\ u_{inter} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{Inf} \\ \varepsilon_{Gdpg} \\ \varepsilon_{Credit} \\ \varepsilon_{inter} \end{bmatrix}$$

Where $U_{inf}, U_{Gdp}, U_{Credit}$ and U_{interb} are the structural disturbances inflation shocks, output shocks, credit shocks, and monetary policy shocks, respectively. $\varepsilon_{inf}, \varepsilon_{Gdp}, \varepsilon_{Credit}$ and ε_{Interb} are reduced-form residuals that describe the unanticipated movements of each regressor, respectively. This identification structure is often called "Cholesky" identification because the matrix B can be recovered by taking a Cholesky decomposition $\sum$. This method can be thought of as imposing a causal variable ordering in the VAR model: the shocks to one equation contemporaneously affect variables below that equation but only affect variables above that equation with a lag. We follow the VAR identification exercise that is similar to many studies used in the context of VARs in advanced economies, including Christiano et al. (1996).

As with the benchmark model (i.e., the VAR model), the selection of the lag order for the SVAR model is based on the AIC and SC information criteria, with a maximum of two lags considered.

4.3. Data and sample selection

We estimate the preceding VARs family using quarterly Rwandan data that runs from 2006Q1 to 2021Q3. In our benchmark model, we consider four variables: a variable to represent the monetary policy stance, the output and inflation measure, and a credit variable. All these variables are sourced from the National Bank of Rwanda.

The ordering inflation, output, credit, and interest rate, means that output and price level react to innovation in credit with a lag, or, alternatively, credit growth responds contemporaneously to innovations in output and prices. This assumption is reasonable for slow-moving macroeconomic variables such as output and prices. The interest rate is ordered after credit, consistent with the practice that the policy rate or other interest rates (e.g., T-bills rate against which policy rates may be benchmarked) are increasingly being used by the National Bank of Rwanda as an additional instrument to signal changes in the monetary policy stance.

5. Empirical findings and interpretations

5.1. Preliminary tests

Before deeper analysis, let us first visualize the features of the data. We observe that the variables exhibit unit roots. However, the series are probably not white noise.

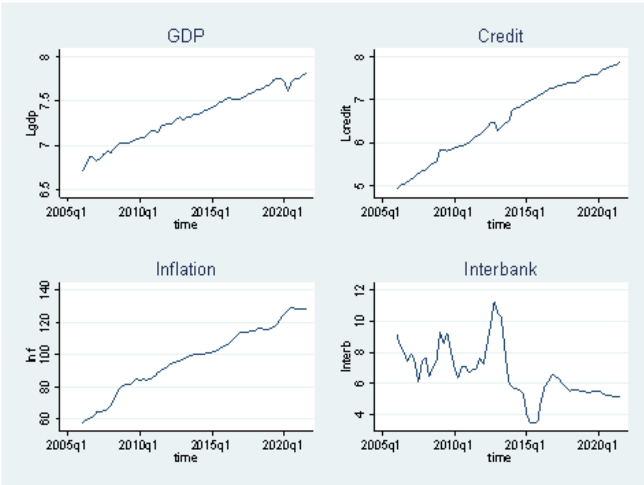

Figure 5: Data visualization

Table 1: Unit root

Variables	Dickey-Fuller test	Decision
GDP_growth	-3.986 (0.0092***)	I(0)
D.Lcredit	-8.378(0.0000***)	I(0)
D.Inf	-4.472 (0.0017***)	I(0)
D.Interb	-6.182(0.0000***)	I(0)
D.Lm3	-5.210 (0.0001***)	I(0)

Notes: With a constant and a linear trend, Lags are based on the SIC criterion. P-values are in parentheses and for the ADF tests, 5% critical value in brackets; *Significant at the 5% level.

The unit root tests suggest that most, but not all, of the variables included in the model are non-stationary, I (1), processes. The VAR is used as a benchmark. Nevertheless, the possibility of spurious relationships between I(1) variables remain. Ensuring this is not the case is perhaps to resort to the VEC model that is plausible on economic grounds.

5.2. Benchmark model- VAR Estimation

i. Optimum Lag and Stability Tests

Table 2 reports the optimal lag lengths of the reduced form VAR. We take into consideration that if the number of lags is too small, then the model does not capture all the information, while if there are too many lags, then the degree of freedom vanishes. Both Akaike's information criterion and likelihood ratio test recommend two lags, which we use throughout the rest of this exercise.

ii. Stability Tests

The stability test (unit root property of the variable) is also performed using the AR roots table. The results show that all the roots of the polynomial's characteristic are smaller than one. The results suggest that the VAR model is variance and covariance stationary, which satisfies the stationary condition shown in table 3.

Table 3: Stability test

Eigenvalue stability condition	
Eigenvalue	Modulus
0.9885106	0.988511
0.6558632 + 0.2094295i	0.688489
0.6558632 - 0.2094295i	0.688489
0.5697597 + 0.3788096i	0.684195
0.5697597 + 0.3788096i	0.684195
0.1899484 + 0.3916506i	0.435282
0.1899484 + 0.3916506i	0.435282
-0.09904908	0.099049

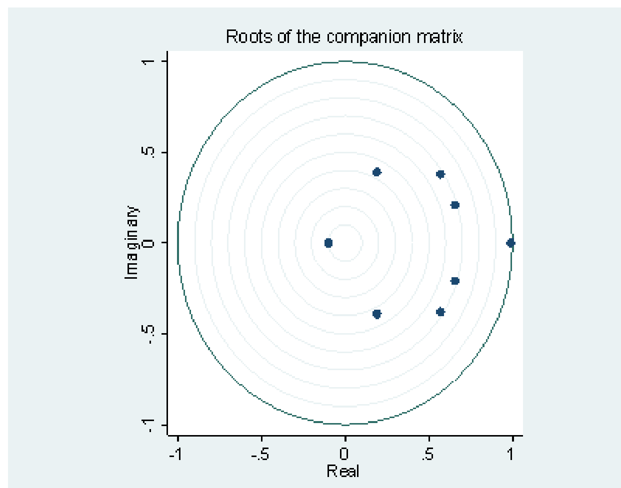

Figure 6: Roots of Companion matrix

iii. VAR estimation

Furthermore, we estimate the VAR model and the results are reported in table 4.

It's often pretty hard to interpret the coefficients of a VAR, as one variable says one thing and another doesn't; there are no clear dynamics between the variables we wish to investigate. However, our analysis focuses mainly on impulse responses. Before going on the impulse response, let us first explore two post-estimation statistics, which are mainly Lagrange-multiplier and normality tests, to assess VAR output in both table 5 and 6.

The results show that the null hypothesis of no autocorrelation in the residuals for any of the five orders tested is not rejected, while the Jarque-Bera test for normality indicates that the residuals are normally distributed; thus, our model is correctly specified.

Table 2: Lag selection criteria

Selection order criteria								
Sample:2007Q3-2021q3							Number of obs=57	
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-193.354				0.011953	6.92472	6.98044	7.06809
1	66.2403	519.19	16	0	2.30E-06	-1.62247	-1.34387	-0.90561*
2	91.2082	49.936	16	0	1.70E-06*	-1.93713*	-1.43566*	-0.64678
3	105.094	27.771	16	0.034	1.90E-06	-1.86294	-1.13859	0.000898
4	118.638	27.088*	16	0.041	2.10E-06	-1.77676	-0.82953	0.660567
5	124.491	11.707	16	0.764	3.30E-06	-1.42074	-0.25063	1.59008
6	133.836	18.691	16	0.285	4.60E-06	-1.18724	0.205741	2.39706
Endogenoua:Inf		Lgdp						
Lcredit Interb								
Exogenous:_cons								

Table 4: VAR estimation results

Vector autoregression					
Sample: 2006q3 - 2021q3 Number of obs = 61					
Log likelihood = 258.815 AIC = -6.68246					
FPE = 8.79e-10 HQIC = -5.93656					
Det(Sigma_ml) = 1.42e-10 SBIC = -4.779213					
	Coeff.	Std.Err.	t	p>|t|	[95% Conf. Interval]
Inf(-1)	0.077601	0.091991	0.84	0.403	-.1071692 .262371
Inf(-2)	-0.03379	0.091283	-0.37	0.713	-.2171426 .1495502
Lgdp(-1)	2.653945	3.634864	0.73	0.469	-4.646894 9.954783
Lgdp(-2)	-2.17309	3.448687	-0.63	0.531	-9.099977 4.753808
Lcredit(-1)	-2.86148	2.069186	-1.38	0.173	-7.017565 1.294601
Lcredit(-2)	1.546576	1.800078	0.86	0.394	-2.068987 5.162139
Interb(-1)	1.035843	0.138775	7.46	0.000	.7571042 1.314581
Interb(-2)	-0.34853	0.144404	-2.41	0.020	-.6385685 .0584827
Lm3(-1)	-6.60152	4.349113	-1.52	0.135	-15.33697 2.133934
Lm3(-2)	6.312371	4.874583	1.29	0.201	-3.478516 16.10326
_cons	5.125712	17.41126	0.29	0.770	-29.84584 40.09727

Table 5: Lagrange-multipliere

lag	chi2	df	prob>chi2
1	22.9104	16	0.11615
2	17.2194	16	0.37154
3	19.6066	16	0.23846
4	17.6754	16	0.34324
5	12.015	16	0.74295
Ho: no autocorrelation at lag order			

Table 6: Jarque-Bera test

Equation	chi2	Df	prob>chi2
Inf	0.07	2	0.96547
lgdp	2.1221	2	0.24626
lcredit	5.678	2	0.0585
Interb	1.215	2	0.54484
All	9.082	8	0.33533
dfk estimator used in computations			

iv. Granger causality tests

Granger Causality in table 7 indicates whether a variable or set of variables is influenced by the other variables in the model. We continue by taking all possible combinations of the four variables included in the VAR model.

The first panel shows that inflation granger causes gross domestic product and all other variables. The second panel indicates that gross domestic product granger causes credit and all other variables. The third panel points out that credit granger causes inflation, the interbank rate, and all other variables, while the last panel illustrates that there is no feedback from the interbank rate to another set of variables.

v. Impulse Responses

We now turn to the impulse response functions from the model, which are presented in figure 7. These basically trace out the implied dynamic paths of the endogenous

Table 7: Granger causality test

Equation	Excluded	F	df	df_r	prob>F
Inf	Lgdp	4.8652	2	52	0.0116
Inf	Lcredit	0.55058	2	52	0.5799
Inf	Interb	0.08722	2	52	0.9166
Inf	All	3.282	6	52	0.0082
Lgdp	Inf	0.11569	2	52	0.891
Lgdp	Lcredit	4.0429	2	52	0.0233
Lgdp	Interb	0.88108	2	52	0.4204
Lgdp	All	3.0871	6	52	0.0116
Lcredit	Inf	5.4923	2	52	0.0069
Lcredit	Lgdp	1.5428	2	52	0.2234
Lcredit	Interb	8.9074	2	52	0.0005
Lcredit	All	4.4737	6	52	0.001
Interb	Inf	0.75624	2	52	0.4745
Interb	Lgdp	0.21944	2	52	0.8037
Interb	Lcredit	0.74142	2	52	0.4814
Interb	All	0.87556	6	52	0.5193

variables in the system following one of the innovations from a one-time shock.

Generally, the effect of interest rate on goal variables is consistent with theoretical propositions and empirical applications. Specifically, the interbank rate shock causes inflation to fall by about five percentage points over eight quarters; since a higher interbank rate means higher borrowing costs, economic agents eventually start spending less. The demand for goods and services then drops, which causes inflation to fall.

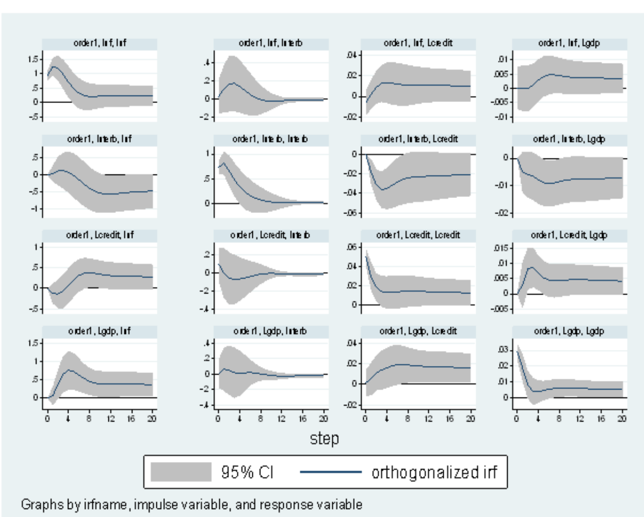

Figure 7: VAR impulse responses

The interbank rate shock reduces credit in the first four quarters by about four percentage points, inducing potential investors or borrowers to become more hesitant to borrow money due to the higher cost. Finally, the shock on the interbank rate tends to reduce consumer spending and investment, leading to a fall in aggregate demand, which subsequently lowers economic growth but its effects die over time before normalizing. Following the transmission process of variables, the empirical finding is in line with those of Garcia (2002), Weise (1999) and Peersman and Smets (2001) who all suggest that a credit shock has a greater impact on output in developing economies. Intuitively, a decrease in the interest rate, on the surface, appears to improve liquidity, hence increasing credit supply. Specifically, when economic agents are more likely to be credit and liquidity constrained, this effect becomes more pronounced. As a result, when economic growth is below par, a monetary policy shock has the greatest impact.

The gray space shows the 95 percent confidence interval derived using the technique of Kilian (1998). In the impulse–response graph, each row represents an impulse, and each column represents a response variable. Each graph's horizontal axis represents the time units in which the VAR is evaluated, in this instance, quarters; so, the impulse–response graph depicts the effect of a shock over 20 quarters. The vertical axis represents the variables in the VAR in their respective units; in this case, everything is measured in percentage points. Hence, the vertical units in all panels are percentage point changes.

5.3. Benchmark model-VEC Estimation

The estimated results of the multivariate VECM in table 8 with rank two and no constant, no trend configuration are presented. The D before variables denotes that they are modeled as first-differences. The model has a low log-likelihood, about 77% value, which indicates that the VECM is relatively good compared to the estimated VAR model. The interpretation of the VECM is difficult since the model in itself is a system of equations where the variables take turns being the

Table 8: VEC estimation results

Vector error-correction model
Sample: 2006q3 - 2021q3 Number of obs = 61
AIC = -1.637259
Log likelihood = 76.93639 HQIC = -1.27109
Det(Sigma_ml) = 9.43e-07 SBIC = -.7029375

	Coeff.	Std.Err.	t	p>|t|	[95% Conf. Interval]
ECM(-1)	-.0012644	.0012404	-1.02	0.308	-.0036955 .0011666
D.linf	.0595003	.0879877	0.68	0.499	-.1129523 .231953
D.lgdp	1.038519	3.498747	0.30	0.767	-5.818898 7.895937
D.Lcredit	.1337111	1.735483	0.08	0.939	-3.267773 3.535196
D.Interb	.2343204	.1326974	1.77	0.077	-.0257617 .4944025
_cons	-.3495956	.2443918	-1.43	0.153	-.8285948 .1294035

dependent and independent variables. What is important is to check whether or not the VECM is adjusting towards the long-run equilibrium.

However, the variables affect each other over time, and different lags can provide different information, which makes it hard to interpret the dynamics. That is why we rely on the IRFs in the underlying VECM framework to trace the dynamics. The "speed of adjustment" coefficient of the ECM term has a negative value, which implies convergence towards the long-run equilibrium. The adjustment term, in this case, the inflation equation, suggests that the previous quarter's deviation from long-run equilibrium is corrected for in the current quarter at an adjustment speed of 0.1%. In the long-run, the coefficients would be interpreted in the opposite sign, and this implies that a positive shock on interbank rate has a negative impact of 0.59%, 1.03%, and 0.13% on credit, GDP, and inflation, respectively.

i. Stability condition of the VECM estimates

We check whether the cointegrating equations are correctly specified and if a VECM has endogenous variables in figure 8.

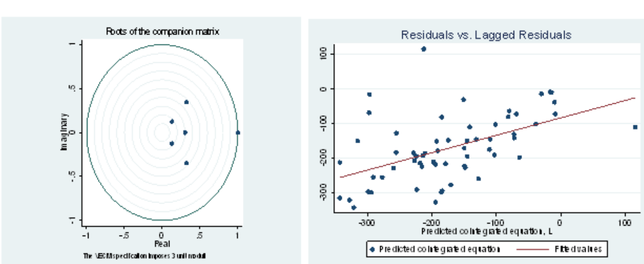

Figure 8: Stability condition of the VECM estimates

The stability condition indicates a well-specified model (stationary variables and correctly specified) with stable results, which is important for the interpretation of the IRFs.

ii. Impulse response function

The impulse responses in figure 9 show that they are quite consistent across the different models, as is evident by looking at the various dynamism and magnitudes in the impulse responses in the context of the variation.

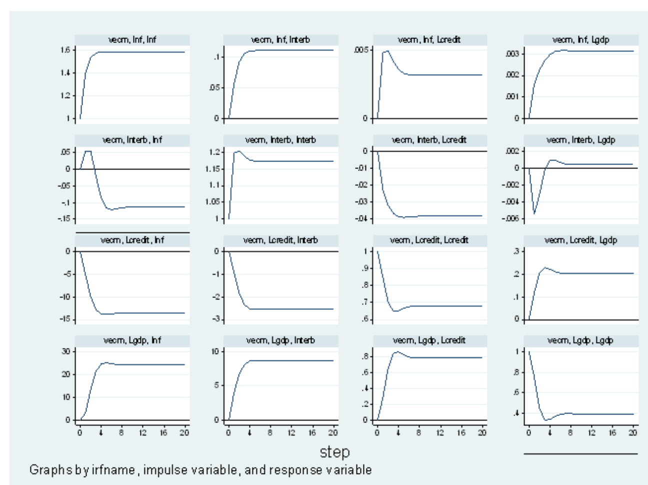

Figure 9: VECM impulse responses

From our benchmark models, the interbank rate shock on inflation is quite robust and the models capture the essential macroeconomic relations, primarily the impact of monetary policy on credit, GDP, and inflation, with no "price puzzle" observed.

5.4. Alternative model- SVAR estimation

The previous models treated all variables symmetrically, and it did not depend on econometric restrictions in Sims (1980) model. Thus, SVAR solves this problem since SVAR introduces enough restrictions to interpret the shocks of the system (Cooley and Dwyer, 1998; Kim and Roubini, 2000).

All impulse responses in figure 10 show the expected signs, and the structural impulse responses have generally

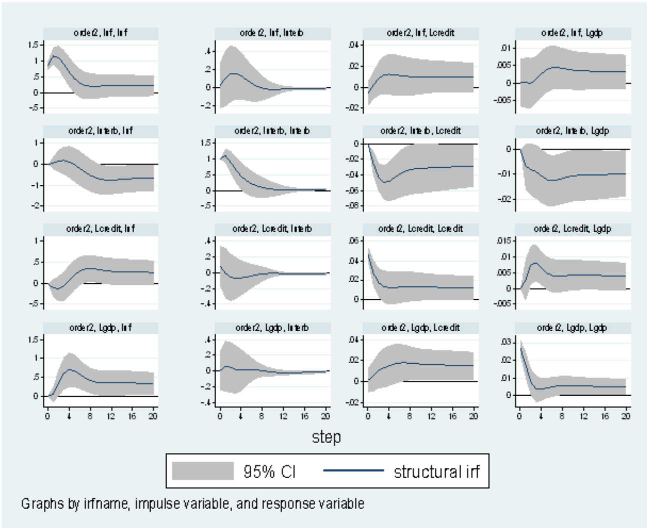

Figure 10: SVAR impulse responses

improved the previous VAR findings, but the stipulated effects are in line with the previous models, and we kept the two lags in our SVAR model for consistency.

The structural interbank rate shock reduces the credit by four percentage points, and the GDP in the first to four quarters and normalizes over the horizon. In addition, the interbank shock is also consistent with our benchmark models, which is consistent with other empirical findings. The SVAR model is particularly quite robust; the impulse responses for all variables have broadly the same shape as baseline findings. Consistent with the baseline models, the structural impulse responses do not show a "price puzzle."

5.5. Other robustness checks-Dynamic Forecasting

We further extend our SVAR and VEC findings to determine their predictive power by providing sample forecasting. Following the graphical approach of Harvey (1989) and Batten and Thornton (1983), the estimated SVAR and the VECM offer similar information about future behavior in our data as shown in figure 11.

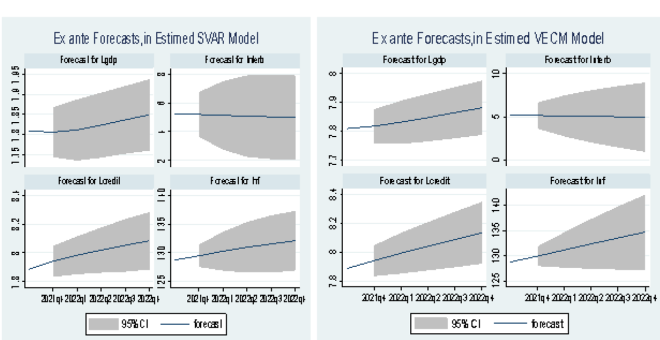

Figure 11: Forecasting comparisons

6. Conclusion

The aim of this paper was to provide a deeper analysis of the effect of monetary policy on target variables, for example, credit, output, and inflation in Rwanda. The paper adds to the body of empirical works by providing a critical review of the existing stock of knowledge and addressing the important gaps.

The paper adds to the scarce literature that examines the effect of monetary policy on credit and economic activity to shed more light on how the central bank's actions reflect and persist in the real economy. Monetary policy cannot be a static and stable function in time, implying that the conduct of monetary policy cannot be the repetition of strategies deemed useful in the past. The present investigation becomes essential to accommodate the effect of structural changes, such as technological, institutional, or policy-related changes, specifically the current move from quantity base monetary policy to price-based monetary policy.

The VAR applied in the specific case of Rwanda is not exhaustive; even though the VAR model has good properties when applied to covariance-stationary time series, most economic variables exhibit unit root; thus, the VEC model is more appropriate. We also check whether or not the pre-observed relationships are biased in the so-called ''price puzzle" that is common observed in the literature.

The empirical findings show that broadly the effect of interest rate on goal variables is consistent with theoretical propositions and empirical applications. Specifically, the interbank rate shock causes inflation to fall by about five percentage points over eight quarters; since a higher interbank rate means higher borrowing costs, economic agents eventually start spending less. The demand for goods and services then drops, which causes inflation to fall. The interbank rate shock reduces credit in the first four quarters by about four percentage points. This means that the shock to the interbank rate induces potential investors or borrowers to become more hesitant to borrow money due to the higher cost. Finally, the shock on the interbank rate tends to reduce consumer spending and investment. This will lead to a fall in aggregate demand which subsequently lowers economic growth but its effects are dying over time before normalizing.

The results from VECM show that the previous quarter's deviation from long-run equilibrium is corrected for in the current quarter at an adjustment speed of 0.1%. The impulse responses show that they are quite consistent across the different models, as is evident by looking at the various dynamics and magnitudes in the impulse responses. From our benchmark models, the interbank rate shock on inflation is quite robust and the models capture the essential macroeconomic relations, primarily the impact of monetary policy on the credit, GDP growth, and inflation, with no "price puzzle" observed. The findings remain robust when we apply SVAR, and the models capture the essential macroeconomic relations between a monetary policy indicator and goals variables, following the recent improvement in financial markets. In line with the baseline models, the structural impulse responses do not exhibit a "price puzzle." We further extend our SVAR and VEC findings to determine their predictive power by providing the samples with ample forecasting; the estimated SVAR and the VECM offer similar information about the future behavior in our data. We assume the structural factors under our analysis as predetermined, an assumption that can be relaxed in the future studies.

References

Aiyar, S., Calomiris, .C., and Wieladek, T. (2016). How does credit supply respond to monetary policy and bank minimum capital requirements?, s.l. *European Economic Review*, vol. 82, pp. 142–165.

Allybokus, M., Sookia, N.U.H., and Gujadhur, P. (2010). A Vector AutoRegressive (VAR) Approach to the Credit Channel for the Monetary Transmission Mechanism in Mauritius.

Angeloni, Kashyap, Mojon, and Terlizzese (2009). Monetary Transmission in the Euro Area : Where Do We Stand?. W.orking Paper Series 114, European Central Bank.

Atanasova (2003). Credit Market Imperfections and Business Cycle Dynamics: A Nonlinear Approach.Studies in Nonlinear Dynamics & Econometrics, De Gruyter, vol. 7(4), pages 1-22, December.

Avdjiev, S., and Zeng, Z. (2014). Credit Growth, Monetary Policy, and Economic Activity in a Three-Regime TVAR Model, : BIS Working Papers No 449.

Balke, N.S. (2000). Credit and Economic Activities: Credit Regimes and Non Linear propoagation of shocks, s.l.: Southern Methodist University and Federal Reserve Bank of Dallas.

Batten, and Thornton (1983). M1 or M2: which is the better monetary target?, s.l.: Federal Reserve Bank of St. *Louis Review*, pp. 36–42.

Beck, T., Fuchs, M., and Uy, M. (2009). Finance in Africa – Achievements and challenges., s.l.VoxEU, 20 July.

Beck, T., and Levine, R. (2002). Industry growth and capital allocation: Does having a market- or bank-based system matter?, s.l. *Journal of Financial Economics*, vol. 64, pp. 147–180.

Bedikanli, M. (2020). Investigating the existence of a bank lending channel in Sweden.

Berkelmans (2005). Credit and Monetary Policy: An Australian SVAR: Reserve Bank of Australia.

Bernanke, B., and Blinder, A. (1988). *Credit , Money , and Aggregate Damand*. Massachusetts Avenue, Cambridge, MA 02138: NBER Working Paper.

Bernanke, B., et al (1988). Inside the black box:the credit channel ofmonetary policy transmission, s.l. *Journal of Economic Perspectives*, pp. 27–48.

Bowman, D., Cai, F., Davies, S., and Kamin, S. (2015). Quantitative easing and bank lending:Evidence from Japan. , s.l. *Journal of International Money and Finance*, vol. 57, pp. 15–30.

Brüggemann, R., and Lütkepohl (2000). Lag Selection in Subset VAR Models with an Application to a U.S. Monetary System., s.l. *SFB 373 Discussion Paper*, vol. 37.

Calza, A., and Sousa, J. (2005). Output and inflation responses to credit shocks: are there threshold effects in the euro area?. Working Paper Series 481, European Central Bank.

Christiano, L., Eichenbaum, M., and Evans, C. (1996). The effects of monetary policy shocks:, s.l. *Review of Economics and Statistics*, vol. 78, pp. 16–34.

Cooley, T..M., and Dwyer (1998). Business cycle analysis without much theory. A look at structural VARs, s.l.: Journal of Econometrics, 83, 57–88. *Journal of Econometrics*, vol. 83, pp. 57–88.

Dempere, K.M. (2022). Monetary policies and bank lending in developing countries: evidence from Sub-Sahara Africa, s.l. *Journal of Economics and Development*.

Fischer, S. (2015). Monetary Policy in the United States and in Developing Countries.

Garcia, R. (2002). Are the eff ects of monetary policy asymmetric?.: Economic Inquiry.

Giannone, D., Lenza, M., Pill, H., and Reichlin, L. (2012). The ECB and the Interbank Market., s.l. *The Economic Journal*, vol. 122(564), pp. 467–486.

Granger, C.W.J., and Newbold, P. (1974). Spurious Regressions in Econometrics, s.l.: Econometrics 2, 1974, 111-120. pp. 111–120.

Harvey, C.R. (1989). Forecasts of economic growth from the bond and stock markets. , s.l.: Financial Analysts Journal. pp. 38–45.

Hitayezu, P., and Nyalihama (2019). *Exchange rate pass-through to consumer prices in Rwanda : a re-examination, s.l.: BNR Economic Review*. National Bank of Rwanda.

Holtemöller (2002). Further VAR evidence for the effectiveness of a credit channel in Germany. *Collaborative Research Center 373: Quantification and Simulation of Economic Processes*.

Irankunda (2014). *The Effectiveness of Monetary Policy in Rwanda., s.l.: COMESA Monetary Institute*.

Kamanzi, C., Irankunda, J., and Bagabe, J. (2019). Bank Lending Channel of Monetary Policy: Evidence from bank level data. *BNR Economic Review*, vol. 14, pp. 19–51.

Kamanzi, C., and Kimenyi, V. (2020). The effect of bank asset quality om monetary transmission in Rwanda. *BNR Economic Review*, vol. 16, pp. 1–29.

Kashyap, A.K., Stein, J.S., and Wilcox, D.W. (1992). Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance, s.l.: National Bureau of Economic Research.

Kigabo, R.T., and Kamanzi, C. (2018). Requirements for using interest rate as an operating target for onetary policy: the case of Rwanda. *BNR Economic Review*, vol. 13, pp. 1–26.

Kigabo, T. (2018). Monetary Transmission Mechanisms in Rwanda. East Africa Research Papers in Economics and Finance EARP-EF No. pp. 29–29.

Kilian, L. (1998). Small-sample confidence intervals for impulse response functions., s.l.: The Review of. *Economics and Statistics*, vol. 80, pp. 218–230.

Kim, S., and Roubini, N. (2000). Exchange rate anomalies in the industrial countries: Asolution with a structural VAR approach., s.l. *Journal of Monetary Economics*, vol. 45(3), pp. 561–586.

Kuttner, K.N. (2018). Outside the box: Unconventional monetary policy in the great recession, s.l. *Journal of Economic Perspectives*, vol. 32(4), pp. 121–146.

Li, F., and St-Amant, P. (2010). Financial Stress, Monetary Policy and Economic Activity, s.l.: Bank of Canada.

Mishkin, F. (1995). International experiences with diffrent monetary policy regimes, Stockholm: Sveriges Riksbank Working Paper Series, No. 57. *Journal of Economic Perspectives*, vol. 9, pp. 3–10.

Mishkin, F. (1998). International experiences with diffrent monetary policy regimes. *Sveriges Riksbank Working Paper Series*, (57).

Mishra, P., Spilimbergo, A., and Montiel, P.J. (2010). Monetary Transmission in Low Income Countries: Intrnational Monetary Fund.

Mugume, A. (2011). Monetary Transmission Mechanisms in Uganda., s.l.: Bank of Uganda.

Mwenese, B., Kigabo, T., and Bagabe, B. (2016). Interest Rate Pass-Through in EAC. BNR Economic Review, Volume 9, pp. 31-52. *BNR Economic Review*, vol. 8, pp. 1–23.

Peersman, G., and Smets (2001). Are the effects of monetary policy in the Euro area greater in recessions than in booms?: Frankfurt: European Central Bank.

Rutayisire (2020). Modelling Interest Rate Pass-through in Rwanda: Are the Interest Rate Adjustment Dynamics Symmetric or Asymmetric?. s.l.:African Economic Research Consortium.

Saiki, A., and Frost, J. (2014). Does unconventional monetary policy affect inequality? Evidence from Japan. *Applied Economics*, vol. 46(36), pp. 4445–4454.

Sims, C. (1980). Macroeconomics and Reality, s.l.: Econometrica. vol. 48, pp. 1–48.

Tnga, H., Kwek, B.T., and K (2015). Financial stress, economic activity and monetary policy in the ASEAN-5 economies. *Bank Negara Malaysia and University of Malaya*.

Weise, C. (1999). The asymmetric effects of monetary policy: A nonlinear vector autoregression approach, Journal of Money, Credit, and Banking.