Journal of Economic Cooperation and Development, **45**, 3 (2024), 225-254

Exploring the Interactions between Monetary and Macro-prudential Policies for Output Growth in South Africa

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ABSTRACT

Given the framework or an economy where the policies target both the price and financial stability objectives, this study examines the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. Using the Vector Autoregression (VAR) model and quarterly time series data spanning the period 2008Q1 – 2023Q4, we show that tighter monetary and macro-prudential policies used to contain inflation and credit growth have also had a declining effect on output growth in the country. Consistent with economic theory, we also find that interest rate shock reduces inflation while money supply increases inflation in the economy. In the same way, the macro-prudential policy shock of an increase in the capital-based reduces the bank credits. Regarding the interaction and coordination of the two policies, we reveal that macro-prudential policy could interact with the monetary policy. As a result, we recommend that macro-prudential policy should continue to have a distinctive policy target different from monetary policy. It should be made a second mandate to work with the monetary policy to stimulate output growth in the country.

ملخص

بالنظر إلى الإطار أو الاقتصاد حيث تستهدف فيه السياسات كل من الأهداف المتعلقة باستقرار النظام المالي والأسعار، تفحص هذه الدراسة الآثار الاقتصادية الكلية لصدمات السياسة النقدية والسياسة الاحترازية الكلية على نمو الناتج في جنوب إفريقيا.

باستخدام نموذج الانحدار الذاتي المتجه (VAR) وبيانات السلاسل الزمنية الفصلية التي تغطي الفترة من الربع الأول من عام 2008 إلى الربع الرابع من عام 2023، نظهر أن السياسات النقدية والاحترازية الكلية الأكثر تشددًا المستخدمة لاحتواء التضخم ونمو الائتمان قد أثرت أيضًا سلبًا على نمو الناتج في البلاد. واتساقاً مع النظرية الاقتصادية، نجد أيضًا أن صدمة سعر الفائدة تقلل من

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التضخم بينما يزيد المعروض النقدي من التضخم في الاقتصاد. بنفس الطريقة، تؤدي صدمة السياسة الاحترازية الكلية المتمثلة في زيادة رأس المال إلى تقليل الائتمانات المصرفية. فيما يتعلق بالتفاعل والتنسيق بين السياستين، نكشف أن السياسة الاحترازية الكلية يمكن أن تتفاعل مع السياسة النقدية. ونتيجة لذلك، نوصي بأن تستمر السياسة الاحترازية الكلية في أن تكون لها أهداف سياسة متميزة تختلف عن السياسة النقدية. يجب أن تكون بمثابة ولاية ثانية للعمل مع السياسة النقدية لتحفيز نمو الناتج في البلاد.

RÉSUMÉ

Dans le cadre d'une économie où les politiques visent à la fois les objectifs de stabilité des prix et de stabilité financière, cette étude examine les effets macroéconomiques des chocs des politiques monétaires et macroprudentielles sur la croissance de la production en Afrique du Sud. En utilisant le modèle d'autorégression vectorielle (VAR) et des séries chronologiques trimestrielles couvrant la période 2008T1 - 2023T4, nous montrons que les politiques monétaires et macroprudentielles plus strictes utilisées pour contenir l'inflation et la croissance du crédit ont également eu un effet décroissant sur la croissance de la production dans le pays. Conformément à la théorie économique, nous constatons également que le choc des taux d'intérêt réduit l'inflation tandis que la masse monétaire augmente l'inflation dans l'économie. De la même manière, le choc de politique macroprudentielle d'une augmentation de la base de capital réduit les crédits bancaires. En ce qui concerne l'interaction et la coordination des deux politiques, nous révélons que la politique macroprudentielle pourrait interagir avec la politique monétaire. Par conséquent, nous recommandons que la politique macroprudentielle continue à avoir un objectif politique distinct de la politique monétaire. Elle devrait avoir pour second mandat de travailler avec la politique monétaire pour stimuler la croissance de la production dans le pays.

Keywords: Monetary Policy, Macro-prudential Policy, Output Growth, VAR Model

JEL Classification: E52; E61; E23; C22

1. Introduction

Before the 2008/2009 global financial crisis, policymakers focused on achieving price stability objectives without aiming at achieving financial stability. However, the aftermath of the financial crisis revealed that financial instability can hurt output growth and the economy's growth. For instance, financial instability with an increase in interest rate will lead to a decline in money supply, which will, in turn, increase the moral hazard

and problems in financial markets (affects borrower's ability due to high interest rate) and causes a further contraction in economic activity (see Smets, 2018). Because of this problem, central banks were pressed to re-examine their objectives in the use of monetary policy and additionally or simultaneously pursue a macro-prudential policy to achieve financial stability and stimulate output growth. The main issue in this approach is how to ensure the additional or simultaneous use and interaction of the two policies in achieving price stability and financial stability without harming output growth and economic activity in the country.

It is important to note that although macro-prudential policy seems to be relatively new, many emerging countries like South Africa have embraced it by establishing more dedicated decision-making frameworks (IMF-FSB-BIS, 2016), appointing a prudential authority to oversee the conduct of macro-prudential policy (SARB, 2024) and introduced a framework for using a countercyclical capital buffer to prevent the build-up of systemic risks and mitigate the real costs of the financial crisis.

According to Kahou and Lehar (2017), macro-prudential policy refers to prudential tools for curbing the build-up of asset price bubbles, preventing financial vulnerabilities, and safeguarding the financial system, while on the other hand, monetary policy involves the use of monetary policy tools to achieve price stability and sustainable economic growth (Chugunov et al., 2021). Given the framework or an economy where the policies target both the price and financial stability objectives, this study, therefore, seeks to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. As a significant contribution to the field of research, this study seeks to shed light on how these policies interact, how they ought to be best combined or coordinated, and their impacts on output growth in the country. To the best of the researchers' knowledge, no study has been done in this area in South Africa, especially in determining the effects of macro-prudential policy shocks on output growth in the country.

Unlike monetary policy, which has a wide range of economic impacts of stabilising prices and output growth, the macro-prudential policy specifically targets the financial sector to achieve financial stability (Ntwaepelo, 2021). This means that macro-prudential policy seeks to maintain the financial sector's resilience to economic shocks and ensures that banks perform their lending function optimally. However, both

policies interact to contribute to the growth of the economy (Lima et al., 2024). Given these policy interactions, especially the use of macro-prudential policy tools to complement monetary policy with the overall objectives of achieving output growth through price stability and financial stability, there has been a growing debate on the simultaneous use of both policies. The debate revolves around the interactions and coordination strategies since monetary policy shocks (changes in interest rate) affect the cost of credit and, subsequently, the demand for credit (affects the lending power of banks). In the same way, the effect of macro-prudential policy instruments on financial stability may affect other segments of the economy, such as inflation and output growth. Hence, this imposes many challenges for policymakers in the country to effectively implement and coordinate macro-prudential and monetary policies to achieve an appropriate policy mix.

Despite the increasing literature in this research area globally, there is still no consensus about the macroeconomic effects of the two policies (effects not well understood), especially in South Africa and other emerging market economies where research has been limited. Against this background, we decided to carry out this study to unravel the effects of both policies on the growth of output in the country and contribute to the body of literature and the IMF's agenda on an integrated policy framework (see IMF, 2020). To the best of our knowledge, this is the first study that seeks to establish these effects in South Africa.

Following this introduction, the rest of the paper is organized into five sections. Section 2 briefly overviews South Africa's economy and policy plans. A discussion of the various divergent empirical and theoretical literature on how the monetary policy and macro-prudential policy affect economic activity is presented in Section 3, followed by an outline of the methodology used to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in the country in Section 4. Section 5 is a discussion of the study results. A summary and conclusion conclude the paper in Section 6.

2. An Overview of South Africa's Economy and Policy Plans

The South African economy is open to industrialization in achieving output growth and development; the government's transformation agenda is thus achievable if policies are well coordinated and implemented.

Guided by the National Industrial Policy Framework (NIPF) adopted in 2007 by the Cabinet, the industrial policy for output growth and development was set out in the Industrial Policy Action Plan (IPAP 1) to generate a new industrialization path, increase total output production, promote a labour-absorbing industrial sector and intensify the sector's contribution to ensuring that South Africa becomes a knowledge economy. As revealed by Mbatha (2018), The IPAP 2 for 2010/11 – 2012/13 was adopted in 2010. It set out critical interventions over a three-year rolling period, updated annually, with a 10-year outlook for desired output growth and economic outcomes (Molekwa, 2018).

The government's (policymakers including the monetary authorities) contribution to output growth and job creation has been to develop a policy package to facilitate employment and promote an environment for private sector growth and investment to stimulate output. The government also directly contributes through public-sector hiring and targeted job-creation programs. The New Growth Path (NGP) launched by the Ministry of Economic Development in November 2010 aims to stimulate output growth, create 5 million jobs over 10 years, and broaden the market for South African goods and services. The following sector targets for output growth and job drivers are identified in this document:

- Infrastructure development and housing – 250 000 jobs a year by 2015;
- Agriculture and agro-processing – 500 000 jobs per year by 2020;
- Mining – 140 000 jobs per year by 2020;
- Manufacturing (IPAP) – 350 000 jobs per year by 2020;
- Tourism – 225 000 jobs per year by 2020;
- "Green economy," "knowledge economy," and "social economy" – 660 000 jobs per year by 2020;
- Health, education, and policing – 100,000 jobs per year by 2020;
- Regional integration – 150,000 jobs per year by 2020.

Furthermore, the IPAP 3 was launched to contribute to output growth through industrial development in Africa, focusing on infrastructure, productive capacity, and regional integration (Mosehla, 2019 and; Moyo, 2020). It is informed by the long-term vision of the National Development Plan (NDP) and complemented by a key pillar of the programs set out in a series of 'drivers' and 'packages' in the NGP. Government policies set out in the IPAP and other documents include:

- diversify the economy: provide strong support for value-added output growth in the manufacturing sector;
- Promote a labour-absorbing industrialization path with systematic output growth and employment-creating linkages;
- An industrialization model focused on the inclusion of historically disadvantaged people and regions;
- Contribute to industrial development in Africa, focusing on infrastructure, output productive capacity and regional integration;
- Long-term intensification of South Africa's industrialization process and movement towards a knowledge-based economy.

Given the various policy measures and plans toward achieving output growth and industrialized the country, South Africa's industrial output production, as reported by Statistics South Africa, averaged 1.7% growth in May 2013, after reaching an all-time high of 10.4% in May 2002, and a record low of -23.2% in April 2009 due to the global recession. The data averaged 2.6% between 2014 and 2019 and reached an all-time high of 104% in April 2021 after a record low of -53.6% in April 2020 due to the COVID-19 pandemic (CEIC Data, 2023). Given this, there is a need for comprehensive and strategic policy implementation and coordination to overcome the challenges of the simultaneous use of monetary and macro-prudential policies. According to Kim et al. (2019) and Borio et al. (2023), "combining both policies is more effective in enhancing the overall economic stability, especially when there are financial shocks in the economy."

3. Literature Review

3.1 Empirical Literature

Several studies, like Lamers et al. (2019) and Fouejieu et al. (2019) have emphasised that there is a trade-off between price stability and financial stability. The trade-off occurs because reducing inflation (price stability) requires an increase in interest rate (contractionary monetary policy), which increases the cost of borrowing and results in financial imbalances. Kim and Mehrotra (2017) revealed that an increase in the interest rate to achieve price stability might affect an individual's or entrepreneur's risk-taking attitude, thereby reducing their optimistic economic expectations of the future and, thus, causing financial imbalances. In the same way, a contractionary macro-prudential policy may increase the cost of credit

and limit its growth below desirable levels, generating macroeconomic instabilities (Ozkan and Unsal, 2014). This means a tighter macro-prudential policy can cause agents to postpone spending due to the high cost of borrowing and discourage aggregate demand (Aikman et al., 2019), which may lead to deflationary pressures.

Given the trade-off between both policies, there are three main divergent views on the link between monetary and macro-prudential policies in the economy: first, both monetary and macro-prudential policies are countercyclical tools aimed at preventing systematic risks, with monetary policy mainly focused on price and output stability and macro-prudential policy focused on financial stability (Glocker and Towbin, 2012; Agenor and da Silva, 2019). Empirical studies conducted by Wright (2015) and Ozkan and Unsal (2014) back up this view among others.

The second view suggests that monetary and macro-prudential policies are substitutes instead of complements. For example, Cecchetti and Kohler (2012) developed a macroeconomic model showing that economic and macro-prudential policies can achieve price and financial stability. According to these authors, by delivering price stability, monetary policy directly reduces financial volatility. Similarly, when capital adequacy requirements reduce financial vulnerabilities, they inevitably deliver macroeconomic stability. This is in line with the study conducted by Aikman et al. (2019), which found that these two policy instruments operate similarly. Hence, monetary and macro-prudential policies are substitutes.

The third view submits that a relationship does not exist between monetary and macro-prudential policies. For instance, Svensson (2018) argues that monetary policy should never respond to financial threats; and macro-prudential policy should never respond to price stability. Moreover, separate entities should conduct these policies and not be coordinated. According to Svensson, this is because monetary policy cannot achieve both price and financial stability. Given these divergent views, knowledge of how monetary and macro-prudential policies affect the objective of the other and the effects on output growth is necessary to stimulate the growth of the country's economy.

While looking at the side effects of the interaction between monetary and macro-prudential policies on output, Nier and Kang (2016) reveal that a tightening of policy tools could have dampening “side effects” on output.

Although the study showed that the effects of macro-prudential policies depend on the tool considered as adjustable loan-to-value (LTV) ratios do affect the composition of both output and overall output growth, capital requirement and reserve requirement are not statistically significant, suggesting no effects on output. On the other hand, Kim and Mehrotra (2022), in their study, reveal that a contractionary macro-prudential shock leads to a decline in output (real GDP), price level, and credit, similar to the monetary policy shock. This means that the relative responses of credit and real GDP, as well as credit and the price level, are not significantly different for the monetary policy and the macro-prudential policy shock. Thus, there is no significant difference in the relative effectiveness of the two policies in stabilising output and prices.

Kim and Mehrotra (2017) also reveal that complementary use of monetary and macro-prudential policies could create challenges for policymakers, especially during times when low inflation coincides with buoyant credit growth. This is because the effects of monetary policy and macro-prudential policy shocks are closely related. For instance, the policy authority may face a dilemma when using one instrument or both instruments in the same direction, which would only stabilise one target variable, while using both in opposite directions would possibly result in the two instruments working at cross-purposes.

While investigating the three alternative institutional arrangements on the simultaneous use of monetary and macro-prudential policies, Agenor and Flamini (2016) talk about the goal-distinct mandate – whereby monetary policy is only concerned with output and price stability, and macro-prudential policy is only concerned with financial stability. In this arrangement, there is no coordination between monetary and macro-prudential authorities, and separate institutions conduct monetary and macro-prudential policies. However, the study concluded that monetary and macro-prudential policies can be used simultaneously.

In contrast, Stein (2013) posits that monetary policy can affect all corners of the economy, including the financial sector, implying that monetary policy can target both price stability and financial stability. Hence, it does not see the need for macro-prudential policy since raising the interest rates in response to inflationary pressures will result in both lower inflation and, at the same time, discourage the growth of credit. Given all these different opinions in the body of literature, there is a need to carry out a study to

examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. To the best of our knowledge, no study seeks to establish these effects in South Africa.

3.2 Theoretical Literature

This study is rooted in the McKinnon and Shaw Hypothesis Theory due to its optimum rule that best fits the economic or financial liberalization and policy formulation strategy adopted by the policymakers. According to the theory, improved economic/output growth can be achieved through financial sector reforms and other policy actions taken by policymakers. As revealed by the theory, financial repression hinders financial deepening and, thus, adversely affects economic/output growth. McKinnon and Shaw (1973) contend that financial repression using interest rate ceilings (monetary policy), high reserve requirements (macro-prudential policy), credit, exchange rate, and control on the source of finance of banking institutions will have a dampening effect on the economy.

Keynesian theory is of the view that low interest rates would stimulate investment spending and economic/output growth. Nevertheless, McKinnon and Shaw (1973), who provide a rationale for liberalization to promote financial development and hence economic/output growth, opposed this. McKinnon and Shaw (1973) further reveal that the cost of capital does not constrain investment in financially repressed economies; instead, it is the availability of finance. This theory is of the view that economic organizations or entities are self-financed and that money is fiat money issued by the public sector. It further reveals that most developing countries have fragmented economic conditions (due to various international trade restrictions) and inefficient financial systems, hence needing good policy formulation, implementation, and coordination. McKinnon (1973), therefore, put forward that complementarity exists between policies (in this case, monetary and macro-prudential policies) to stimulate demand and investment (output growth).

Shaw (1973) believes that as the amount of money stock relative to economic activity increases, the level of intermediation between savers and investors through the financial system becomes greater. At this point, it is debated that a higher interest rate is needed to attract savings. He further notes that increasing interest rates would improve the quality of investments undertaken. With an increase in interest rates, previously

unfunded or underfunded projects with high economic returns will be funded by banks because they enjoy economies of scale in collecting and processing information of the borrowers.

In conclusion, McKinnon and Shaw (1973) advocate for financial liberalization and well-coordinated policies. Liberalizing financial markets in a well-coordinated manner allows financial deepening by encouraging savings in the form of various financial assets, reducing constraints on capital accumulation, and improving allocative efficiency since investors are now undertaking projects with higher expected rates of return. Financial deepening reflects an increasing use of financial intermediation by savers and investors and monetization of the economy. It allows an efficient flow of resources among people and institutions over time.

4. Methodology

4.1. Data Description and Data Sources

We base our analysis on quarterly data from 2008Q1 - 2023Q4 to examine the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in the country. The starting date corresponds to the period of the 2008/2009 global financial crisis, while the cut-off date is dictated by data availability and an attempt to stay current. The data used in this paper is sourced from various sources such as Statistics South Africa (Stat. SA), Quantec Database, South African Reserve Bank (SARB), the World Bank's World Development Indicators (WDI), IMF's International Financial Statistics (IFS) and the Federal Reserve Bank of St. Louis. The variables employed for the analysis are output variables (proxied by Real GDP growth rate), monetary policy variables (interest rate and money supply), macro-prudential variables (counter-cyclical capital buffer and capital requirements), and target variables (inflation and credit). All these variables are rooted in past empirical studies like Madya (2018), Machirinani et al. (2020), Ntwaepelo (2021), and Nyati et al. (2023), among others.

4.2. Definition and Description of Variables

- The output variable: the real GDP growth rate, which reflects the inflation-adjusted value of goods and services, is employed in this study to capture output growth in the country. This is in line with

Ntwaepelo (2021), who studied the effects of macro-prudential and monetary policy shocks in BRICS countries. Given that the GDP measures the final goods and services produced in a specific period by a country, it is employed to proxy output growth in the country.

- Monetary policy variables: monetary policy involves the use of interest rate (IN) and money supply (MS) by the monetary authority to achieve broader objectives of price stability and output growth (high employment). These variables are rooted in Effiong and Okon (2020) and Ntwaepelo (2021), who carried out a study to investigate the effectiveness of monetary policy in stimulating real sector output in Nigeria.
- Macro-prudential variables: as defined by Kahou and Lehar (2017), macro-prudential policy involves using prudential tools to curb the build-up of asset price bubbles, prevent financial vulnerabilities, and keep the financial system stable. Following Ntwaepelo (2021) and Makrelov et al. (2023), the actual counter-cyclical capital buffers (CCB) provided by the South African Prudential Authority and capital requirements (CR) are employed in this study as a macro-prudential tool used by policymakers to prevent system-wide risk that can build up within a financial system.
- Target variables: the target variables are inflation (INF) and credit (C). Using the monetary policy, the monetary authority aimed at targeting the price level to keep inflation in check (price stability) and achieve output growth, while bank credit is usually the immediate target of macro-prudential policy to achieve a stable financial system (Basu, 2015). Ntwaepelo (2021) also reveals that while monetary policy targets price stability and output growth to achieve its objective, macro-prudential primarily targets credit to achieve financial stability. Both policies are based on the stable relationship between money, output, and prices.

4.3 Empirical Model

4.3.1 Model Specification

Borrowing from the theoretical framework and the empirical studies of Kim and Mehrotra (2017), Machirinani et al. (2020), and Ntwaepelo (2021), this study employs a Vector Autoregression (VAR) model to examine the macroeconomic effects of monetary and macro-prudential

policy shocks on output growth in South Africa. The choice of the VAR model over other methods is because it can accommodate both stationary and non-stationary variables and does not require pre-filtering (Taylor and McNabb, 2007). The model is suitable for dynamic impact analysis with the ability to capture the intertwined nature of time series data (Zivot and Wang, 2006). Additionally, the model is flexible and does not require identification restrictions for Structural Vector Autoregression (SVAR) and other models (Elbourne and de Haan, 2009). Finally, it can accommodate up to six and seven variables without running out of a degree of freedom due to its systematic and flexible approach to capturing complex real-world behaviour (see Giordano et al., 2007 and George et al., 2008 Hill et al. (2017) reveal that several studies have used VAR model to test for the interaction between a set of variables since it can be employed to study multivariate time series data and also account for dynamic properties and interactions among variables.

Given the above advantages of using the VAR model, suppose South Africa's economy can be represented in the following relationship model:

$$\emptyset Y_t = \alpha_o + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots \ldots . . + A_p Y_{t-p} \; + \; B\varepsilon_t \qquad (1)$$

where $\emptyset$ is a $(k \times k)$ matrix describing the contemporaneous relationship among the variables; Y_t is a $(k \times 1)$Vector of endogenous variables that range from $Y_{t-1,}\, Y_{t-2,} \ldots \ldots Y_{t-p}$. α_o is a $(k \times 1)$ vector of constant variables; A_1 to A_p are $(k \times k)$ coefficients of lagged endogenous variables; B is a $(k \times k)$ matrix whose non-zero off-diagonal elements allow for the direct effects of some shocks on more than one endogenous variable in the system and ε_t is the error terms or structural disturbances in the model.

The VAR in equation (1) cannot be estimated because it is a long-form VAR, and there is a contemporaneous feedback inherent in it (Enders, 2004). In addition, since the endogenous variables are allowed to affect each other in the current and past realisation time path of $\emptyset Y_t$, This makes it impossible to estimate the equation. Nevertheless, the VAR can be transformed from its long form into a reduced-form equation (see Ngalawa and Viegi, 2011). To transform the equation, we pre-multiplying it (equation 1) by an inverse of the matrix $\emptyset$ which gives:

$$Y_t = \emptyset^{-1}{}_{\alpha_o} + \emptyset^{-1}A_1Y_{t-1} + \emptyset^{-1}A_2Y_{t-2} + \cdots \emptyset^{-1}A_pY_{t-p} + \emptyset^{-1}B\varepsilon_t \quad (2)$$

One can denote $\emptyset^{-1}{}_{\alpha_o} = \beta_o,\ \emptyset^{-1}A_i = \beta_i\ for\ i = 1 \ldots\ldots\ldots p\ and\ \emptyset^{-1}B\varepsilon_t = \mu_t.$

Therefore, equation (2) becomes:

$$Y_t = \beta_o\ + \beta_1Y_{t-1} + \beta_2Y_{t-2} + \cdots \ldots\ldots\ldots + \beta_pY_{t-p}\ + \mu_t \quad (3)$$

As revealed by Ngalawa and Viegi (2011), equation (3) is a reduced form VAR or a VAR in a standard form that can now be estimated because there is no contemporaneous feedback inherent in it (no variable has a direct contemporaneous (immediate) effect on another in the model) and all the right-hand side variables are predetermined at time *t*. In addition, the vector error term (μ_t) is a composite of shocks in Y_t (Enders, 2004). Equation (3) can further be simplified and rewritten as:

$$Y_t = G(L)Y_t + \mu_t \quad (4)$$

Where Y_t is a vector of the South African endogenous variables used in the study (see section 4.2); $G(L)$ is a matrix polynomial lag that captures the relationship between the endogenous variables. $\mu_t = \emptyset^{-1}B\varepsilon_t$ is a vector of random disturbances.

4.3.2 The Identification of the Recursive VAR Scheme

Following Cheng (2006), this study employs the Cholesky factorization scheme with the ordering of variables given by equation (4) and shown in equations (5). GDP is ordered first because it is the most endogenous variable in the VAR model. The ordering and position of the other variables are shown in the matrixes equation 5. Theoretically, this amounts to estimating the reduced form VAR and then computing the Cholesky factorization of the reduced form VAR covariance matrix as given by Cheng (2006).

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ f_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ f_{31} & f_{32} & 1 & 0 & 0 & 0 & 0 \\ f_{41} & f_{42} & f_{43} & 1 & 0 & 0 & 0 \\ f_{51} & f_{52} & f_{53} & f_{54} & 1 & 0 & 0 \\ f_{61} & f_{62} & f_{63} & f_{64} & f_{65} & 1 & 0 \\ f_{71} & f_{72} & f_{73} & f_{74} & f_{75} & f_{76} & 1 \end{bmatrix} \begin{bmatrix} \mu_t^{GDP} \\ \mu_t^{INF} \\ \mu_t^{C} \\ \mu_t^{CCB} \\ \mu_t^{CR} \\ \mu_t^{MS} \\ \mu_t^{IN} \end{bmatrix} = \begin{bmatrix} b_1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_2 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_3 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_4 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_5 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_6 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_7 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{GDP} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{C} \\ \varepsilon_t^{CCB} \\ \varepsilon_t^{CR} \\ \varepsilon_t^{MS} \\ \varepsilon_t^{IN} \end{bmatrix} \quad (5)$$

Therefore, the relationship between the reduced-form errors and the structural disturbances is given by the following scheme in Equation 5 above.

The way variables affect each other in the model is based on economic theory and also depends on their position in the identification scheme. The non-zero coefficients (f_{kj}, which is captured by $f_{21} - f_{76}$) in the matrices indicate that variable j effects variable k instantaneously while the zeros (0) represent sluggish responses. For example, row 1 measures the GDP. The GDP is ordered first because it is the most endogenous variable in the VAR model (see Cheng, 2006, Naraya et al., 2008 and Tiwari, 2011). The second and third rows represent the target variables (inflation and credit). The fourth and fifth rows characterize the macro-prudential tools (counter-cyclical capital buffer and capital requirements), while money supply and interest rate are the monetary policy tools that are captured in the sixth and seventh rows.

Intuitively, it assumes that inflation has a sluggish effect on output (GDP), credit (C) has a sluggish effect on inflation and GDP, and counter-cyclical capital buffer (CCB) has a sluggish effect on GDP, inflation, and credit. In addition, capital requirements (CR) have a sluggish effect on GDP, inflation, credit and counter-cyclical capital buffer. Money supply (MS) has a sluggish effect on GDP, inflation, credit, counter-cyclical capital buffer, and capital requirement, while interest rate (IN) has a sluggish effect on GDP, inflation, credit, counter-cyclical capital buffer, capital requirement, and money supply. "Technically, this amounts to estimating the reduced form, then computing the Cholesky factorization of the reduced form VAR covariance matrix" (Cheng, 2006:12).

4.4 Robustness Checks

4.4.1 Unit Root Test

To carry out an effective estimation and efficient analysis, a robustness check is conducted on the VAR model to ensure the stationarity of the dataset. The essence of this is to help the study prevent spurious results. To achieve this, this study follows Nwakanma and Ibe (2014) and Cheng et al. (2014) to conduct a unit root test on the dataset. The robust version of Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests are employed to ensure consistency and obtain valid results. It also

allows the study to compare the results of the two unit root tests and ensure the efficiency and stability of the model.

4.4.2 Analytical Tests

To further enhance the robustness and reliability of the model, serial correlation, heteroscedasticity, and normality tests are carried out on the VAR model. These three tests are conducted to ensure that the model is consistent, reliable and favourable (i.e., free from serial correlation, heteroscedasticity, and non-normality of the residuals) in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa. The benchmark null hypotheses that are tested for the serial correlation, heteroscedasticity, and normality tests are:

- $H0: \alpha = 1$, there is no serial correlation or heteroscedasticity, and the residuals are normally distributed.
- $H1: \alpha \neq 1$, there is a serial correlation, heteroskedasticity, and non-normality of residuals.

4.4.3 Stability Test

To investigate the stability or instability of the VAR model (given that the sample period included the global recession and COVID-19 periods), the study employs the Cusum test to estimate the coefficients in the model. The benchmark hypothesis observed for the study is whether the VAR model is stable over the sample period without structural breaks. Following Leipholz (2013) and Bose et al. (2017), the study employs the roots of the characteristic polynomial of the coefficient matrix A, as in the example in equation 4, using the cusum test graphical approach.

5 Empirical Study Results and Analysis

5.1 The Unit Root Test Result

Based on the result derived from the Phillips Perron (PP) and Augmented Dickey-Fuller (ADF) unit root tests, Table 1 shows that at a 5% significant level, all the variables in the model were not stationary in levels (I(0)), but after first differencing (I(1)).

Table 1: Unit Roots Test Results on the Model Variables

Variable	Philip's Peron (P-P)			Augmented Dickey-Fuller (ADF)		
	Order of integration	t-Statistics	P-Value	Order of integration	t-Statistics	P-Value
GDP	I(1)	-3.9442	0.0419	I(1)	-4.4491	0.0000
INF	I(1)	-2.3602	0.0277	I(1)	-8.3036	0.0000
C	I(1)	-2.2137	0.0033	I(1)	-3.6215	0.0471
CCB	I(1)	-3.6631	0.0056	I(1)	-8.0726	0.0000
CR	I(1)	-2.0138	0.0009	I(1)	-7.4137	0.0000
MS	I(1)	-3.5731	0.0144	I(1)	-5.7351	0.0000
IN	I(1)	-2.6107	0.0475	I(1)	-6.3374	0.0000

Therefore, the main reason for ensuring the stationarity of the dataset in preventing spurious results and misleading/unreliable regression results has been achieved. This result satisfies the view of Taylor and McNabb (2007), who revealed that the VAR model can accommodate both stationary and non-stationary variables. However, there are other studies like Sims et al. (1990) and Enders (2015) that recommended against differencing even if the variables contain a unit root. According to them, "VAR analysis is to determine the interrelationships among the variables, not to determine the parameter estimates". In addition, their recommendation against differencing is to prevent the loss of information that is associated with a differenced VAR. Nevertheless, studies like Hwang (2017:583) revealed that "this differing nature may not matter much in short-horizon forecasting as first difference will improve the small-sample performance of the estimates and may eliminate all the nonstandard asymptotic theories associated with unit-root data."

5.2 Lag Length Selection

In estimating a VAR model, the selection of an optimal lag is important to prevent a lapse of time when variables respond to each other. For example, too many lags can lead to a loss of a degree of freedom, cause multicollinearity, serial correlation in error, and misspecification errors, while shortening the estimation sample too much with a small lag can

compromise the degrees of confidence (Kim and Lee, 2019). Borrowing from Coibion (2012), this study tests for various lag lengths using the five different lag selection criteria: the Akaike Information Criteria (AIC), Final Prediction Error (FPE), Sequential Modified LR test, Schwarz Information Criterion (SC) and the Hannan-Quinn information criterion (HQ). Five different lag selection criteria are used to select the best result, allow for adjustments in the model, and attain well-behaved residuals. Based on the result derived from the analysis and as shown in Table 2, the VAR model is estimated using 2-lags as chosen by the majority decision of AIC, SC, and HQ. The 2-lag optimal selection offers more accurate and robust dynamics because it prevents an unnecessary shortening or widening of the estimation sample, which would compromise the degrees of confidence. This conforms to Ngalawa and Viegi (2011), who carried out a study on the dynamic effects of monetary policy shocks in Malawi.

Table 2: Lag Length Selection

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-2894.339	NA	2.01e+35	98.31658	98.52786	98.39905
1	-2486.762	718.4410	6.86e+29	85.72075	96.74371	86.29806
2	-2424.843	96.55157	2.96e+29	83.23382*	87.19967*	85.56281*
3	-2379.431	61.57630	2.37e+29	83.50098	87.58871	86.09006
4	-2313.279	76.24263*	1.14e+29	84.52307	88.53730	86.11406
5	-2269.398	41.65008	1.04e+29*	84.84214	88.78285	86.41055

5.3 The Presentation of the VAR Results and Analysis

To analyse the response of the economy (output growth) to the shocks from monetary and macro-prudential policies, an impulse or a shock of one standard deviation is applied. Since this study focuses on the macroeconomic effects of monetary policy and macro-prudential policy shocks on output growth, the impulse response functions of GDP (which captured output growth) to the tools of these policies are presented in Figure 1. In addition, since this study employs quarterly data, the impulse response functions are divided into periodical bases covering 3 years (as shown on the horizontal axis) in order to achieve a suitable analysis and

flexible interpretations of the response of the economy (output) to the shocks that occur through the process.

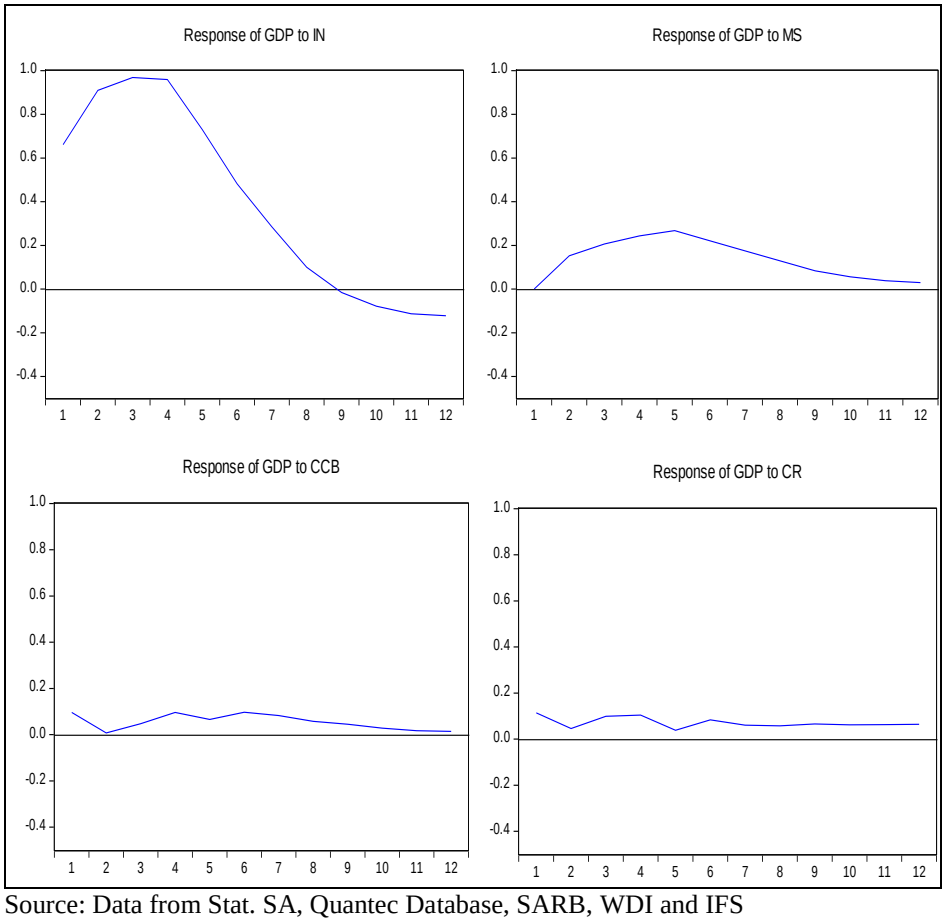
The response of GDP to monetary policy shock shows that a one standard deviation shock from interest rate negatively contracts output in the end while the money supply increases and stabilizes output growth in the long run. For example, the figure shows that GDP initially responds to an interest rate shock; it starts increasing, albeit marginally, reaching the peak in the third period and thereafter decreasing rapidly over a relatively long period and significantly contracting to a negative level for the remaining periods. The initial increase in GDP (output growth) observed is, nevertheless, surprising. A likely explanation is that following a rise in the expected rate of return (reflected by the increase in interest rates), South Africa's economy starts to attract capital inflows which trickle to the different sectors of the economy (including the industrial sector), hence, increase output production, the impact of which shows at the beginning. The persistent response (decline) that follows is consistent with the findings of Adelakun and Yousfi's (2020) and Ndou's (2023) study of monetary policy and output in South Africa. Both studies reveal that monetary policy shocks significantly explain a large portion of declines in output growth in the country.

In addition, a monetary policy shock characterized by an unexpected shock in money supply significantly causes output to initially increase and later decrease, bottoming out after eight periods. Thereafter, output remains generally constant for the entire period. This outcome may be due to the slight differences in the use of interest rates and money supply, as policymakers are always conscious or mindful of inflation when increasing the money supply in the economy. This finding conforms to Tumala et al. (2021) that expansionary monetary policy shock has a positive and stable effect on output growth. Overall, it can be inferred that monetary policy is capable of achieving the broader objective of price stability and output growth/stability in the economy. This is in line with Stein (2013), who states that monetary policy can affect all corners of the economy, including output and prices.

On the other hand, the macro-prudential policy shocks slightly and significantly affect output growth in the country. The two policy tools (counter-cyclical buffer (CCB) and capital requirements (CR)) show a slight and significant contraction or impact (when compared to monetary

policy) on output growth in the country. This might not be unconnected to the fact that banks in South Africa are well-capitalized, and an increase in the capital-based instruments does not drastically affect the performance of the banking sector; hence, they are still able to perform their function and contribute to the overall growth of the economy. This finding conforms to Maredza (2016), Hollander and Havemann (2021), and van Heerden et al. (2022), who reveal that South Africa's banking sector is properly regulated, well-developed, well-capitalized, and supported by a good legal framework. Our finding is in line with Kim and Mehrotra (2017), who reveal that the impacts of monetary and macro-prudential policy shocks on key macro variables are similar, with both contractionary policy shocks leading to a decline in real GDP.

Figure 1: Response of GDP to Monetary and Macro-prudential Shocks



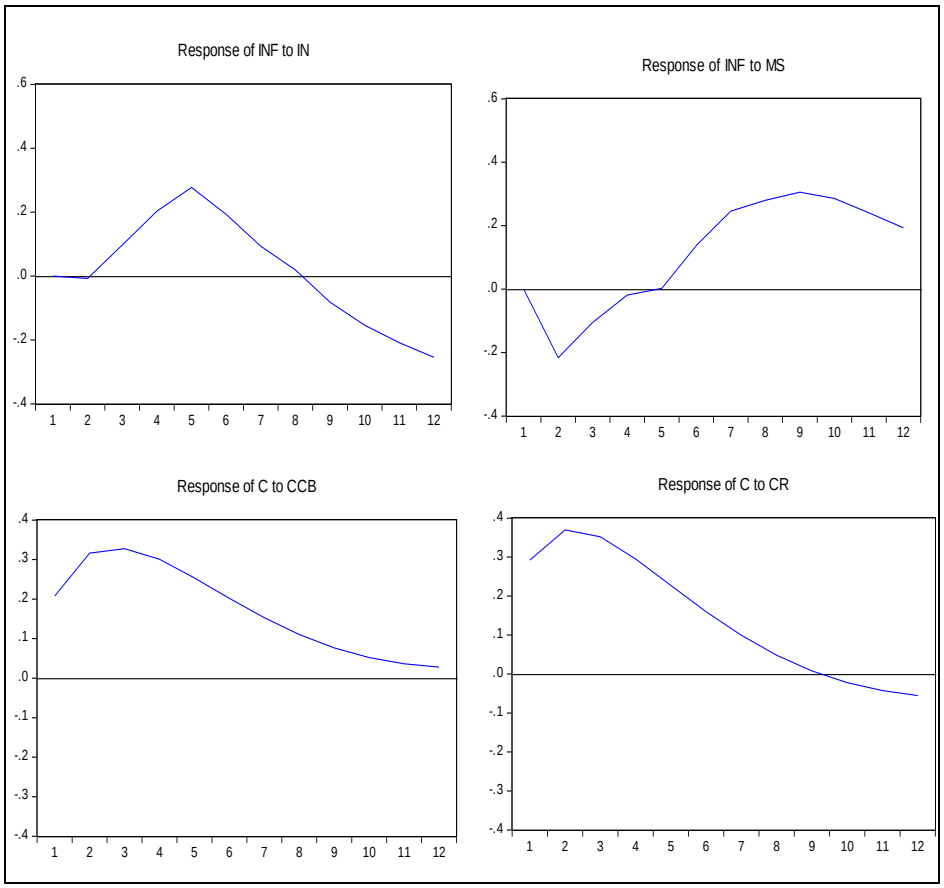
Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

Given the above findings from the macroeconomic effects of monetary and macro-prudential policy shocks on output growth, this study further investigates the effect of the policies on their primary targets. We test the view canvasses by Ntwaepelo (2021) that while monetary policy targets price stability to achieve its objective of stimulating the economy, macro-prudential policy primarily targets credit to achieve financial stability. This argument is also in line with the view expressed by Svensson (2018) that monetary policy should never respond to financial threats, and macro-prudential policy should never respond to price stability. As shown in Figure 2, an interest rate shock significantly reduces inflation, while money supply significantly increases inflation in the economy. In the same way, macro-prudential policy shocks of an increase in the capital base significantly reduce the bank credits. This shows that both the monetary policy and macro-prudential policies are strong and capable of achieving their targets. That is, monetary policy has a wide range of economic impacts of stabilising prices to achieve output growth, and macro-prudential policy has the impact of targeting the financial sector to achieve financial stability and increase the resilience of the financial system as well as supporting the monetary policy in achieving output growth through the indirect impact of credit on the economy. Therefore, we support the view of Kim and Mehrotra (2019) that the use of both policies will be more effective in enhancing the overall economic stability in South Africa.

In terms of the interaction and coordination of the two policies, it can be concluded that the macro-prudential policy could interact with the monetary policy function based on their impact on GDP (output). Although these policies pursue different objectives of financial and price stability, respectively, there is a possibility or likelihood of spillover effects as macro-prudential policy shocks were found to have a marginal an significant impact on output growth in the country. This is because; a strong and well-developed financial sector can indirectly contribute to the growth of output through the availability of credit to the investors. However, the preliminary deductions about how they should be set and coordinated are that macro-prudential policy should continue to have a distinctive policy target different from monetary policy. This is because macro-prudential policy shocks were found to strongly reduce credit, as shown in Figure 2. Therefore, making it a second mandate to work with the monetary policy will help to stimulate output growth in the economy. This means that the two policies should be conducted by SARB and not

by separate entities. Since both policies are interconnected, policymakers (monetary authorities) need to coordinate them effectively to achieve the optimal policy mix for stabilising the economy.

Figure 2: Response of the Target Variables to Monetary and Macro-prudential Shocks



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

5.4 Robustness Checks

The results presented in Tables 3 and 4, as well as Figure 3, are the various tests conducted on the VAR model to test its consistency, reliability, and normality. While Tables 3 and 4 present the results of the test for serial correlation and heteroskedasticity, Figure 3 presents the normality test results, respectively. Based on the results derived from the analysis, the p-value results of the three tests show that the model is free from serial

correlation, heteroscedasticity, and non-normality of the residuals. Given the benchmark null hypothesis that was tested for the model at a 5% level of significance, we do not have sufficient evidence to reject the null hypothesis of no serial correlation, no heteroskedasticity in the model, and the residuals being normally distributed.

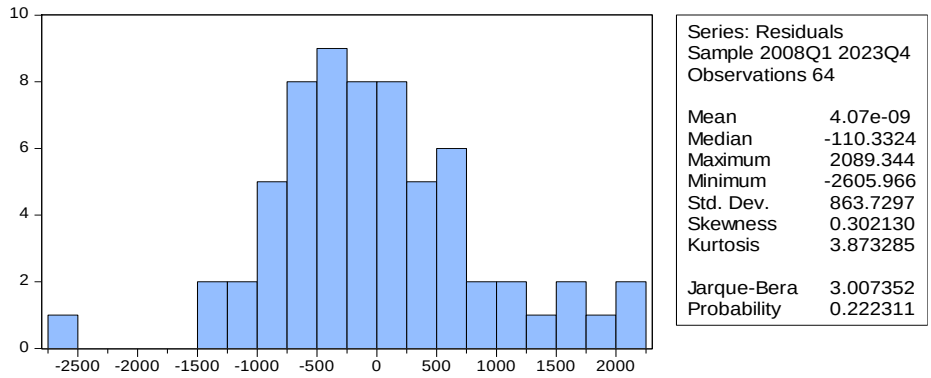
Table 3: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.015171	Prob. F(2,56)	0.3689
Obs*R-squared	2.239206	Prob. Chi-Square(2)	0.3264

Table 4: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	3.57342	Prob. F(8,84)	0.1418
Obs*R-squared	24.91137	Prob. Chi-Square(8)	0.1331
Scaled explained SS	16.71094	Prob. Chi-Square(8)	0.1571

Figure 3: Normality Test



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

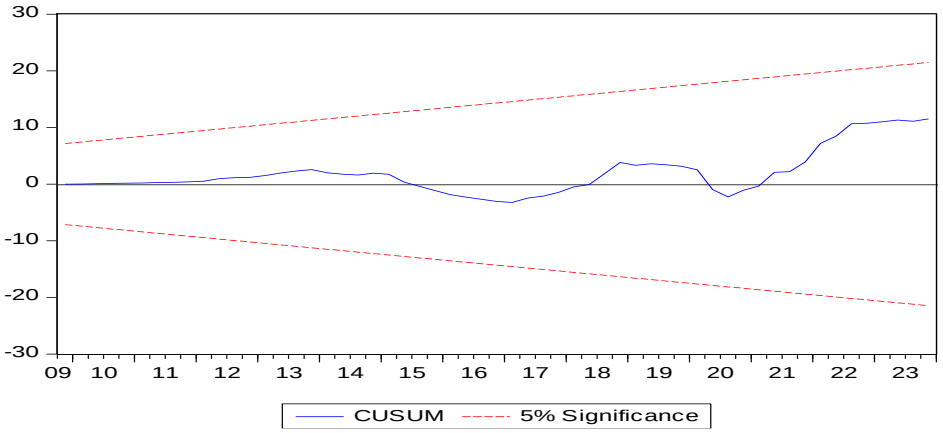
This means that the null hypothesis of no serial autocorrelation, no heteroscedasticity, and residuals are normally distributed is accepted for the Godfrey LM test, Breusch-Pagan-Godfrey test, and normality test for all lags since their p-values are greater than the significance values of 0.05 (5%). In line with Islam and Erum (2019), these results show that our

model is consistent, reliable and favourable in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa.

5.5 Stability Test

Figure 4 presents the result of the stability test conducted on the VAR model. The stability test investigates the stability or instability of the estimated coefficients in the model using the roots of the characteristic polynomial of the coefficient matrix A. The Recursive Chow test suggests that the benchmark VAR model will be stable over the sample period with no structural breaks.

Figure 4: Stability Test



Source: Data from Stat. SA, Quantec Database, SARB, WDI and IFS

The graphical Cusum test approach is employed for the stability test. Based on the result presented in Figure 4, since the line capturing our data passes within the 5% confidence interval, it means that our model is stable. The null hypothesis that the benchmark VAR model has no structural breaks, with sequential break dates starting from 2008 (and covering the period of COVID-19), shows that the model is stable over the time horizon. Given that the p-value is significantly higher than 5%, the null hypothesis of stability is accepted and cannot be rejected in line with Aastveit et al. (2017). The global financial crisis and COVID-19 do not constitute threats or create any structural breaks to the data. Hence, our model is stable and has no structural breaks in examining the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa.

5. Summary, Conclusion and Recommendation

This study examined the macroeconomic effects of monetary and macro-prudential policy shocks on output growth in South Africa using a VAR model and data that span from 2008Q1 – 2023Q4.

As shown by the impulse response functions, the main findings suggest that monetary and macro-prudential policy shocks have a significant impact on output growth in South Africa. Based on the results derived from the VAR analysis, a contractionary monetary and macro-prudential shock leads to a significant decline in output (real GDP), price level, and credit, similar to the findings revealed by Kim and Mehrotra (2017) that carried out a study on the effects of monetary and macro-prudential policies in the Asia-Pacific region. The contractionary effects can be due to the impacts of macro-prudential policy on lending by banks, investors, and household borrowing (impact on total credit), with the transmission indirectly affecting the level of output. Similarly, changes in the monetary policy interest rate significantly affect prices and output growth in the country. Interest rate shock was found to negatively contract output while the money supply increases and stabilizes output growth in the long run. Consistent with several studies like Adelakun and Yousfi's (2020) and Ndou's (2023), among others, monetary policy shocks to the interest rate significantly explain a large portion of declines in output growth while money supply helps to stimulate the economy.

While pursuing their specific objective, we find that an interest rate shock significantly reduces inflation while the money supply increases inflation in the economy. In the same way, the macro-prudential policy shock of an increase in the capital-based significantly reduces the bank credits. This is evidence that monetary policy and macro-prudential policies are capable of achieving their targets of price and financial stability, respectively. A contraction of monetary and macro-prudential policy will significantly reduce growing inflation and excess credit in the economy. Hence, helps to stabilize output growth and increase the resilience of the financial system in the country.

In terms of the interaction and coordination of the two policies and as policy suggestions and recommendations from this study, we revealed that macro-prudential policy could interact with the monetary policy based on its impact on output growth. The evidence from the VAR analysis reveals that there is a likelihood for spillover effects as macro-

prudential policy shocks were found to have a significant and marginal impact on output growth in the country. As a policy suggestion/recommendation, macro-prudential policy should continue to have a distinctive policy target different from monetary policy and should be made a second mandate to work with the monetary policy to stimulate output growth in the country. This invariably suggests that both policies should be conducted by SARB and not by separate entities because each policy cannot be conducted in a vacuum due to the spillover effects of both of them on the economy. Given that monetary policy enhances the effectiveness of macro-prudential policy to achieve the financial stability objective and macro-prudential policy also enhances the effectiveness of monetary policy to achieve the price stability objective, the two policies should be pursued jointly by the policymakers to simultaneously achieve stability in both the real sector and the financial sector.

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