

A Service of



Leibniz-Informationszentrum Wirtschaft Leibniz Information Centre for Economics

Buthelezi, Eugene Msizi

Article South African inflation response to fiscal policy shocks

Journal of Applied Economics

Provided in Cooperation with: University of CEMA, Buenos Aires

Suggested Citation: Buthelezi, Eugene Msizi (2024) : South African inflation response to fiscal policy shocks, Journal of Applied Economics, ISSN 1667-6726, Taylor & Francis, Abingdon, Vol. 27, Iss. 1, pp. 1-28, https://doi.org/10.1080/15140326.2024.2381168

This Version is available at: https://hdl.handle.net/10419/314284

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.



WWW.ECONSTOR.EU

https://creativecommons.org/licenses/by/4.0/

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.







Journal of Applied Economics

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/recs20

South African inflation response to fiscal policy shocks

Eugene Msizi Buthelezi

To cite this article: Eugene Msizi Buthelezi (2024) South African inflation response to fiscal policy shocks, Journal of Applied Economics, 27:1, 2381168, DOI: 10.1080/15140326.2024.2381168

To link to this article: https://doi.org/10.1080/15140326.2024.2381168

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



6

Published online: 30 Jul 2024.



Submit your article to this journal





View related articles 🗹



View Crossmark data 🗹

RESEARCH ARTICLE

OPEN ACCESS Check for updates

Routledge

Taylor & Francis Group

South African inflation response to fiscal policy shocks

Eugene Msizi Buthelezi

Department of Economics, University of Free State, Bloemfontein, South Africa

ABSTRACT

The research employs Bayesian Vector Autoregressions with hierarchical priors to analyze the intricate economic implications of fiscal policy shocks on inflation, monetary policy, and fiscal authorities in the context of South Africa. The study explores data spanning from 1979 to 2022. Contrary to conventional economic theories, our analysis demonstrates that unexpected increases in national government expenditure led to counterintuitive initial decreases in inflation. This highlights the complexity of inflation dynamics and challenges existing paradigms. Moreover, the lagged response of inflation to changes in government revenue emphasizes the role of inflation expectations and market dynamics. Clear communication by fiscal authorities is crucial for shaping these expectations and understanding their impact on inflation.

ARTICLE HISTORY

Received 1 March 2024 Accepted 2 July 2024

KEYWORDS

Fiscal theory of the price level; fiscal policy; Bayesian vector autoregressions; hierarchical prior

1. Introduction

In contemporary economic landscapes, the interplay between fiscal policy, inflation dynamics, and monetary policy has been the subject of enduring intrigues and scrutiny (Alrawashdeh et al., 2022; Coibion et al., 2021; Ferrara et al., 2021; Jørgensen & Ravn, 2022; Le & Finch, 2022; Sriyana & Ge, 2019; Ben Zeev & Pappa, 2017). The nuanced relationship between these pivotal economic forces has significant implications for policymakers and practitioners. However, fiscal policy plays a major role in an economy by influencing macroeconomic performance to increase economic activity and achieve price stability. Fiscal policy's role in regulating economic activity over time using instruments such as public spending and taxation levels influences aggregate demand and, therefore, economic growth, but these tools also lead to higher inflation.

At the empirical level there is no consensus on the effect of fiscal policy on inflation (Alrawashdeh et al., 2022; Coibion et al., 2021; Ferrara et al., 2021; Jørgensen & Ravn, 2022; Le & Finch, 2022; Sriyana & Ge, 2019; Ben Zeev & Pappa, 2017) found that a government spending shock increases price or inflation. Other studies have been conducted (Galí et al., 2007; Mohamed, 2016; Otto & Ukpere, 2015; Ramey, 2011) find either a non-significant response or mixed evidence. However, a large number of papers (Caramp & Silva, 2023; Checherita-Westphal et al., 2023; D'alessandro et al., 2019;

© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/ licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

CONTACT Eugene Msizi Buthelezi 🖾 msizi1106@gmail.com 🖃 Department of Economics, University of Free State, Bloemfontein, South Africa

Lowndes & Mccaughie, 2013; Nakata & Schmidt, 2022; Paulus & Tasseva, 2020; Ricco et al., 2016) find that a government spending shock is deflationary.

The literature provides a fragmented view of how fiscal policy influences inflation, leading to mixed results and inconclusive policy implications. This study contributes significantly by adopting a comprehensive approach that considers both expansionary and contractionary fiscal policy shock. This goes beyond previous studies by examining the effects of these shocks on inflation using a Bayesian Vector Autoregression (BVAR) model,¹ which allows for a more nuanced understanding of the dynamics involved. Additionally, this study utilizes a novel dataset developed by Buthelezi and Nyatanga (2023c) that captures the time-varying fiscal consolidation government expenditure *tvp_elstcy_capb_g* and tota government revenue *tvp_elstcy_capb_tgr*, developed by Buthelezi and Nyatanga (2023c). Annexure 2 Equation A1 to A6 show the calculation of the discretionary action of the fiscal authorities. This dataset adds a temporal dimension to the analysis, enabling a more accurate representation of the actions of fiscal authorities. Moreover, the utilization of novel data sets allows for a more accurate assessment of the real-time impact of fiscal authority actions, enabling policymakers to make more informed and timely adjustments to fiscal policy in response to changing economic conditions. Ultimately, this study serves as a valuable resource for policymakers seeking to manage inflation and to promote economic stability in South Africa.

Figure 1 shows the economic variables, and it is noted that over time, the inflation rate has shown a declining trend. However, in the persistent time the challenge is that inflation is operating near or at the upper band of the target range of since the adoption of the inflation targeting of 3% to 6% framework suggests underlying structural issues that may hinder the effectiveness of monetary policy in controlling price levels. Despite efforts to maintain price stability through inflation targeting, the economy has struggled to consistently keep inflation within the desired range. The sustained increase in government expenditure over the years reflects the government's efforts to stimulate economic growth. However, excessive government spending, especially when not matched by corresponding revenue generation, can strain fiscal sustainability, and exacerbate inflationary pressures. Lastly, the repo rate has remained relatively stable over time and falling. A low repo rate encourages borrowing and spending by businesses and consumers since it makes credit more affordable. If borrowing and spending increase significantly without a corresponding increase in productivity and output, it can lead to excess demand in the economy, which fuels inflationary pressures.

This study applies Bayesian vector autoregression to analyze fiscal policy shocks, inflation, and monetary policy in South Africa from 1979 to 2022. It challenges conventional economic theories, revealing that unexpected government expenditure increases initially reduce inflation. This underscores the importance of clear communication from fiscal authorities to shape expectations. Coordination between fiscal and monetary authorities is vital, with the South African Reserve Bank needing to adjust monetary policy strategies to tackle nontraditional inflation responses to fiscal shocks.

¹The departure point of this paper from the current literature is its focus on examining the inflationary effects of both expansionary fiscal policy through an increase in government expenditure in the BVAR model and contractionary fiscal policy through government revenue shocks in the same model.



Figure 1. Economic variables. Note *infl* inflation, g is national government expenditure, tgr is the national government revenue as % of GDP and pr the repo rate.

The findings have crucial implications for policy formulation in South Africa. Understanding how different fiscal policy measures impact inflation is of paramount importance to policymakers. By examining expansionary and contractionary fiscal policies, this study provides policymakers with a more nuanced understanding of the potential consequences of their decisions. This knowledge can inform the design of more effective and targeted fiscal policies to achieve specific inflation targets. The findings challenge conventional economic theories, such as the fiscal theory of price, by showing unexpected responses of inflation to government expenditure shocks. This challenges policymakers to reassess their strategies and understand the complex dynamics between fiscal policy, monetary policy, and inflation. Policymakers rely on accurate assessments of the effects of their actions on the economy. These results offer nuanced insights into how government spending and revenue impact inflation rates over time, informing the design and implementation of fiscal and monetary policies aimed at achieving macroeconomic stability.

The remainder of this paper is organized as follows. Section 2 outlines the literature review. Section 3 discusses the methodology used in this study. Finally, section 4 discusses the empirical results. Finally, Section 5 presents the conclusions of the study.

2. Literature review

Tanjung et al. (2019) investigated government spending impacts inflation in emerging economies. VEC modeling from 1970 to 2010 shows significant correlation in three countries, suggesting a consistent relationship regardless of governance differences. Asandului et al. (2021) investigate fiscal policy's asymmetric effects on inflation with the PMG model. Long-term fiscal policy negatively affects inflation and economic activity. Short-term effects are insignificant. Eita et al. (2021) examined fiscal deficit's impact on inflation using ARDL from 2002 to 2017. Long-term: fiscal deficit positively affects Namibia's inflation. Causality runs from fiscal deficit to inflation. Liu et al. (2021) studied monetary and fiscal policies in China from 1993 to 2017. Found significant impact on inflation and output growth in short and long terms. Banerjee et al. (2022) use a panel of advanced economies to examine the inflationary effects of fiscal deficits. It was found that higher deficits had an average effect on inflation. Moreover, both the mean and variance of future inflation are higher under fiscal dominance than they are under monetary dominance. Bianchi and Melosi (2022) studied fiscal framework's impact on inflation. Found changes affect trend inflation significantly, while cost-push shocks have temporary effects. Pre-pandemic, moderate fiscal inflation countered deflationary pressure, aiding central bank in averting deflation. Nguyen et al. (2022) investigate fiscal policy and inflation from 1997 to 2020 using the Vector Autoregression (VAR) model. They found that inflation is positively influenced by fiscal deficits. Among these, government expenditure has the greatest influence on inflation. Abo-Zaid and Sheng (2023) examine labor markets, fiscal policy, and inflation dynamics. It was found that they are downward nominal wage rigidity plays a role in wage and price inflation. Fiscal policy alone cannot replicate inflation behavior, and matching frictions can, but coupling it with changes in matching efficiency generates a faster reversal in inflation. Cevik and Miryugin (2023) explored the fiscal shock effects on inflation across 139 countries from 1970 to 2021. The findings show that inflation increases with an expansionary fiscal policy. Notably, this impact is more pronounced in developing countries. In addition, the extent of the inflationary impact depends on factors such as fiscal capacity, economic conditions, monetary policy, exchange rates, and fiscal rules during the shock.

Sriyana and Ge (2019) investigated the symmetric responses of both fiscal variables to the inflation rate in the short- and long-run from 1971 to 2017 using the nonlinear autoregressive distributed lag model (NARDL). It was found that government spending contributes more than the budget deficit to an increase in the inflation rate. Coibion et al. (2021) fiscal policy's link to household inflation expectations via a survey of 92,390 households. It was found that present debt or deficit awareness minimally impacted inflation expectations. However, households anticipated higher short and long-term inflation when informed about future debt levels. Ferrara et al. (2021) investigated the impact of government spending shocks on inflation, spanning 1964Q1 to 2015Q4, by employing Bayesian VAR analysis. Their findings indicate that an increase in government spending leads to an appreciation of the real exchange rate and triggers inflationary pressures of 0.27% in the first three years. Jørgensen and Ravn (2022) investigated the impact of government spending shocks on inflation using the SVAR model from the fourth quarter of 1966 to the fourth quarter of 2019. The study uncovered a notable contradiction in the empirical evidence, showing that

prices do not exhibit a significant increase in response to a positive government spending shock. Le and Finch (2022) studied trend inflation's impact on policy shocks using a New Keynesian DSGE model from 1996Q1 to 2015Q1. Results: Higher trend inflation exacerbates effects of policy shocks. Money supply may lose effectiveness, and using government budget for recurrent spending has severe consequences in high-trend inflation economies. Alrawashdeh et al. (2022) investigated the effectiveness of fiscal policies in targeting inflation from 1992 to 2000 using ARDL. It was found that direct taxes have a significant negative impact on the consumer price index. They found a significant and positive effect of indirect taxes, the import price index, and real GDP on the consumer price index. D'alessandro et al. (2019) used a Bayesian structural vector autoregression analysis from 1954Q3 to 2007Q4 it was found that increase in government purchases it was found that an increase in government spending increases hours and induces skill accumulation, and real wages. Overall, marginal costs decrease, lowering expected inflation and increasing consumption. Paulus and Tasseva (2020) examined Europe through the crisis of discretionary policy changes and automatic stabilizers from 2007 to 2019 in 27 EU countries. It was found that higher-than-price inflation was clearly pro-poor across countries, leading to larger relative income gains at the bottom than at the top of the distribution.

Bordo and Levy (2021) investigated if rising fiscal deficits caused inflation using historical data from 1965 to 2019. During the Global Financial Crisis, expansionary policies didn't cause inflation. However, COVID-19 responses raised concerns about fiscal dominance and future inflation Nakata and Schmidt (2022) analyzed optimal time-consistent policies in New Keynesian DSGE model. Simulations show raising inflation target, appointing low inflation-biased central banker, or using government spending for stabilization may worsen deflationary pressures and demand shortfalls in liquidity trap periods. Caramp and Silva (2023) fiscal policy and monetary transmission. Economy's response to monetary policy depends on fiscal support. DSGE model simulations show inflation decrease from contractionary monetary policy relies on subsequent contractionary fiscal policy implementation. Checherita-Westphal et al. (2023) examined inflation differences and fiscal policies in 19 Euro area countries from 1999 to 2019. Their findings reflect the impact of fiscal policies on the inflation differences. Fiscal policy seems to be more effective in controlling inflation differences when the economy exceeds its potential.

As reflected in Table 1, the existing literature presents mixed findings on the relationship between fiscal policy and inflation, employing various methodologies, such as proxying fiscal policy through narrative approaches based on government expenditure increases and cuts (expansionary and contractionary fiscal policies), government expenditure shocks, tax shocks, the narrative approach, shock of fiscal economic variables, and stochastic volatility shocks.

3. Methodology

This study uses quantitative analysis to investigate the fiscal theory of the price level in action in the South African inflation response to fiscal policy shocks analyzed through Bayesian vector autoregressions with hierarchical priors. South Africa is selected for

| Response of inflation | Scholars | Mesurese of fiscal policy |
|--------------------------|---|---|
| Inflationary | Alrawashdeh et al., (2022); Coibion et al., (2021); Ferrara et al., (2021); Jørgensen and Ravn, (2022); Le and Finch, (2022); Sriyana and Ge, (2019); Ben Zeev and Pappa, (2017) | Government expenditure shock, tax shock, the narrative approach, shock of the fiscal economic variables, and stochastic volatility shocks. |
| Disinflationary | Bordo and Levy, (2021); Caramp and Silva, (2023); Checherita-Westphal et al., (2023); D'alessandro et al., (2019); Lowndes and Mccaughie, (2013) Nakata and Schmidt, (2022), Paulus and Tasseva, (2020); Ricco et al., (2016) | Government expenditure shock, tax shock, the narrative approach, the shock of the fiscal economic variables, and stochastic volatility shocks. |
| Not reported | Galí et al., 2007; Mohamed, 2016; Otto and Ukpere, (2015); Ramey, (2011). | Government expenditure shock, tax shock, the narrative approach, shock of the fiscal economic variables, and stochastic volatility shocks. |

| Table | 1. | Empirical | estimates | of | inflation | response. |
|-------|----|-----------|-----------|----|-----------|-----------|
|-------|----|-----------|-----------|----|-----------|-----------|

| Variable | Description | Sourced | | | |
|--|--|--------------------------------|--|--|--|
| Theoretical framework variables | | | | | |
| infl | Inflation rate | SARB (2023) | | | |
| e_infl | Expected inflation | Computed | | | |
| e_m_P | Real balances | Computed | | | |
| pr | Repo rate | SARB (2023) | | | |
| e_g | National government expenditure | SARB (2023) | | | |
| e_tgr | National government revenue as % of GDP | SARB (2023) | | | |
| Economic variables that proxy fiscal consolidation used the discretion of fiscal authorities | | | | | |
| tvp_elstcy_capb_g | Time-varying CAPB for government expenditure | Buthelezi and Nyatanga (2023c) | | | |
| tvp_elstcy_capb_tgr | Time-varying CAPB for total government revenue | Buthelezi and Nyatanga (2023c) | | | |

| Table 2. Economic | variables | utilized. |
|-------------------|-----------|-----------|
|-------------------|-----------|-----------|

investigation as it proved a dynamic economy fiscal consolidation impact of price levels. On the other hand, recent policy changes, including fiscal consolidation measures, make it a pertinent case study. Comprehensive data, exemplified by Buthelezi and Nyatanga (2023c), allows for in-depth analysis and meaningful conclusions. This study uses annual data from 1979 to 2022. The economic variables in this study are reflected in Table 2, where *infl* is inflation, which is the central economic variable of interest when investigating the FTPL.

This serves as an anchor for understanding how fiscal policy impacts the overall price level in South Africa. The *e_infl* is essential for capturing the role of expectations in the FTPL. This allows us to assess how economic agents anticipate future inflation, based on their perceptions of fiscal policy decisions. The real balance *e_m_p*, representing the real value of money or financial assets held by households and firms, plays a pivotal role in the transmission of fiscal policy instrument. Its inclusion allows us to examine how monetary policy responds to fiscal policy shocks, and how changes in interest rates affect inflation. The *e_greflects* the government spending decisions that directly impact the economy. By including national government expenditures, we can analyze how changes in fiscal policy, particularly government spending, affect inflation dynamics. The *e_tgr* revenue-to-GDP ratio reflects a government's fiscal health. It provides insights

into the government's ability to finance expenditure and fiscal sustainability. The time-varying cyclically adjusted primary balance for government expenditure is denoted as *tvp_elstcy_capb_g*. This variable offers a nuanced perspective on government fiscal policies. This captures the cyclically adjusted primary balance for government expenditure, accounting for economic fluctuations. This allows us to assess how fiscal sustainability and budget constraints evolve, and their implications for inflation. The *tvp_elstcy_capb_tgr* reflects the time-varying cyclically adjusted primary balance for total government revenue, similar to the previous variable, which provides insights into the cyclically adjusted primary balance, but for total government revenue (Buthelezi, 2024; Buthelezi & Nyatanga, 2023a, 2023b).

The Bayesian vector autoregression (VAR) with Hierarchical Priors is the preferred model for investigating the Fiscal Theory of the Price Level (FTPL) in the context of South African inflation responses to fiscal policy shocks. This model has key advantages over the error correction model and autoregressive distributed lag, among others. Bayesian VAR models offer greater flexibility in capturing the dynamics and interactions among macroeconomic variables (Kuschnig & Vashold, 2021b). Hierarchical priors in BVAR models enable the incorporation of prior information at different levels of the model. This allows for the incorporation of expert knowledge and historical data, which may provide valuable insights into the relationship between fiscal policy and inflation (Gefang et al., 2023; Lenza & Primiceri, 2022). Unlike many traditional models, Bayesian VARs can easily accommodate time-varying parameters (Chan, 2022; Tsionas et al., 2022). Bayesian VAR models can be used to recover structural shocks, which can help identify the underlying economic mechanisms. In the context of investigating FTPL, understanding structural responses to fiscal policy shocks is essential for drawing meaningful policy conclusions (Bruns & Piffer, 2023). Buthelezi (2023) investigated the impact of inflation in different states of unemployment: evidence with the Phillips curve in South Africa. It was found that there are 2 states of unemployment mean rates of 25.55% and 33.59%, expected to run for 67 and 7 quarters, respectively.

3.1. Theoretical framework

In the FTPL, the price level depends on expectations of future fiscal policy actions, such as changes in government spending or taxation. Agents' expectations about these actions influence their behavior and price-setting decisions. This framework is presented in Equation 1.

$$P = E[P] + E\left[\sum \left(\frac{m}{p}\right) + \Delta e_g - \Delta e_tgr\right]$$
(1)

Where P = infl is the price level or inflation rate, $E[P] = e_infl$ expected inflation, E[] is the expectation operator, $\sum \left(\frac{m}{p}\right)$ is the sum of the real balances $\left(\frac{m}{p}\right) = e_m_p$ held by agents, Δe_g is the expected change in government spending, Δe_tgr is the expected change in taxes. In this study, we expected the theoretical framework to include other economic variables of interest, as reflected in Equation 2. 8 👄 E. M. BUTHELEZI

$$P = E[P] + E\left[\sum \left(\frac{M}{P}\right) + \Delta e_{g} - \Delta e_{tgr}\right] + pr + tvp_elstcy_capb_g + tvp_elstcy_capb_tgr$$
(2)

The variable *pr* represents the repo or policy rate, which signifies the impact of monetary policy on inflation. Meanwhile, *tvp_elstcy_capb_g* and *tvp_elstcy_capb_tgr* indicate the contractionary effect of the fiscal policy on inflation. These variables encapsulate fiscal consolidation measures involving reductions in government spending and tax increases.

3.2. Model specification

The Bayesian VAR (BVAR) model adopted in this study is reflected in Equation 3.

$$y_t = \alpha_0 + A_1 y_{t-1} + \ldots + A_p y_{t-p} + \in_t, \in_t \tilde{N}\left(0, \sum x\right)$$
(3)

In the model, we have a column vector consisting of seven endogenous variables denoted as *inf*, *e_infl*, *e_m_p*, *e_g*, *e_tgr*, pr, *tvp_elstcy_capb_g*, and *tvp_elstcy_capb_tgr*. A 7×1 vector is represented by α_0 , which serves as the intercept. However, we have a 7×7 matrix (j = 1, ..., p) that contains autoregressive coefficients for the regressors, where p is the order of the BVAR. Finally, \in_t is a 7×1 vector comprising Gaussian exogenous shocks characterized by a zero mean and a variance-covariance matrix denoted by $\sum x$. The total number of coefficients to be estimated in this model is 7+7²_p, and this number increases quadratically with the number of included variables and linearly with lag order.

The Bayesian methodology employed for the estimation of VAR (Vector Autoregressive) models effectively addresses a notable constraint by introducing an augmented structural framework. We follow the estimation framework by (Zungu et al., 2022). This augmentation entails the incorporation of prior information, a strategic choice that has garnered empirical validation to alleviate the curse of dimensionality. As evidenced by the empirical study of (Marta et al., 2010), this approach enables the estimation of expansive models. The utilization of informative priors serves to guide model parameters towards a more parsimonious reference point, yielding a reduction in estimation errors and a consequent improvement in out-of-sample projection accuracy, as expounded by Koop (2013). Notably, this process of "shrinkage" bears resemblance to prevalent frequentist regularization techniques, as delineated in the research of De Mol et al. (2008).

3.3. Selection of hierarchical priors and specification

Effective information on prior beliefs is crucial, as flat priors often yield suboptimal results (Marta et al., 2010). Del Negro and Schorfheide (2004) favored values that optimize data density, and Marta et al. (2010) addressed overfitting. Annexure 1 show the residuals of the economic variables considered. Giannone et al. (2015) introduced data-driven hyperparameters in Bayes' law, as reflected in Equations 4 to 5.

$$p(\gamma|\gamma)\alpha p(\gamma|\theta,\gamma)p(\theta|\gamma) \tag{4}$$

$$p(y|y) \quad p(y|\theta, y)p(\theta|y)d\theta$$
 (5)

The equation $y = (y_p + 1..., y_p)$ defines the VAR parameter θ and hyperparameter γ . Equation 3 marginalizes Equation 2, yielding the data density function $p(y|\gamma)$ and the marginal likelihood (ML). ML depends on γ and indicates the hyperparameter choice. Giannone et al. (2015) advocate this empirical Bayes approach as it robustly explores the hyperparameter space while acknowledging uncertainty, yielding theoretically sound results when efficiently implemented. In the selected Normal-inverse-Wishart (NIW) framework, we approach the model in Equation 1 by letting $A = [a_0, A_1, \ldots, A_p]^T$ and $\beta = vec(A)$, and then the conjugate prior setup, as reflected in Equations 6 to 7.

$$\beta | \sum \sim N \left(b, \sum \otimes \Omega \right) \tag{6}$$

$$\sum \sim IW(\Psi, d) \tag{7}$$

where *b*, and Ω , Ψ , and *d* are all dependent on a lower-dimensional vector of hyperparameters, denoted as γ . Giannone et al. (2015) considered three priors in their study: the sum-of-coefficients prior, single unit-root prior, and Minnesota (Litterman) prior, which was used as a baseline. The prior is characterized by Equations 8–9.

$$E(A_s)_{ij} | \sum = \begin{cases} 1, and \ i = j, s = 1\\ 0, and otherwis \end{cases}$$
(8)

$$cov(A_s)_{ij}(A_r)_{kl} | \sum = \begin{cases} \lambda^2 \frac{1}{S^{\sigma}} \frac{\sum jk}{\Psi/(d-m-1)}, \text{ and if } l = j \text{ and } r = s \\ 0, \text{ and otherwis} \end{cases}$$
(9)

where λ controls for prior influence, with $\lambda \to 0$ enforcing strict priors and $\lambda \to \infty$ approximating ordinary least squares. The ψ represents the prior standard deviation of the variable lags. The Minnesota prior reduces the deterministic component, while the sum-of-coefficients prior assumes no change initially using dummy observations (Giannone et al., 2015). It is implemented via Theil mixed estimation by adding artificial dummy observations to the data matrix, which is reflected in Equation 10.

$$\frac{y^+}{M*M} = diag\left(\frac{\bar{y}}{\mu}\right) + \frac{x^+}{M*(1+MP)} = [0, y^+, \dots, y^+]$$
(10)

Equation 10 is a 7×1 vector of the variable averages over the initial p observations. Variance is controlled by μ , and $\mu \to \infty$ makes the prior uninformative, and $\mu \to 0$ leads to unit roots with no co-integration. The single unit root (SUR) prior by Sims and Zha (1998) allows cointegration relations and influences variables accordingly. These types of priors are associated with the dummy observations in Equation 11.

$$\frac{y^{++}}{1*M} = \frac{\bar{y}}{\delta} + \frac{x^{++}}{1*(1+MP)} = \left[\frac{\bar{y}}{\delta}, y^{++}, \dots, y^{++}\right]$$
(11)

where \bar{y} is again distinct, as mentioned above, and δ is the key parameter governing the tightness of the SUR prior. Numerous heuristics for determining hyperparameters associated with prior distributions have been explored in the literature, with notable

contributions from Doan et al. (1984) and Marta et al. (2010). The estimation of these hyperparameters, achieved through the maximization of marginal likelihood (ML), embodies an empirical Bayes methodology, as elucidated by Giannone et al. (2015), offering a distinct interpretation from the frequentist perspective within the realm of economic analysis.

3.4. Robust check model with SVAR

The model adopted in this study is the SVAR because it offers attractive properties of imposing structural restrictions (Gottschalk, 2001), which may been need on the analysis of climate change and fiscal sustainability. Moreover, the SVAR model capture the dynamic interactions between variables over time and address endogeneity issues inherent in VAR and VEC models (Braun & Brüggemann, 2023). On the other hand, the model provides a framework for assessing the impact of policy interventions on the economy (Braun & Brüggemann, 2023). This allows for informed decision-making and the design of policies that balance environmental objectives and financial sustainability. The SVAR starts from the VAR which reflects the data generation process with endogeneity for each variable as reflected in Equation 12.

$$x_t = A_t x_{t-1} + \ldots + A_p x_{t-p} + \varepsilon_t \tag{12}$$

where variables of N number: $x_t = (x_t, \ldots, x_{kt})'$ while x_t is the Nx1 vector containing the model variables f_t is a matrix containing NxN autoregression coefficients, and $\varepsilon_t = (u_t, \ldots, u_{kt})$ is the unobserved error term which is a vector with Nx1 Gaussian distribution containing a discrete representation white noise process and $\varepsilon_t(0, E(u_t, u_t'))$ is a positive definite covariance matrix. In formulating Equation 12, with various limitations on the parameters, the study employs Cholesky's approach for the short-term constrain which depict shocks (Higham, 2009). Conversely, employing the Blanchard-Quah method involves imposing long-term restrictions. To achieve this the reduced form VAR in Equation 12 is multiplied by A^{-1} an inverse to formulate the SVAR model in Equation 13.

$$Ax_{t} = A_{t}^{s} x_{t-1} + \ldots + A_{p}^{s} x_{t-p} + bu_{t}$$
(13)

where $\varepsilon_t = A^{-1}bu_t$ and $s = A^{-1}b$. Cholesky's long-run shocks are reflected in the matrix 14.

$$\varepsilon_{t} = su_{t} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{t21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{t31} & a_{t32} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{t41} & a_{t42} & a_{t43} & 1 & 0 & 0 & 0 & 0 \\ a_{t51} & a_{t52} & a_{t53} & a_{t54} & 1 & 0 & 0 & 0 \\ a_{t61} & a_{t62} & a_{t63} & a_{t64} & a_{t65} & 1 & 0 & 0 \\ a_{t71} & a_{t72} & a_{t73} & a_{t74} & a_{t75} & a_{t76} & 1 & 0 \\ a_{t81} & a_{t82} & a_{t83} & a_{t84} & a_{t85} & a_{t86} & a_{t87} & 1 \end{bmatrix} = \begin{bmatrix} u_{t}^{u_{t}^{tn}} \\ u_{t}^{e_{-m}-P_{t}} \\ u_{t}^{e_{-g_{t}}} \\ u_{t}^{e_{-g_{t}}} \\ u_{t}^{tvp_elstcy_capb_g_{t}} \\ u_{t}^{tvp_elstcy_capb_g_{t}} \\ u_{t}^{tvp_elstcy_capb_g_{t}} \end{bmatrix}$$
(14)

4. Empirical analysis and interpretation results

4.1. Impulse responses of the Bayesian VAR

Figure 1 shows the impulse responses of e_g and e_tgr and prfrom the Bayesian VAR model. The first graph in Figure 1 shows $e_g \rightarrow \uparrow$ inf the plot of inflation rate response to an unexpected 1% shock on national government expenditure. The shock of national government expenditure resulted in a slight decrease in the inflation rate in the first two years. This result is inconsistent with the fiscal theory of price, which states that an increase in government expenditure results in an increase in price levels (Buiter, 2002; Cochrane, 2023). These results are similar to those of (Bordo & Levy, 2021; Caramp & Silva, 2023; Checherita-Westphal et al., 2023; D'alessandro et al., 2019; Lowndes & Mccaughie, 2013; Nakata & Schmidt, 2022; Paulus & Tasseva, 2020; Ricco et al., 2016). Lowndes and Mccaughie (2013) provide evidence of the disinflationary nature of fiscal policy. These results imply that in South Africa, a decrease in inflation, even if temporary, could be seen as a positive sign for macroeconomic stability in the short term, as it may reduce the likelihood of inflationary pressures. South African policymakers may need to reassess the effectiveness of fiscal policies in influencing inflation. If government expenditure does not lead to expected price increases, alternative strategies may be needed to achieve the desired inflation targets. SARB may need to carefully consider its monetary policy stance in response to unexpected fiscal shocks. If fiscal policy does not lead to inflationary pressure, the central bank may need to take a more proactive role in managing inflation through its monetary policy tools.

Figure 2, second graph, shows $e_tgr \rightarrow \uparrow inf$ the plots inflation rate response to unexpected 1% shock on to national government revenue as % of GDP. In the shock of the national government revenue as % of GDP is significant and starts to have a stable effect on inflation in the first year in the second year inscription starts to increase. These results are similar to those of (Alrawashdeh et al., 2022; Coibion et al., 2021; Ferrara et al., 2021; Jørgensen & Ravn, 2022; Le & Finch, 2022; Sriyana & Ge, 2019; Ben Zeev & Pappa, 2017). Ben Zeev and Pappa (2017) among others that found fiscal policy results in inflationary pressure. The result also suggests that inflation during the first year following the shock implies that there might be a lag in how changes in government revenue affect consumer prices and the general price level. This lag could be due to various factors, including expectations and market dynamics. When businesses face the shock of the national government revenue. This is reflected in an increase in costs and businesses' profit margins can come under pressure. To maintain or protect their profit levels, businesses may respond by passing on these higher costs to consumers in the form of higher prices for goods and services.

Figure 2, third graph shows $pr \rightarrow \uparrow inf$ the plot's inflation rate response to the unexpected 1% shock on the repo rate. The shock of the repo rate on the inflation rate is found to result in a fall in the inflation rate from year one to year four. The results are in line with that of (Banerjee et al., 2022; Cevik & Miryugin, 2023; Liu et al., 2021) among others who have also found that monetary policy interventions can effectively influence inflation outcomes. On the other hand, the result reflects the transmission of the repo rate shock reflecting that the unexpected hike typically leads to higher interest rates in the broader economy. Higher interest rates can reduce borrowing and spending by both



Figure 2. Generated impulse responses of *e*_*g* and *e*_*tgr* and *pr*from the Bayesian VAR. The area is 90%, 95%, 70% and 50% credible interval for the estimation. Where *infl* inflation rate, *e*_*infl*expected inflation, *e*_*m*_*p* real balances, *pr*repo rate, and *e*_*g*national government expenditure.

consumers and businesses, which, in turn, can lead to decreased demand for goods and services. This reduced demand can put downward pressure on prices, contributing to a decline in the inflation rate.

Figure 3 shows the impulse responses of $tvp_elstcy_capb_g$ generated from the Bayesian VAR model. The first graph in Figure 3 shows $tvp_elstcy_capb_g \rightarrow \uparrow inf$ the plot of inflation rate response to an unexpected 1% shock on national government expenditure. An increase in government expenditure cuts (proxied by time varying CAPB for government expenditure) led to a sustained decrease in the price level over the first four years. However, in the fifth year, this trend reversed dramatically, causing prices to surge above the equilibrium level; this upward trajectory continued in subsequent years. This result is contrary to those of (Bordo & Levy, 2021; Caramp & Silva, 2023; Checherita-Westphal et al., 2023; D'alessandro et al., 2019; Lowndes & Mccaughie, 2013; Nakata & Schmidt, 2022; Paulus & Tasseva, 2020; Ricco et al., 2016). Lowndes and Mccaughie (2013). The



Figure 3. Generated impulse responses of *tvp_elstcy_capb_g* from the Bayesian VAR. The area is 90%, 95%, 70% and 50% credible interval for the estimation. Where *infl* inflation rate, *e_infl*expected inflation, *e_m_p* real balances, *pr*repo rate, *e_gnational government expenditure*, and *tvp_elstcy_capb_g* time-varying CAPB for government expenditure.

shock of an increase in government expenditure cuts reduces the components of aggregate demand in an economy. If the reduction is significant, it can lead to a situation in which the supply of goods and services exceeds demand, putting downward pressure on prices. On the other hand, a decrease in government spending is a form of fiscal policy tightening, which can counterbalance inflationary pressures that might have been increasing. Business and consumer expectations play a role in shaping inflation. If government expenditure cuts are seen as a signal that policymakers are committed to fiscal discipline and price stability, they can influence expectations. Businesses may reduce their price-setting behavior and consumers may adjust their inflation expectations downward.

Figure 4 shows the impulse responses of tvp_elstcy_capb_g generated from the Bayesian VAR model. The first graph in Figure 4 shows $tvp_elstcy_capb_g \rightarrow \uparrow inf$ the



Figure 4. Generated impulse responses of *tvp_elstcy_capb_g* from the Bayesian VAR. The area is 90%, 95%, 70% and 50% credible interval for the estimation. Where *infl* inflation rate, *e_infl*expected inflation, *e_m_p* real balances, *pr*repo rate, *e_gnational government expenditure*, and *tvp_elstcy_capb_tgr* time-varying CAPB for total government revenue.

plot of inflation rate response to an unexpected 1% shock on national government expenditure. An unexpected surge in total government revenue triggered an inflation rate increase in the first year. This upward trend continues through the second year, peaking in year six, after which diminishing returns set in, leading to a subsequent decline in the inflation rate.

This result suggests that in the first year, the infusion of additional government revenue into the economy can be seen as a fiscal stimulus. Increased government spending, particularly on capital expenditure or other economic activities, injects money into the economy and drives up demand for goods and services. This heightened demand in turn exerts upward pressure on prices, resulting in an initial increase in the inflation rate. The sustained upward trend in inflation over the first few years suggests a delayed impact of the fiscal stimulus. It takes time for increased government revenue to filter through the economy and for businesses and consumers to adjust their behavior in response to surplus funds. During this period, inflationary pressure continued to increase. The peak inflation in year six indicates that the initial stimulative effect of the surge in government revenue has reached its zenith. At this point, the economy may operate at or near full capacity, and the impact of additional spending becomes less potent. Consequently, diminishing returns are set in, leading to a subsequent decline in the inflation rate. The pattern observed may also reflect the supply demand dynamics in the economy. Initially, increased demand drives prices up. However, as supply adjusts to meet the heightened demand, inflationary pressures ease, contributing to the decline in the inflation rate. Over time, businesses and consumers may adjust their expectations and pricing behavior in response to a sustained inflationary environment. Businesses may anticipate higher costs and increase their prices accordingly, whereas consumers may factor in higher inflation when making spending decisions.

4.2. Robust check with the SVAR

Figure A4 in Annexure 4 depicts the impulse responses of *e_g* from the SVAR, indicating that the shock of *e_g* leads to a decrease in inflation in year 3, stabilizing below the equilibrium. This finding aligns with the observation in Figure 2. Conversely, Figure A5 illustrates the impulse responses of *e_tgr* from the SVAR, suggesting that the shock results in a decline in inflation. This contrasts with the increase depicted in Figure 2. Furthermore, Figure A6 displays the impulse responses of pr from the SVAR, showing that the shock leads to a decrease in inflation. This result is consistent with that of Figure 2, indicating robustness in the model. However, it is worth noting that the magnitude of the BVAR is slightly higher than that of the SVAR model. Additionally, Figure A7 demonstrates the impulse responses of *tvp_elstcy_capb_g* from the SVAR, revealing a decline in inflation in year 3 followed by a slight increase. Conversely, in Figure 3, there is a decrease in the inflation rate, aligning with both the BVAR and SVAR results. Figure A8 show the impulse responses of *tvp_elstcy_capb_tgr* from the SVAR result to the fall in inflation that is significant compared to other school using the SVAR.

The comparison between the SVAR and BVAR models provides insights into the stability and reliability of the results. The results indicate that while there are some variations in the magnitude of the impulse responses between the SVAR and BVAR models, the overall patterns remain consistent. This consistency suggests that the observed relationships between the variables are robust across different modeling frameworks.

4.3. Discussion

The analysis of the impulse responses provides critical insights into the behavior of inflation in response to various fiscal and monetary policy shocks in South Africa. Policymakers should reconsider traditional models and explore alternative strategies for achieving inflation targets.² Furthermore, the delayed response of inflation to shifts

²Establishing formal coordination mechanisms between fiscal and monetary authorities is essential to facilitate information sharing, policy alignment, and joint decision-making, particularly in response to unexpected fiscal shocks.

in national government revenue underscores the importance of managing inflation expectations and understanding market dynamics. Expectations and market reactions play a significant role in shaping inflation outcomes, highlighting the need for clear and consistent communication of fiscal policy decisions to guide public perceptions and market behavior effectively.

The sustained decline in inflation following an unexpected increase in the repo rate highlights the effectiveness of monetary policy in influencing inflation dynamics. This emphasizes the importance of coordination between fiscal and monetary authorities to achieve macroeconomic stability. Policymakers should be prepared to adjust monetary policy tools in response to unconventional inflation dynamics resulting from fiscal policy shocks. Long-term economic stability should be prioritized over short-term reductions in inflation. The findings emphasize the need for evidence-based policymaking and proactive measures to maintain price stability and macroeconomic equilibrium in South Africa. There is a need of must carefully consider the implications of fiscal and monetary policy decisions on inflation dynamics to ensure sustainable economic outcomes.³ The SARB may respond to sustained inflationary pressures by implementing monetary policy measures such as raising interest rates. These measures can dampen borrowing and spending, reduce demand, and curb inflation. This could explain the eventual decline in the inflation rate. The coordination between fiscal and monetary authorities is crucial for maintaining macroeconomic stability. Policymakers should engage in long-term fiscal planning to mitigate potential diminishing returns. Assessing the sustainability of inflationary pressures resulting from government revenue allocation to capital expenditure is essential for effective economic management.

The results also suggest that unexpected shocks to the repo rate (monetary policy tool) can influence inflation rates, with an unexpected hike leading to a decline in inflation over time. The findings highlight the challenge policymakers face in managing inflationary pressures through monetary policy interventions. While raising interest rates can help counteract inflation, it may also have adverse effects on economic growth and employment. This dilemma underlines the importance of carefully balancing inflation concerns with other macroeconomic objectives.⁴

5. Conclusion

The study utilizes Bayesian Vector Autoregressions to analyze South African inflation responses to fiscal policy shocks from 1979 to 2022. The findings challenge conventional wisdom, showing an unexpected decrease in inflation following a 1% increase in national government expenditure. This underscores the need to reevaluate the fiscal policy-inflation relationship. Additionally, the lagged response of inflation to changes in

³Policymakers should consider implementing targeted fiscal measures aimed at addressing specific economic challenges or structural imbalances identified in the analysis, particularly in response to unexpected fiscal shocks that may have significant implications for inflation dynamics. Moreover, adopting flexible monetary policy frameworks that allow for timely adjustments in response to unexpected shocks is crucial for ensuring effective policy responses and maintaining macroeconomic stability, especially in light of the potential impacts of fiscal policy developments on inflation dynamics.

⁴Coordination between fiscal and monetary authorities is essential to ensure that policy measures are aligned and mutually reinforcing. Monetary policymakers must consider the potential impact of fiscal policy decisions on inflation dynamics, while fiscal policymakers should take into account the implications of monetary policy actions on overall economic stability.

government revenue highlights the importance of managing inflation expectations and suggests potential nonlinear effects from fiscal austerity measures. Policymakers must carefully coordinate fiscal and monetary policies to maintain price stability. Future research should further explore the drivers of inflation responses to fiscal shocks and investigate the interaction between monetary and fiscal policies for effective macroeconomic stability.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Notes on contributor

Eugene Msizi Buthelezi, hold a Ph.D. from the University of KwaZulu-Natal. I am an nGAP lecturer at the University of Free teaching Economics for Public Managers. My research interest is on macroeconomic modelling; fiscal policy, monetary theory; and monetary systems.

ORCID

Eugene Msizi Buthelezi D http://orcid.org/0000-0002-2233-7347

Author contributions

I am a single author who conceived, designed, analyzed, and interpreted the data. I drafted the paper and revised it critically for intellectual content.

Data availability statement

The data used in the paper can be provided upon request.

References

- Abo-Zaid, S. M., & Sheng, X. S. (2023). Labor markets, fiscal policy and inflation dynamics: A pandemic perspective. *Fiscal Policy and Inflation Dynamics: A Pandemic Perspective*. Retrieved February 27, 2023. https://doi.org/10.2139/ssrn.4372282
- Alrawashdeh, S. T. A., Zyadat, A. A. F. H., & Abkal, A. M. M. (2022). The EFFECTIVENESS of FISCAL POLICY in TARGETING INFLATION in JORDAN. Academy of Entrepreneurship Journal, 28, 1–11.
- Asandului, M., Lupu, D., Maha, L.-G., & Viorică, D. (2021). The asymmetric effects of fiscal policy on inflation and economic activity in post-communist European countries. Post-Communist Economies.
- Banerjee, R., Boctor, V., Mehrotra, A., & Zampolli, F. (2022). *Fiscal deficits and inflation risks: The role of fiscal and monetary policy regimes.* Bank for International Settlements.
- Ben Zeev, N., & Pappa, E. (2017). Chronicle of a war foretold: The macroeconomic effects of anticipated defence spending shocks. *The Economic Journal*, 127(603), 1568–1597. https://doi. org/10.1111/ecoj.12349
- Bianchi, F., & Melosi, L. (2022). Inflation as a fiscal limit. Fed working parper. https://doi.org/10. 21033/wp-2022-37

18 👄 E. M. BUTHELEZI

- Bordo, M. D., & Levy, M. D. (2021). Do enlarged fiscal deficits cause inflation? The historical record. *Economic Affairs*, 41(1), 59–83. https://doi.org/10.1111/ecaf.12446
- Braun, R., & Brüggemann, R. (2023). Identification of SVAR models by combining sign restrictions with external instruments. *Journal of Business & Economic Statistics*, 41(4), 1077–1089. https://doi.org/10.1080/07350015.2022.2104857
- Bruns, M., & Piffer, M. (2023). A new posterior sampler for Bayesian structural vector autoregressive models. *Quantitative Economics*, 14(4), 1221–1250. https://doi.org/10.3982/QE2207
- Buiter, W. H. (2002). The fiscal theory of the price level: A critique. *The Economic Journal*, *112* (481), 459–480. https://doi.org/10.1111/1468-0297.00726
- Buthelezi, E. M. (2023). Impact of Inflation in Different States of Unemployment: Evidence with the Phillips Curve in South Africa from 2008 to 2022. *Economies*, *11*(1), 29. https://doi.org/10. 3390/economies11010029
- Buthelezi, E. M. (2024). Impact of fiscal consolidation on government debt in South Africa: Evidence to structural and cyclical effect. *Journal of Economics and Financial Analysis*, 7, 1–23. http://dx.doi.org/10.1991/jefa.v7i2.a60
- Buthelezi, E. M., & Nyatanga, P. (2023a). The dynamic relationship between government debt, fiscal consolidation, and economic growth in South Africa: A threshold analysis. *Cogent Economics & Finance*, 11(2), 2261329. https://doi.org/10.1080/23322039.2023.2261329
- Buthelezi, E. M., & Nyatanga, P. (2023b). Impact of fiscal consolidation in different states of domestic government debt in South Africa 1979 to 2022. Cogent Economics & Finance, 11(2), 2280326. https://doi.org/10.1080/23322039.2023.2280326
- Buthelezi, E. M., & Nyatanga, P. (2023c). Time-varying elasticity of cyclically adjusted primary balance and effect of fiscal consolidation on domestic government debt in South Africa. *Economies*, 11(5), 11. https://doi.org/10.3390/economies11050141
- Caramp, N., & Silva, D. H. (2023). Fiscal policy and the monetary transmission mechanism. *Review of Economic Dynamics*. https://doi.org/10.1016/j.red.2023.08.001
- Cevik, S., & Miryugin, F. (2023). It's never different: Fiscal policy shocks and inflation. *IMF Working Papers*, 2023(98), 1. https://doi.org/10.5089/9798400242878.001
- Chan, J. C. (2022). Large hybrid time-varying parameter VARs. Journal of Business & Economic Statistics, 41(3), 890–905. https://doi.org/10.1080/07350015.2022.2080683
- Checherita-Westphal, C. D., Leiner-Killinger, N., & Schildmann, T. (2023). Euro area inflation differentials: The role of fiscal policies revisited. *SSRN Electronic Journal*. https://doi.org/10. 2139/ssrn.4351415
- Cochrane, J. H. (2023). The fiscal theory of the price level. Princeton University Press.
- Coibion, O., Gorodnichenko, Y., & Weber, M. (2021). Fiscal policy and households' inflation expectations: Evidence from a randomized control trial. National Bureau of Economic Research.
- D'alessandro, A., Fella, G., & Melosi, L. (2019). Fiscal stimulus with learning-by-doing. *International Economic Review*, 60(3), 1413–1432. https://doi.org/10.1111/iere.12391
- Del Negro, M., & Schorfheide, F. (2004). Priors from general equilibrium models for VARs. *International Economic Review*, 45(2), 643–673. https://doi.org/10.1111/j.1468-2354.2004. 00139.x
- De Mol, C., Giannone, D., & Reichlin, L. (2008). Forecasting using a large number of predictors: Is Bayesian shrinkage a valid alternative to principal components? *Journal of Econometrics*, 146(2), 318–328. https://doi.org/10.1016/j.jeconom.2008.08.011
- Doan, T., Litterman, R., & Sims, C. (1984). Forecasting and conditional projection using realistic prior distributions. *Econometric Reviews*, 3(1), 1–100. https://doi.org/10.1080/ 07474938408800053
- Eita, J. H., Manuel, V., Naimhwaka, E., & Nakusera, F. (2021). The impact of fiscal deficit on inflation in Namibia. *Journal of Central Banking Theory and Practice*, *10*(1), 141–164. https://doi.org/10.2478/jcbtp-2021-0007
- Ferrara, L., Metelli, L., Natoli, F., & Siena, D. (2021). Questioning the puzzle: Fiscal policy, real exchange rate and inflation. *Journal of International Economics*, 133, 103524. https://doi.org/10. 1016/j.jinteco.2021.103524

- Galí, J., López-Salido, J. D., & Vallés, J. (2007). Understanding the effects of government spending on consumption. *Journal of the European Economic Association*, 5(1), 227–270. https://doi.org/ 10.1162/JEEA.2007.5.1.227
- Gefang, D., Koop, G., & Poon, A. (2023). Forecasting using variational Bayesian inference in large vector autoregressions with hierarchical shrinkage. *International Journal of Forecasting*, 39(1), 346–363. https://doi.org/10.1016/j.ijforecast.2021.11.012
- Giannone, D., Lenza, M., & Primiceri, G. E. (2015). Prior selection for vector autoregressions. *The Review of Economics and Statistics*, 97(2), 436–451. https://doi.org/10.1162/REST_a_00483
- Gottschalk, J. (2001). An introduction into the SVAR methodology: Identification, interpretation and limitations of SVAR models. *Kiel working paper*.
- Higham, N. J. (2009). Cholesky factorization. Wiley Interdisciplinary Reviews Computational Statistics, 1(2), 251–254. https://doi.org/10.1002/wics.18
- Jørgensen, P. L., & Ravn, S. H. (2022). The inflation response to government spending shocks: A fiscal price puzzle? *European Economic Review*, 141, 103982. https://doi.org/10.1016/j.euro ecorev.2021.103982
- Koop, G. M. (2013). Forecasting with medium and large Bayesian VARs. Journal of Applied Econometrics, 28(2), 177–203. https://doi.org/10.1002/jae.1270
- Kuschnig, N., & Vashold, L. (2021a). BVAR: Bayesian vector autoregressions with hierarchical prior selection in R. *Journal of Statistical Software*, 100(14), 1–27. https://doi.org/10.18637/jss. v100.i14
- Kuschnig, N., & Vashold, L. (2021b). BVAR: Bayesian vector autoregressions with hierarchical prior selection in R. *Journal of Statistical Software*, 100(14), 1–27. https://doi.org/10.18637/jss. v100.i14
- Le, T. H., & Finch, N. (2022). Effects of trend inflation on monetary policy and fiscal policy shocks in Vietnam. *Journal of Economics and Development*, 24(2), 158–175. https://doi.org/10.1108/ JED-04-2021-0052
- Lenza, M., & Primiceri, G. E. (2022). How to estimate a vector autoregression after March 2020. *Journal of Applied Econometrics*, 37(4), 688–699. https://doi.org/10.1002/jae.2895
- Liu, D., Sun, W., & Chang, L. (2021). Monetary-fiscal policy regime and macroeconomic dynamics in China. *Economic Modelling*, 95, 121–135. https://doi.org/10.1016/j.econmod. 2020.12.007
- Lowndes, V., & Mccaughie, K. (2013). Weathering the perfect storm? Austerity and institutional resilience in local government. *Policy & Politics*, 41(4), 533–549. https://doi.org/10.1332/030557312X655747
- Marta, B., Giannone, D., & Lucrezia, R. (2010). Large Bayesian vector auto regressions. *Journal of Applied Econometrics*, 25(1), 71–92. https://doi.org/10.1002/jae.1137
- Mohamed, I. A. (2016). The impacts of monetary policies on inflation rates in Sudan (1970-2014). *International Journal of Advance Research in Management, Engineering and Technology, 1.* https://ssrn.com/abstract=2810016
- Nakata, T., & Schmidt, S. (2022). Expectations-driven liquidity traps: Implications for monetary and fiscal policy. *American Economic Journal Macroeconomics*, 14(4), 68–103. https://doi.org/ 10.1257/mac.20190228
- Nguyen, T. T., Phan, T. D., & Tran, N. A. (2022). Impact of fiscal and monetary policy on inflation in Vietnam. *Investment Management and Financial Innovations*, 19(1), 201–209. https://doi.org/10.21511/imfi.19(1).2022.15
- Otto, G., & Ukpere, W. I. (2015). The impact of fiscal policy on inflation in Nigeria. *Risk Governance and Control: Financial Markets & Institutions*, 5(1), 123–132. https://doi.org/10. 22495/rgcv5i1c1art5
- Paulus, A., & Tasseva, I. V. (2020). Europe through the crisis: Discretionary policy changes and automatic stabilizers. Oxford Bulletin of Economics and Statistics, 82(4), 864–888. https://doi.org/10.1111/obes.12354
- Ramey, V. A. (2011). Identifying government spending shocks: It's all in the timing*. *Quarterly Journal of Economics*, 126(1), 1–50. https://doi.org/10.1093/qje/qjq008

20 😉 E. M. BUTHELEZI

- Ricco, G., Callegari, G., & Cimadomo, J. (2016). Signals from the government: Policy disagreement and the transmission of fiscal shocks. *Journal of Monetary Economics*, *82*, 107–118. https://doi.org/10.1016/j.jmoneco.2016.07.004
- Sarb. (2023). Online statistical query (historical macroeconomic time series information) [online]. Retrieved March 20, 2023, from https://www.resbank.co.za/Research/Statistics/Pages/ OnlineDownloadFacility.aspx
- Sims, C. A., & Zha, T. (1998). Bayesian methods for dynamic multivariate models. International Economic Review, 39(4), 949–968. https://doi.org/10.2307/2527347
- Sriyana, J., & Ge, J. J. (2019). Asymmetric responses of fiscal policy to the inflation rate in Indonesia. *Economics Bulletin*, 39, 1701–1713.
- Tanjung, A. A., Daulay, M. & Ruslan, D. (2019). The impact of monetary and fiscal policy on poverty in Indonesia. *Journal of Applied Economic Sciences*, 14(4). https://doi.org/10.14505/jaes. v14.4(66).12
- Tsionas, M. G., Izzeldin, M., & Trapani, L. (2022). Estimation of large dimensional time varying VARs using copulas. *European Economic Review*, 141, 103952. https://doi.org/10.1016/j.euro ecorev.2021.103952
- Zungu, L. T., Makhoba, B. P., & Greyling, L. (2022). A scrutiny into fiscal policy in the South African economy: A Bayesian approach with hierarchical priors. *Cogent Economics & Finance*, 10(1), 2028975. https://doi.org/10.1080/23322039.2022.2028975

Annexure 1.



Figure A1. Residual of the economic variables considered.

Annexure 2.

Annexre 2 reflect in the frameworks of the OECD and IMF are shown in Equations A1 to A3.

$$\Delta cnstnt_elstcy_CAPB_tgr_t = \sum_{j=1}^{4} TGR_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{tgr}}$$
(A1)

$$\Delta cnstnt_elstcy_CAPB_g_t = G_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_g}$$
(A2)

$$\Delta cnstnt_elstcy_CAPB_t = \sum_{j=1}^{4} TGR_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{tgr}} - G_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_g}$$
(A3)

where elasticity is given by ε_{tgr} and ε_g is the constant elasticity of government revenue and government expenditure. The time-varying elasticity is reflected in Equations A4 to A6.

$$\Delta tvp_elstcy_CAPB_tgr_t = \sum_{j=1}^{4} TGR_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{tgr_t}}$$
(A4)

$$\Delta tvp_elstcy_CAPB_g_t = G_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{g_t}}$$
(A5)

$$\Delta tvp_elstcy_CAPB_t = \sum_{j=1}^{4} TGR_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{tgr_t}} - G_t \left(\frac{y_t}{Y_t}\right)^{\varepsilon_{gt}}$$
(A6)

where $\varepsilon_{tgr} = \varepsilon_{r_t}$ and $\varepsilon_g = \varepsilon_{g_t}$ with the key distinction being the *t* time subscript reflecting timevarying elasticity.

Annexure 3.

A.3.1. Data transformation and stationarity

Developing a BVAR model ⁵requires the data to be coercible into a rectangular numeric matrix with no missing data points. We used 7 variables in our BVAR model, we use seven variables: *inf*, *e_infl*, *e_m_p*, *e_g*, *e_tgr*, pr, *tvp_elstcy_capb_g*, and *tvp_elstcy_capb_tgr*. We followed the transformation adopted by Kuschnig and Vashold (2021a) to transform all variables into log levels to demonstrate dummy priors.⁶ We then used the code argument derived from the direct-transformation codes. In the transform, we selected two log differences and 1st differences. We then set the number of lags to two for the yearly differences.

A.3.2. The prior setup and configuration

Following the meticulous preparation of our dataset,⁷ we set priors and configured our model. Specifically, we fine-tuned the Minnesota prior by defining hyperparameters with upper and lower bounds for the Gaussian proposal distribution within the Metropolis-Hastings step. Notably, we did not implement hierarchical treatment for α at this stage. In this version of the BVAR, this is equivalent to providing the character vector *c*(*Lambda*, *soc*, *sur*), after setting the

⁵The function that we *bvar*().

⁶Our transformation was performed through the function *fred* - *transform*().

⁷Using the code of *priors*() as a function, which holds arguments for the Minnesota and dummy-observation priors.

configuration of the model's priors and Metropolis-Hastings (Kuschnig & Vashold, 2021a). Table A1 in Annexure 3 shows the sum of the posterior marginal likelihood results.

| Table AT. Posterior marginal likelihood. |
|---|
| "Optimisation concluded. |
| Posterior marginal likelihood: -1237.656 Hyperparameters: lambda = 0.45459; soc = 0.86602; sur = 1.10648 |
| Finished MCMC after 42.74 secs. Compelled by the author |

Table A1. Posterior marginal likelihood.

A.3.3. Estimation of the model

The model was subjected to estimation,⁸ featuring a bespoke setup with meticulous parametrization. Specifically, the total number of initial iterations was predefined. Within this framework, we prescribed 50,000 iterations for the burn-in phase, and subsequently executed 25,000 iterations for the draw phase. Importantly, during the model estimation process, the *verbose* = *TRUE* option was invoked to implement a progress bar to facilitate real-time monitoring of the Markov Chain Monte Carlo (MCMC) sampling procedure (Kuschnig & Vashold, 2021a).

The BVAR function returns an object that generates multiple outputs: These outputs include essential parameters hierarchically treated as hyperparameters, the VCOV matrix, and the posterior draws of the VAR coefficients. Additionally, the BVAR object includes ML1 values for each draw, specified prior settings, initial values for prior hyperparameters obtained from the optima, and automatically set values (Kuschnig & Vashold, 2021a).

A.3.4. Analysing outputs

The BVAR model incorporates established methodologies. Our assessment pertains to an in-depth examination of the global properties and convergence characteristics of the MCMC algorithm employed for parameter estimation, as a pivotal aspect for ensuring the stability of the model.

Table A2 presents a comprehensive summary of the BVAR model. This table provides vital insights into the key parameters of the model and details of the sampling process used in the analysis. First, we present the parameter coefficients for *lambda*, *soc*, and *sur* which are essential components of the BVAR model. These coefficients are valuable for understanding the relationships and dynamics within a model. In this case, the coefficients are 0.45459 for lambda, 0.86602 for soc, and 1.10648 for sur. These values offer crucial insights into the structural relationships in the model. Furthermore, Table 3 presents an in-depth examination of the iterative process used in the analysis. The number of iterations was 50,000. Among these iterations, there are 5,000 "burnt"

Table A2. Summary of the BVAR mode.

Bayesian VAR consists of 35 observations, 8 variables and 4 lags. Time spent calculating: 42.74 secs Hyperparameters: lambda, soc, sur Hyperparameter values after optimisation: 0.45459, 0.86602, 1.10648 Iterations (burnt/thinning): 50000 (5000/1) Accepted draws (rate): 14299 (0.318) Compelled by the author

⁸Using the function *bvar*(), also noting that this function needed us to prepare the data and provide the lag order of p as arguments. On the other hand, the *n_burn* and *n_draws*is used.

24 👄 E. M. BUTHELEZI

iterations, which are typically excluded from the analysis to mitigate the impact of initial values and ensure convergence. The inclusion of burnt iterations is common practice in Bayesian analysis. The "thinning" rate, indicated as 1, suggests that every iteration was retained for analysis without any subsampling. Thinning can be employed to reduce the volume of data used for analysis, making it more manageable, while still providing an accurate representation of the underlying model. Finally, the table reports an acceptance rate of 31.8% for the draws in the model. This acceptance rate is a critical metric in MCMC methods such as those used in Bayesian analysis. This indicates the efficiency of the sampling procedure: a higher acceptance rate generally implies more efficient sampling and faster convergence.

Subsequently, we employed a reasoned approach to select the appropriate visualization technique, as shown in Figure A2. This figure presents graphical representations of the density⁹, trace¹⁰, and hierarchical treatment of the hyperparameters. The scrutiny of these



Figure A2. Trace and density plots of all hierarchically treated hyperparameters and the ML.

⁹This figure presents graphical representations of the density, trace, and hierarchical treatment of hyperparameters. The scrutiny of these density and trace plots serves as an indicator of the convergence achieved in the critical hyperparameters within the estimated BVAR model.

¹⁰The trace plot, on the other hand, is a time series plot that displays the values of the hyperparameters as the MCMC chain progresses. It allows us to monitor how the chain traverses the parameter space.

density and trace plots serves as an indicator of the convergence achieved in the critical hyperparameters of the estimated BVAR model. Visual examination suggests that the MCMC chain effectively explores the posterior distribution, with no conspicuous outliers identified. Figure A3 shows the density plot for the autoregressive coefficient corresponding to inflation and inflation expectations. Figure A1 shows the residuals of the economic variables.



Figure A3. Density plot for the autoregressive coefficient corresponding to inflation and inflation expectations.

Annexure 4.



SVAR Impulse Response from pr

95 % Bootstrap CI, 100 runs







95 % Bootstrap CI, 100 runs

Figure A4.2 Impulse responses of *e_g* from the SVAR.



SVAR Impulse Response from e_tgr



Figure A4.3 Impulse responses of *e_tgr* from the SVAR.



SVAR Impulse Response from tvp_elstcy_capb_g

95 % Bootstrap CI, 100 runs

Figure A4.4 Impulse responses of *tvp_elstcy_capb_g* from the SVAR.



Figure A4.5 Impulse responses of *tvp_elstcy_capb_tgr* from the SVAR.