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Article

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Reserves' influence on South Africa's total domestic debt: evidence from GFECRA

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ABSTRACT

This research tackles a gap in existing literature by offering empirical insights into the effectiveness of utilizing the Gold and Foreign Exchange Contingency Reserve Account (GFECRA) in overseeing total domestic debt, thereby enhancing our comprehension of fiscal policy implications and debt management strategies in South Africa. This study delves the influence of leveraging the GFECRA on total domestic debt in South Africa by analyzing time series data from January 1, 1990, to October 1, 2023. Employing the Vector Error Correction (VEC) model, the results reveal a negative lag impact of GFECRA on the present government debt levels. Conversely, disturbances to the GFECRA reduce total domestic debt, albeit at a diminishing pace. Moreover, GFECRA accounts for 56.5% of the fluctuations in domestic debt over a span of 24 months. Fiscal authorities can use a GFECRA amounting to R150 billion throughout the 2024 Medium-Term Expenditure Framework (MTEF) to oversee total domestic debt. Future research should investigate the mechanisms for managing total domestic debt, particularly within South Africa.

IMPACT STATEMENT

This research provides critical empirical evidence on the role of the Gold and Foreign Exchange Contingency Reserve Account (GFECRA) in managing total domestic debt in South Africa. By analyzing data spanning over three decades, the study reveals the negative lag effect of GFECRA on current government debt levels and demonstrates that disturbances to this account can effectively reduce domestic debt. This work significantly enhances our understanding of fiscal policy and debt management strategies, offering actionable insights for fiscal authorities. By quantifying the impact of GFECRA, the study underscores its potential as a strategic tool for stabilizing domestic debt, particularly under the 2024 Medium-Term Expenditure Framework (MTEF).

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SUBJECTS

Economics; Finance; Political Economy

1. Introduction

The economy of South Africa is characterized by numerous challenges, with notable concerns revolving around the national government's debt burden and budget deficit. The budget speech for 2024 sheds light on critical macroeconomic variables national government's debt is poised to escalate to approximately 75.3% of Gross Domestic Product (GDP), and the budget deficit for 2023–24 is expected to deteriorate further, reaching 4.9% of GDP (BS, 2024). In response to these pressing economic challenges, fiscal authorities have outlined strategies aimed at mitigating the burden of government debt. One prominent initiative is the utilization of the Gold and Foreign Exchange Contingency Reserve Account (GFECRA). With the GFECRA having increased R500 billion, as reflected in Figure 1, the government plans to harness 30% of its reserves, equivalent to R150 billion, over the 2024 Medium-Term Expenditure Framework (MTEF) (BS, 2024). This strategic move anticipates a substantial decline of approximately R30.2 billion in government debt servicing costs (BS, 2024).

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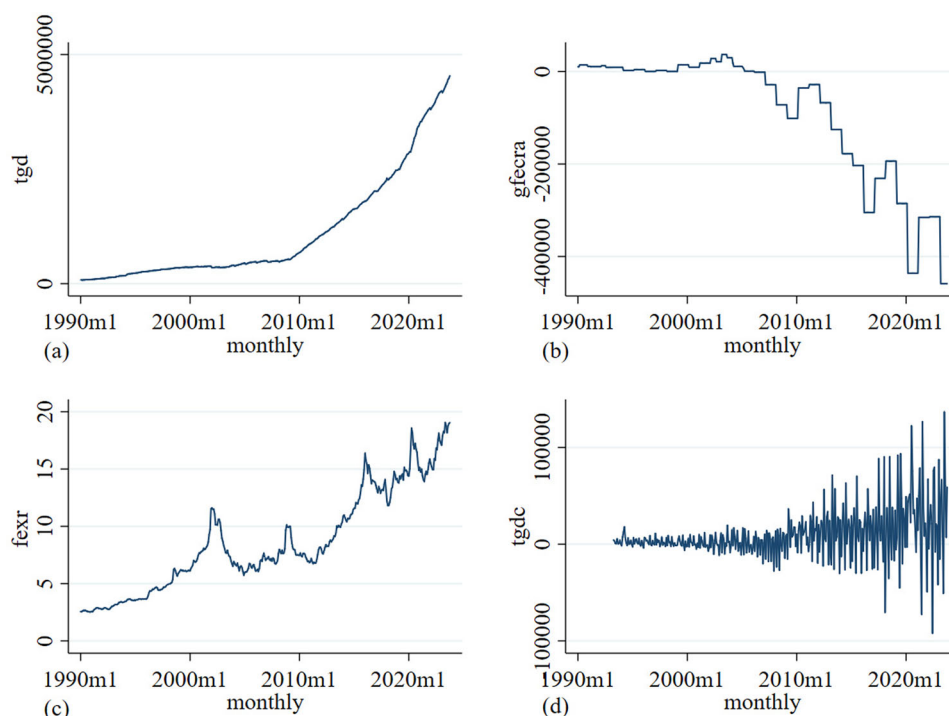


Figure 1. Economic variable. The economic variables are: the total domestic debt, the gold and foreign exchange contingency reserve account, *tgdc*, the national government deficit and surplus, inflation, interest rates, government securities and the foreign exchange rate: SA cent per USA dollar.

Empirical studies that examined manometry policy and fiscal policy concerning the South African budget are that of Jooste and Marinkov (2012), Saungweme and Odhiambo (2018), and Nzama et al. (2019), which are silent in the direct investigation of the GFECRA and total domestic debt. This reflects the gap for investigation in the context of the South African economy. On the other hand, Brkić (2021), Onyele and Nwadike (2021), Agandhi et al. (2022), Sosa-Padilla and Sturzenegger (2023) and Kebede et al. (2023) provided an overview of total domestic debt and its relationship with foreign exchange reserves. However, they look at it in the context of the relationship between macroeconomic variables. This reflects the limited gap in looking at this variable in the context of the fiscal budget of the country, which this study seeks to address. Moreover, these studies consider foreign exchange reserves. This study undertaking the economic variables is border context with inclusion of gold in the form of GFECRA. It is noted that there is still sum level of the on censuses at an imperial level, with Gill (2018), Ito and McCauley (2020) and Du and Schreger (2022), among others, indicating that foreign exchange reserves have a negative and significant effect on yields on government bonds. Adiwibowo and Sihombing (2019), and De Santis (2020) state that the exchange rate has a positive and significant effect on yields on government bonds.

The problem identified in this study is that the national government of South Africa is facing significant challenges. Despite these challenges, there is a lack of comprehensive understanding regarding the effectiveness of utilizing the GFECRA in mitigating the government's debt burden. Existing empirical studies have primarily focused on monetary and fiscal policies in relation to South Africa's budget, with a limited direct investigation into the GFECRA's impact on total domestic debt. On the other hand, while some studies have examined the relationship between foreign exchange reserves and government bonds, there remains a gap in understanding how the inclusion of gold reserves in the form of GFECRA affects debt dynamics and fiscal budget strategies. Moreover, there is a lack of consensus among existing studies regarding the impact of foreign exchange reserves on government bond yields, with conflicting findings regarding the effects of exchange rates and reserve levels. This inconsistency underlines the need for further empirical research to clarify these relationships and effectively inform debt management strategies. This study aims to bridge the gap in understanding the relationship between GFECRA use and total domestic debt within the context of South Africa's fiscal budget. The findings of this study can

assist fiscal authorities in developing more effective debt management strategies by leveraging GFECRA reserves. Moreover, it can inform monetary policymakers about the potential impact of GFECRA use on overall economic stability, aiding in the formulation of monetary policies aimed at supporting fiscal initiatives and maintaining financial equilibrium. Given the background proved above, this study's economic question is: does leveraging the GFECRA matter for total domestic debt?

Through the application of the Vector Error Correction (VEC) model to time series data spanning January 1, 1990, to October 1, 2023, significant insights emerge. Notably, the analysis reveals a discernible negative lag effect of the GFECRA on current government debt levels. Conversely, shocks to the GFECRA precipitate a reduction domestic debt, albeit at a diminishing rate. Moreover, the study finds that GFECRA explains a considerable portion of the variance domestic debt over a specified period. These findings underscore the potential effectiveness of leveraging GFECRA as a strategic tool in managing total domestic debt, highlighting its relevance for policymakers among fiscal challenges.

The rest of the paper highlights the following:. First, [section 2](#) outlines the literature review. Second, [section 3](#) discusses the methodology. Third, [section 4](#) discusses descriptive statistics and empirical results. Finally, [section 5](#) outlines the conclusion of the paper.

2. Literature review

2.1. Theoretical review

Keynesian theory emphasizes the role of government intervention in stabilizing the economy. The theory provide key insights that, during economic downturns, increasing foreign exchange reserves can provide the necessary resources for countercyclical fiscal policies, such as increased public spending to stimulate demand (Blinder, 2008; King, 2022). Government spending financed by reserves can have a multiplier effect, boosting economic activity and indirectly influencing domestic debt levels through increased tax revenues and reduced need for additional borrowing (King, 2022). Debt management theory focuses on strategies for managing a country's debt to minimize costs and risks. It outline that managing the mix of domestic and foreign debt is crucial. Foreign exchange reserves can provide a buffer against exchange rate volatility, which affects the cost of servicing foreign debt (Hitt et al., 2021). Maintaining adequate reserves ensures liquidity to meet debt obligations, reducing the risk of default and improving credit ratings (Dottori & Manna, 2016). International finance theory outlines that the accumulation of foreign exchange reserves affects the balance of payments, which in turn influences the exchange rate. A favorable balance of payments, supported by high reserves, can strengthen the currency and reduce the cost of servicing foreign-denominated debt (Obstfeld et al., 2010; Ito & McCauley, 2020). The government budget constraint is a fundamental concept in public finance and macroeconomics. It reflects the requirement that a government's spending must be financed by revenues, borrowing, or money creation. Adequate foreign exchange reserves can provide a buffer against external shocks, helping to stabilize the economy and manage debt more effectively (Kornai, 1986; Mao & Yang, 2020). Exchange rate theories, such as the Mundell-Fleming model, suggest that a country's reserves can influence its exchange rate and, consequently, its macroeconomic stability. High reserves can defend against speculative attacks and stabilize the currency (Frenkel & Razin, 1987; Serrano & Summa, 2015). By effectively managing the GFECRA, South Africa can influence its exchange rate stability, which in turn affects its debt dynamics, especially if a significant portion of its debt is denominated in foreign currency. The monetary policy transmission mechanism describes how policy actions taken by a central bank influence the economy, particularly through interest rates, exchange rates, and credit availability (Boivin et al., 2010; Miranda-Agrippino & Ricco, 2021). The GFECRA can serve as a tool within the broader monetary policy framework. By using reserves to influence exchange rates and liquidity conditions, South Africa can indirectly impact interest rates and debt servicing costs.

2.2. Empirical review

To empirically understand gold and foreign exchange contingency reserve accounts and total domestic debt, studies by De Luigi and Huber (2018), Cantore et al. (2019) and Tan et al. (2020) have stressed the

effectiveness monetary and fiscal policies. De Luigi and Huber (2018) investigated the debt regimes and the effectiveness of monetary policy from 1967 Q2 to 2012 Q4. They used the bayesian dynamic stochastic general equilibrium (DSGE) model. It was found that monetary policy is less pronounced in 'high' debt regimes, pointing towards differences in the underlying monetary policy transmission mechanisms. The result was limited to foreign exchange rates and government debt. Cantore et al. (2019) examined optimal fiscal and monetary policy using the DSGE model. It was found that monetary shocks increased government spending in the first 5 quarters and started to decrease thereafter. When the government can issue also long-term bonds under commitment, the optimal debt consolidation pace is slower than in the case of short-term bonds. Tan et al. (2020) investigated the impacts of monetary and fiscal policies from 1980 Q1 to 2017 Q1. Using the autoregressive distributed lag (ARDL), it was found that monetary policy is more effective, while fiscal policy is more effective on government debt. These studies contribute to the understanding of how monetary and fiscal policies interact with government debt dynamics, highlighting the importance of considering debt regimes, policy transmission mechanisms, and the maturity structure of government bonds.

The relationship between external reserves, external debt, and other macroeconomic indicators has been investigated by Zakari and Umar (2020), Osadume and Ovuokeroye (2021) and Rahmawati and Suriani (2022), among others. Zakari and Umar (2020) examined spending, public debt, and the role of external reserves. Utilizing the ARDL spanning from 1980 to 2019, it was evident that governments should implement measures aimed at increasing external reserves. Osadume and Ovuokeroye (2021) studied external debt, external reserves, and debt service costs from 1979 to 2019 using the Granger causality. The results showed that external debt has a statistically significant negative relationship with external reserves. Rahmawati and Suriani (2022) analyzed the macroeconomic indicators and foreign exchange reserves from 2010 to 2019. The VEC model was used, and it was found that external debt has a positive impact on foreign exchange reserves. The shocks from debt had little effect on foreign exchange reserves. The empirical studies point out the importance of maintaining adequate external reserves for financial stability and highlight the complex interactions between debt management, reserve accumulation, and economic stability.

Studies provide insights into the relationship between foreign exchange reserves and government debt, as well as the factors influencing this relationship, including that of Ito and McCauley (2020), Zhang (2021), Du and Schreger (2022) and Manuel et al. (2023). Jooste and Marinkov (2012) investigated South Africa's transition to a consolidated budget from 2000 Q1 to 2011 Q1 using vector autoregression (VAR). It was found that public debt to a 1% increase in deficit by 0.57%. They did not factor in the foreign exchange rate in their model. Dudzich (2020) examined the public foreign currency borrowing from the period 2000 to 2018 using the GMM. The findings reveal that fixed exchange rate regimes and high real exchange rate volatility are promoting foreign currency borrowing. Moreover, it was noted that countries that want to reduce the burden should lean towards a more flexible exchange rate policy. Ito and McCauley (2020) analyze the factors that govern the choice of the currency composition of official foreign exchange reserves for the 1999–2017 period. Using the fixed effect model, it was shown that the dollar foreign exchange reserve rises 1% for each 1% higher dollar share in external debt. Zhang (2021) analyzed the impact of foreign exchange reserves on the macro economy using the DSGE model, using data from 1985 to 2019. It was found that foreign exchange reserves can not only meet the needs of principal and interest repayment during the peak period of debt repayment but also provide necessary conditions and guarantees. Du and Schreger (2022) undertook a comprehensive examination of sovereign risk and corporate external borrowing from 2003 to 2017. The calibrated dynamic model was used to simulate moments of currency and credit risk. The model proved that foreign currency is associated with higher sovereign default risk Manuel et al. (2023) investigated the effects of government expenditure on foreign reserves from 2002 to 2020 using the ARDL model. The results show that an increase in government expenditure reduces foreign reserves. The studies mentioned shed light on the intricate interplay of various factors between foreign exchange reserves, government debt, and various economic factors. They highlight the importance of considering exchange rate policies, debt management strategies, and government expenditure decisions in understanding the dynamics of foreign reserves and government debt.

Brkić (2021), Onyele and Nwadike (2021), Agandhi et al. (2022), Sosa-Padilla and Sturzenegger (2023), and Kebede et al. (2023) are among others that examine various factors influencing total domestic debt and its relationship with foreign exchange reserves. Brkić (2021) investigated the costs and benefits of government borrowing in foreign currency from 2010 to 2012 using distributive statistics. The analysis suggested that the public finances of these countries are not heavily exposed to currency risk. Onyele and Nwadike (2021) examined the impact of national debt on the economy from 1981 to 2019 using the ARDL model. It was found that the exchange rate has a positive and significant impact on economic stability in the long run. On the other hand, in the short run, debt burden and debt overhang have a negative and significant impact on economic stability. Agandhi et al. (2022) investigated the impact of foreign debt, exchange rate and debt service ratio from 2000 to 2019 using the VAR model. The study showed that foreign debt financing and domestic private credit financing have positive correlations, but foreign direct investment, exchange rate, and debt service ratio have a negative correlation to GDP. Sosa-Padilla and Sturzenegger (2023) investigated how central banks accumulate reserves and sovereign spreads from 2015 and 2018 using the DSGE model. It was found that strengthening through external debt, such as those typically implemented by multilateral organizations, Kebede et al. (2023) investigated foreign public debt on foreign exchange reserves in 20 Sub-Saharan African (SSA) countries using the generalized method of moments (GMM) model from 2006 to 2020. It was found that foreign public debt predicted the foreign exchange reserve positively and significantly. On the other hand, low performance of foreign debt in enhancing foreign exchange reserve partly attributed to bad governance. These studies provided evidence of debt dynamics, exchange rates, central bank reserves, and sovereign risk. While the studies do not directly address the role of leveraging GFECRA, they provide valuable insights into the broader context in which such reserves operate and their implications for total domestic debt management.

The investigation of government debt management and budget includes that of Saungweme and Odhiambo (2018), Nzama et al. (2019), Mothibi and Mncayi (2019), Ayunku and Markjackson (2020), and Rangkuty and Hidayat (2021), among others. Saungweme and Odhiambo (2018) investigated the public debt service in South Africa from 1960 to 2015 using qualitative analysis. The debt service management reforms were divided into fiscal, monetary, institutional and legal framework rearrangements. Nzama et al. (2019) used qualitative analysis to investigate financial performance indicators and budget allocation in South Africa. The results of the study demonstrated that there is no significant relationship between national grant allocation and actual spending of municipalities. The study recommends the use of effective performance budgeting to promote accountability. However, it is silent on the use of the foreign exchange rate and government debt. Mothibi and Mncayi (2019) examined key drivers of government debt from 1994 to 2017 using the ARDL model. It was found that there is a long-run relationship between government debt government expenditure and real interest rates. Ayunku and Markjackson (2020) investigated the external debt and international reserves from 1981 to 2018 using the VAR model. It was found that external debt stock negatively effects foreign exchange reserve portfolios. Moreover, external debt service payments exert a positive but statistically insignificant impact on the international reserves. Rangkuty and Hidayat (2021), using two-tailed least squares (TSLS), investigated foreign debt and foreign exchange reserves from 1988 to 2017. It was found that foreign debt negatively impacts foreign exchange reserves. Monetary policy reduces foreign debt. These imperial works contribute to the understanding of various aspects related to public debt management, budget allocation, drivers of government debt, and the relationship between external debt and foreign exchange reserves.

The impact of foreign exchange reserves, exchange rates, government debt dynamics, bond yield volatility, and currency mismatches has been investigated by Wicaksono et al. (2022), Venkatesh and Hiremath (2020), and Regifere (2022). The research conducted by Gill (2018) states that foreign exchange reserves have a negative and significant effect on yields on government bonds. This is supported by research conducted by Adiwibowo and Sihombing (2019), and De Santis (2020), which states that the exchange rate has a positive and significant effect on yields on government bonds. Trinh et al. (2020) investigated the government bond yield volatility from July 2006 to December 2019 using the generalized autoregressive conditional heteroskedasticity (GARCH) model. It was found that yields on government bonds have an impact on foreign interest rates, fiscal deficit and public debt. Varirahartia and Marsoem (2022) analyzed the effect of foreign exchange reserves on the yield to maturity of government bonds from 2014 to 2020 using the ordinary least squares (OLS). It was found that foreign

exchange reserves have a negative impact on government bonds. Wicaksono et al. (2022) analyze foreign exchange reserves on the yield to maturity bonds from 2015 to 2021 using moderated regression analysis (MRA) model. It was found that the exchange rate had a significant negative effect on yield-to-maturity bonds, and foreign exchange reserves had a negative effect on yield-to-maturity bonds. Venkatesh and Hiremath (2020) investigated the currency mismatch from 2008 to 2017 using the fixed effect model. It was found that monetary and fiscal policies are the primary causes of currency mismatches. Moreover, monetary independence, stable fiscal policy, and minimizing currency mismatches. Regifere (2022) examined currency mismatches and public debt using the DSGE model simulation. It was found that the domestic interest rate impacts the risk premium on foreign debt. Moreover, foreign currency impacted government debt and risk premium on foreign debt. These studies point out the importance of prudent financial management, policy coordination, and stability in mitigating risk.

These studies provide valuable insights into various aspects related to government debt management, external reserves, exchange rates, and their interactions. While they do not directly address the role of leveraging GFECRA specifically, they offer important context and understanding that can inform the broader discussion on the relationship between GFECRA and total domestic debt. Research by De Luigi and Huber (2018), Cantore et al. (2019) and Tan et al. (2020) sheds light on the effectiveness of monetary and fiscal policies in managing government debt dynamics. Being sympathetic to how monetary and fiscal shocks impact debt accumulation and sustainability is crucial for assessing the potential role of GFECRA in mitigating debt-related risks. Zakari and Umar (2020), Osadume and Ovuokeroye (2021), and Rahmawati and Suriani (2022) explore the relationship between external reserves, external debt, and macroeconomic indicators. These findings underline the importance of maintaining adequate reserves for financial stability, which indirectly relates to the potential role of GFECRA in managing total domestic debt. Jooste and Marinkov (2012), Dudzich (2020), Ito and McCauley (2020), Zhang (2021), Du and Schreger (2022) and Manuel et al. (2023) examine the relationship between foreign exchange reserves and government debt, as well as factors influencing this relationship. These insights provide a nuanced understanding of how exchange rate policies, debt management strategies, and economic factors affect debt dynamics, indirectly informing the discussion on GFECRA's potential impact on domestic debt. Brkić (2021), Onyele and Nwadike (2021), Agandhi et al. (2022), Sosa-Padilla and Sturzenegger (2023) and Kebede et al. (2023) highlight the importance of prudent financial management, policy coordination, and stability in mitigating debt-related risks. These factors provide context for assessing the potential role of GFECRA in managing total domestic debt within the broader framework of fiscal and monetary policy coordination. Kartal (2020) finds that implementing the first proposal would lead to the accumulation of an additional USD 29.7 billion in reserves. Considering that the Central Bank of the Republic of Turkey (CBRT) had net reserves of USD 30.2 billion as of March 2019, this underscores the effectiveness of the recommendation. Kartal and Tan (2020) emphasize that adverse developments in indicators like foreign exchange reserves (FER) have negative effects on economic actors, inducing uncertainty and uneasiness. Such developments also impact various macroeconomic indicators, such as the foreign debt burden and interest payments. In a study by Kartal et al. (2021), it was revealed that the pandemic and monetary policy indicators significantly and substantially affect foreign exchange rates. The influence of independent factors on foreign exchange rates varies across different periods.

2.3. Overall literature review

Various economic theories shed light on how reserves influence total domestic debt dynamics. Keynesian theory outlines the role of government intervention during economic downturns, suggesting that increased reserves can support countercyclical fiscal policies, stimulating economic activity and indirectly affecting debt levels. Debt management theory highlights the importance of managing the mix of domestic and foreign debt, with reserves acting as a buffer against exchange rate volatility and enhancing liquidity to meet debt obligations. International finance theory explores how the accumulation of reserves impacts the balance of payments and exchange rates, potentially strengthening the currency and reducing the cost of servicing foreign-denominated debt. The government budget constraint emphasizes the need for adequate reserves to stabilize the economy and effectively manage debt among external shocks. Exchange rate theories, such as the Mundell-Fleming model, suggest that reserves play a crucial role in

defending against speculative attacks and stabilizing the currency, thereby influencing debt dynamics. Finally, the monetary policy transmission mechanism highlights how reserves can indirectly impact interest rates and debt servicing costs by influencing exchange rates and liquidity conditions.

While the existing literature provides comprehensive insights into the relationship between foreign exchange reserves, government debt, and macroeconomic stability, there are several limitations and gaps. First, many studies focus primarily on external debt and reserves without adequately addressing the interplay with domestic debt. For instance, De Luigi and Huber (2018) focus on monetary policy's effectiveness in different debt regimes but do not differentiate between the impacts on external versus domestic debt. Secondly, the methodologies used vary significantly, making it challenging to compare findings directly. For example, the use of DSGE models Cantore et al. (2019) versus ARDL models Zakari and Umar (2020) and Tan et al. (2020) can lead to different interpretations of the data. This methodological diversity underscores the need for a unified approach to studying the impact of reserves on domestic debt. Thirdly, most studies do not consider the specific context of South Africa in detail. While some research, such as Jooste and Marinkov (2012), focuses on South Africa, it does not integrate the role of GFECRA comprehensively. This gap suggests a need for more focused studies on South Africa's specific economic conditions and policy frameworks. The literature has extensively explored the relationship between foreign exchange reserves, external debt, and various macroeconomic indicators. However, there is a notable gap in the understanding of how GFECRA specifically influences total domestic debt, particularly in the context of South Africa. Existing studies have not adequately addressed the simultaneous impact of GFECRA on both external and domestic debt within a unified analytical framework. Moreover, the dynamic interactions between GFECRA, total domestic debt, and other macroeconomic variables such as exchange rates, interest rates, and fiscal policy need further empirical investigation. This gap is critical, as understanding these interactions can provide valuable insights for policymakers aiming to enhance financial stability and economic resilience.

3. Data and methods

This study investigates whether leveraging the gold and foreign exchange contingency reserve accounts matters for total domestic debt in South Africa using time series data from January 1, 1990, to October 1, 2023. The economic variables used are reflected in Table 1.

The selection of economic variables in this study is driven by the need to comprehensively analyze the impact of leveraging the gold and foreign exchange contingency reserve account on total domestic debt in South Africa. Each variable serves a specific purpose and *tgdc* provides a comprehensive measure of the accumulated debt within the nation. On the other hand, by leveraging, policymakers may influence the availability of foreign currency reserves, which can in turn impact borrowing costs, exchange rate stability, and ultimately total domestic debt levels. *tgdc* reflects the fiscal position of the national government, indicating whether it is running a deficit or a surplus. Additionally, it is a key macroeconomic indicator that influences borrowing costs, debt repayment dynamics, and overall economic stability. This reflects the cost of government borrowing and the prevailing market conditions for debt issuance. Finally, it plays a vital role in international trade, capital flows, and external debt servicing.

The VEC model was chosen to investigate the relationship between leveraging the GFECRA and total domestic debt in South Africa. The VEC model is designed to handle co-integrated variables, which share a long-term equilibrium relationship (Watson, 1994). The long-run relationship is expected between GFECRA leverage and total domestic debt, and the VEC model enables us to test for cointegration and determine whether there is a stable long-term relationship between these variables (Engle & Granger, 1987). On the

Table 1. Economic variables used.

Variable	Description	Source
<i>tgdc</i>	Total domestic debt	SARB (2024)
<i>gfecra</i>	Gold and foreign exchange contingency reserve accounts	SARB (2024)
<i>tgdc</i>	National government deficit and surplus	SARB (2024)
<i>infl</i>	Inflation	SARB (2024)
<i>intrst</i>	Interest rates on government securities	Fed-USA (2024)
<i>fexr</i>	Foreign exchange rate: the SA cent per US dollar	Fed-USA (2024)

other hand, the VEC model includes an error correction term that captures the short-term adjustments of variables toward their long-term equilibrium relationship (Engle & Granger, 1987; Watson, 1994). This feature is particularly useful for analyzing how deviations from the long-term equilibrium impact the adjustment process and help restore equilibrium between GFECRA leverage and total domestic debt. Finally, the VEC model allows for the inclusion of multiple variables and lagged terms (Watson, 1994), providing flexibility in capturing the complex dynamics of the relationship between GFECRA leverage and total domestic debt.

This study uses lag-order selection criteria, namely the Akaike information criterion (AIC), Hannan-Quinn information criterion (HQIC) and Schwarz-Bayesian information criterion (SBIC). These criteria play a crucial role in determining the optimal lag order for the VEC model (Hu, 2007; Amaefula Chibuzo, 2023). In addition to the lag-order selection criteria and unit root tests, this study employs Johansen tests for co-integration. The Johansen test is for the long-term equilibrium relationship that exists between nonstationary variables (Bierens, 1997). The establishment of co-integration indicates that the VEC model is effective for estimation. They used the Granger causality between inflation expectations of financial institutions, business organizations, trade unions, and the repo rate (Tjøstheim, 1981).

3.1. Theory framework

The theoretical framework used is the government budget constraint, which reflects the intertemporal trade-offs between government spending, taxation, and debt accumulation. The government budget constraint is represented in Equation 1.

$$B_t = (1 + r_t)B_{t-1} + G_t - T_t \quad (1)$$

where B_t represents government debt at time t , r_t represents the interest rate on government debt, G_t represents government spending and T_t represents tax revenues. In Equation 1, the deficit and surplus in the economy denoted by $tgdc_t$, given that farmwork can be simplified in Equation 2.

$$B_t = (1 + r_t)B_{t-1} + tgdc_t \quad (2)$$

The theoretical framework presented in Equation 2 in the context of this study is extended with other economic and controlled variables, which are reflected in Equation 3.

$$\Delta tgdc_t = (1 + r_t)tgdc_{t-1} + gfecra_t + tgdc_t + infl_t + intrst_t + fexr_t \quad (3)$$

The economic variables are: total domestic debt, gold and foreign exchange contingency reserve account, $tgdc$, the national government deficit and surplus, inflation, interest rates, government securities and the foreign exchange rate. SA cent US dollar.

3.2. Model specification: VEC

This study uses the VEC model, a specialized form of the unrestricted Vector Autoregressive (VAR) model, to capture the intricate dynamics between government fiscal policies and debt levels over time. The VEC model is particularly suited for analyzing time series data where variables are cointegrate, meaning they share a long-term equilibrium relationship despite short-term fluctuations. By integrating both short-term and long-term dynamics, the VEC model provides a comprehensive framework for understanding the interplay between fiscal adjustments and debt outcomes. The VEC model is reflected in Equation 4.

$$y_t = \beta_0 + \sum_{j=1}^p \beta_j X_{t-1} + e_t \quad (4)$$

where y_t is a vector of the nonstationary $I(1)$ variable, β_1 is a vector of constants, p is the number of lags, β_j is a matrix of estimable parameters, and e_t is a vector of independent and identically distributed error terms. The VEC model can handle co-integrated and different economic variables. Therefore, the VAR model is rewritten as the VEC model, as shown in Equation 5.

$$\Delta y_t = \beta_0 + \sum_{j=1}^p \Gamma_j \Delta X_{t-1} + \sum_{j=1}^p \Pi_j X_{t-1} + \gamma_j ECT + e_t \quad (5)$$

where Δ is the difference operator, and the VECM specification contains information on both the short- and long-run adjustment to changes in X_t via the estimated parameters Γ and, Π , respectively. In the context of this study, the VEC model is reflected in Equation 6.

$$\Delta Intgd_t = \beta_0 + \sum_{j=1}^p \Gamma_j \Delta \begin{pmatrix} \beta_1 Intgd_t \\ \beta_2 lngfecra_t \\ \beta_3 Intgdc_t \\ \beta_4 lninfl_t \\ \beta_5 lnintrst_t \\ \beta_6 lnfxr_t \end{pmatrix} + \sum_{j=1}^p \Pi_j \begin{pmatrix} \beta_1 Intgd_t \\ \beta_2 lngfecra_t \\ \beta_3 Intgdc_t \\ \beta_4 lninfl_t \\ \beta_5 lnintrst_t \\ \beta_6 lnfxr_t \end{pmatrix} + \gamma_j ECT + e_t \quad (6)$$

Other scholars that have similar economic models include Jibin (2023), Manuel et al. (2023) and Jooste and Marinkov (2012), among others.

4. Result

Table 2 shows the descriptive statistics; notably, the mean *tgdc* stands at 1106075.1, reflecting the substantial domestic debt accumulated by the nation. Concurrently, the mean *gfecra* is -90564.2, indicating an increase in the account over time. The national average is found to have a mean value of 9304.338, which indicates a relatively small deficit or surplus on average over the observed period. In addition, the mean *infl* rate is 6.859%, reflecting the general price level increase within the economy. Meanwhile, the mean *intrst* is 11.131%, which influences borrowing costs and investment decisions. Moreover, the mean *fxr* of 8.595 SA cents per US dollar indicates the relative value of the South African currency.

Table 3 shows the matrix of the correlations. There exists a strong negative correlation of -0.943 between *tgdc* and *gfecra*. This suggests that as the total domestic debt increases, the gold and foreign exchange contingency reserve account tend to decrease, and vice versa. On the other hand, a positive correlation of 0.344 between *tgdc* and *tgdc* is evident. While this correlation is relatively modest compared to others, it suggests a tendency for higher debt levels to coincide with larger government deficits, reflecting the government's borrowing activities to finance expenditure gaps. Moreover, there is a negative correlation of -0.263 between *infl*. This suggests that higher levels of total domestic debt are associated with lower levels of inflation and vice versa. There is a negative correlation of -0.286 between *intrst*. In addition, this relationship reflects the influence of government borrowing on bond markets and the dynamics of interest rate determination. Lastly, a strong positive correlation of 0.910 between *tgdc* and *fxr*. This positive correlation suggests the potential impact of debt accumulation on exchange rate dynamics and the country's external position.

Table 4 shows the conventional unit root and structural break. The Dickey-Fuller and Phillips-Perron tests for unit roots reflect that all variables are stationary at first difference *d.tgdc*, *d.gfecra*, *d.tgdc*, *d.infl*, *d.intrst*, and *d.fxr*.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. Dev	Min	Max	Kurtosis
<i>tgdc</i>	406	1106075.1	1175301.2	79004	4534957	0.009
<i>gfecra</i>	406	-90564.2	136774	-458715	36577	0.347
<i>tgdc</i>	367	9304.338	26230.532	-92298	136922	0.000
<i>infl</i>	406	6.859	3.422	.2	16.8	0.033
<i>intrst</i>	406	11.131	3.07	6.96	18.3	0.000
<i>fxr</i>	406	8.595	4.389	2.524	19.053	0.000

Table 3. Matrix of correlations.

Variables	<i>tgdc</i>	<i>gfecra</i>	<i>tgdc</i>	<i>infl</i>	<i>intrst</i>	<i>fxr</i>
<i>tgdc</i>	1.000					
<i>gfecra</i>	-0.943	1.000				
<i>tgdc</i>	0.344	-0.367	1.000			
<i>infl</i>	-0.263	0.228	-0.142	1.000		
<i>intrst</i>	-0.286	0.306	-0.111	0.396	1.000	
<i>fxr</i>	0.910	-0.910	0.318	-0.260	-0.421	1.000

Table 4. Conventional unit root.

Test Variable		Dickey-Fuller		Phillips-Perron	
		Test stat	5% critical value	Test stat	5% Critical value
<i>d.tgd</i>	Z(t)	−10.059	−2.874	−10.059	−2.874
<i>d.gfecra</i>	Z(t)	−20.138	−2.874	−20.138	−2.874
<i>d.tgdc</i>	Z(t)	−34.510	−2.875	−34.510	−2.875
<i>d.infl</i>	Z(t)	−12.790	−2.874	−12.790	−2.874
<i>d.intrst</i>	Z(t)	−15.533	−2.874	−15.533	−2.874
<i>d.fexr</i>	Z(t)	−15.600	−2.874	−15.600	−2.874

Table 5. Lag-order selection criteria.

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
	−10263.6				1.0e + 16	56.7438	56.7737	56.819
1	−6591.58	7344.1	49	0.000	2.1e + 07	36.7269	36.9663	37.329
2	−6441.45	300.25	49	0.000	1.2e + 07	36.1682	36.617	37.297
3	2902.010	18687	49	0.000	0.000	−15.182	−14.524	−13.527
4	3251.130	698.240	49	0.000	1.1e-16*	−16.8792*	−16.0415*	−14.7721*
5	3288	73.742*	49	0.013	0.000	−16.851	−15.834	−14.292

Table 6. Johansen tests for cointegration.

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value: 5%
0	105	−6441.1216	0.0000	243.4821	124.24
1	118	−1617.1561	1.00000	243.4821	94.15
2	129	−1533.6205	0.36808	76.4109	68.52
3	138	−1516.6226	0.08917	42.4150*	47.21

Table 7. Shapiro-Wilk W test for normal data.

Variable	Obs	W	V	z	Prob > z
<i>tgd</i>	406	0.777	62.172	9.834	0.000
<i>gfecra</i>	406	0.788	59.109	9.713	0.000
<i>tgdc</i>	406	0.871	32.864	8.277	0.000
<i>infl</i>	406	0.924	21.249	7.277	0.000
<i>intrst</i>	406	0.878	34.089	8.403	0.000
<i>fexr</i>	406	0.934	18.291	6.920	0.000

Table 8. White's test.

chi2(20)	=	42.39
Prob > chi2(10)	=	0.0025

H0: homoskedasticity; Ha: unrestricted heteroskedasticity.

Table 5 shows the lag-order selection criteria. In selecting the lag order for each variable, the study uses three commonly used information criteria: AIC, HQIC, and SBIC. Based on these criteria, the lag order of 4 is selected because it yields the lowest values for AIC, HQIC, and SBIC, indicating a better trade-off between model fit and complexity.

Table 6 presents the results of the Johansen tests for co-integration. These tests determine the presence of long-term relationships among the variables. It is found that the maximum rank statistic 3, the economic variables co-integration third equations, suggests evidence of co-integration at the critical value at the 5% p-value. These results suggest the existence of long-term relationships among the variables, indicating that they move together over time. These results provide evidence of the validity of estimating the VEC model.

Table 7 shows the Shapiro-Wilk W test for normal data. All variables in the Shapiro-Wilk test statistic (W) are less than 1, indicating that none of the variables perfectly fit a normal distribution. The 'Prob>zz' values for each variable are very close to 0.000, suggesting that all variables significantly deviate from a normal distribution. To address this in the VEC. There is an application of transformations of variables to logarithms.

Table 8 shows the White's test result, which indicates that the chi-squared statistic is 42.39 with 20 degrees of freedom, and the associated p-value is 0.0025. Since the p-value is less than the significance level,

Table 9. Breusch-Pagan/Cook–Weisberg test for heteroscedasticity.

chi2(1)-	=	0.91
Prob > chi2(10)	=	0.3403

Assumption: Normal error terms, and H0: constant variance test for white noise.

Table 10. ARCH family regression.

Variables	Coef	p-value
<i>tgd</i>		
<i>gfecra</i>	−5.845	0.000
ARCH		
Arch		
L1	1.42206	0.000
Constant	1.62108	0
N	406	

Table 11. Short-run estimations of the VEC.

Estimation	(1)	(2)
Variables	<i>Intgd</i>	<i>Intgd</i>
main		
<i>ce1</i>	−0.0137*** (−3.34)	−0.0309** (−2.65)
<i>L2.Intgd</i>	−0.4640*** (−9.94)	
<i>L4.Intgd</i>	−0.5980 (−1.12)	−0.0477 (−0.86)
<i>L2.Intgd</i>		−0.445*** (−9.400)
<i>L2.lngfecra</i>	−0.0242** (−2.770)	
<i>L2.lngfecra</i>		−0.0110* (−2.400)
<i>L.Intgdc</i>	0.0731*** (3.400)	
<i>L.Intgdc</i>		−5.3908 (−1.620)
<i>L.lninfl</i>		0.0018 (1.390)
<i>L.lnintrst</i>		0.0011 (0.52)
<i>L.lnfexr</i>		−0.00325 (−1.49)
<i>_cons</i>	730.4 (0.83)	0.000419 (0.45)
<i>R</i> ²	0.63	0.68
N	406	406

Note that t-statistics are in parentheses and * $p < 0.05$, ** p .

usually 0.05, there is a rejection of the null hypothesis of homoscedasticity. As such, there is a suggestion that the error terms in the model exhibit heteroskedasticity, indicating that the variance of the error terms is not constant across observations. The heteroskedasticity in the VEC model violates one of the key assumptions of the model, which is that the error terms are homoscedastic. Parameter estimates may be biased, leading to incorrect inferences regarding the significance of coefficients. In an effort to resolve this, the estimation of VEC is estimated with robust standard errors to correct for heteroskedasticity. The standard errors adjust for heteroskedasticity and provide more reliable estimates of the coefficient standard errors.

Table 9 shows the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity. The chi-square reflects a value of 0.91, and the probability with the chi-square statistic is 0.3403, which indicates that there is no significant evidence against the null hypothesis. Therefore, you would fail to reject the null hypothesis of constant variance. These results reflect that the variability of the errors is likely constant across all levels of the fitted values. The absence of heteroskedasticity strengthens the validity of the VEC model regression results. The estimated coefficients and their significance levels are more reliable, assuming that the other assumptions of the regression model are also met.

Table 10 shows the ARCH family regression. It is found that for every one unit increase, the decrease decreases by 5.845%, holding other factors constant. The coefficient of the lagged ARCH term is 1.42206, with a highly significant p-value of 0.000. This positive coefficient indicates that past volatility (heteroskedasticity) has a significant and positive effect on current volatility. Table 11 shows the short-run estimations of VEC, with estimations 1 and 2 at 63% and 68%, respectively. This indicates that the variance in the dependent variables is explained by the independent variables included in the VEC model. The remaining 37% and 32% of the variance are unexplained and may be attributed to other factors not included in the model. The coefficient of *ce1* in both estimations 1 and 2 is statistically significant at 1%. These results indicate that there are 0.0137% and 0.0309% adjustments to equilibrium. The slow adjustment process implies that total domestic debt levels may persist above or below their

equilibrium for an extended period. This prolonged deviation from equilibrium can increase the vulnerability of the economy to external shocks and internal imbalances. Persistently high debt levels can strain government finances, leading to higher debt servicing costs and reduced fiscal flexibility. Estimations 1 and 2 reflect that the coefficients of $L2.Intgd$ are both statistically significant at 1%.

This result indicates that a 1% increase in $L2.Intgd$ results in 0.464% and 0.445% fall in the $Ingd$. These results are similar to that of Ayunku and Markjackson (2020). On the other hand, Jooste and Marinkov (2012), Saungweme and Odhiambo (2018), and Nzama et al. (2019) were silent on the lag effect of government debt. A negative coefficient suggests a corrective mechanism in place, where higher levels of debt in the previous periods lead to subsequent reductions in debt levels. This could be due to fiscal austerity measures, outline South African budget review (BR, 2017, BR., 2018, BR., 2020) and empirically indicated by (Burger & Marinkov, 2012, Burger et al., 2012, Burger et al., 2016, Buthelezi & Nyatanga, 2023, Buthelezi & Nyatanga, 2023, Buthelezi, 2024) among others. In estimations 1 and 2, reflect coefficients of $L4.Intgd$ are both insignificant.2024),

Thus, it cannot be ascertained what is the magnitude effect on $Intgd$. On the other hand, estimations 1 and 2 of $L2.Ingfecra$ indicated the coefficients that are significant, indicating that a 1% increase in $L2.Ingfecra$ resulted to a 0.0242% and 0.0110% fall $Intgd$. The results imply that when GFECRA reserves increase, they appear to dampen government debt levels in subsequent periods. This could be due to the availability of additional financial resources from GFECRA reserves, which may enable the government to finance its expenditures without resorting to increased borrowing, thus reducing debt levels. Policymakers should expect the GFECRA to play a potential role in managing and stabilizing government debt levels. Policymakers may consider leveraging GFECRA reserves as a strategic tool for debt management, particularly during periods of fiscal strain. This result is in line with the proposed outline in the 2024 South Africa budget speech to use GFECRA to reduce government debt (BS, 2024). Estimation 1, the coefficients of other variables such as $L.Intgdc$, is significant, indicating that 1% increase results in a 0.0731% increase in $Intgd$. This result indicates the persistence of government debt over time. Policymakers should be cognizant of the long-term implications of high debt levels and take proactive measures to ensure fiscal sustainability. On the other hand, in estimation 2 $L.Ininfl$, $L.Inintrst$, and $L.Infexr$ are not statistically significant at conventional levels, indicating that changes in government debt, inflation, interest rates, and foreign exchange rates may not have a significant impact on current changes in $Intgd$.

The variance decomposition is 24 months ahead, which is equivalent to an 8-quarter horizon, which is crucial for understanding the medium-term effects of leveraging the Gold and Foreign Exchange Contingency Reserve Account (GFECRA) on total domestic debt. Economic policies and structural changes often manifest their impacts over several quarters rather than immediately. This timeframe allows for the capture of the delayed and more sustained effects of such policies. Figure 2 shows that

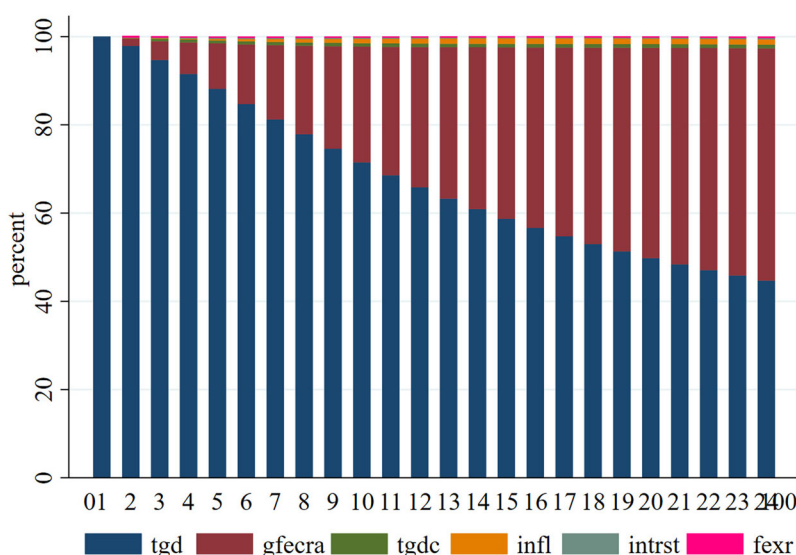


Figure 2. The variance of the deception of the economy varies with the total domestic debt.

the variance of the deception of the economy varies with the total domestic debt. The variance decomposition analysis highlights the evolving impact of *gfecra* use on *tgd* over time. Initially, in the 6th month, this explains a relatively smaller proportion of 19.5% of the variance, suggesting a gradual influence on debt dynamics. However, as time progresses, the impact of *gfecra* becomes more pronounced, with 40% and 56.5% of the variance in *tgd* being attributed to *gfecra* in the 16th and 24th months, respectively. This indicates that the effects of *gfecra* use will become more substantial over the medium to long term, potentially reflecting the effectiveness of *gfecra* in managing and stabilizing government debt dynamics.

Figure 3 shows that the variance deception of the economy varies on the gold and foreign exchange contingency reserve accounts. It is found that 5.3% and 2.4% explain the variation in the *gfecra* coming from *fexr* and *infl* respectively in month 6. In month 10, 1% variation in the *gfecra* explained by *fexr*. The significant percentage of variance explained by *fexr* suggests that fluctuations in exchange rates play a crucial role in influencing the GFECRA. This could indicate that movements in exchange rates affect the value of foreign currency reserves held in the GFECRA, thereby affecting overall reserve levels and financial stability. The contribution of inflation to the variance in GFECRA implies that changes in inflation levels may also influence reserve accumulation decisions. These results are in line with what is outlined in the 2024 South African report, which states that GFECRA accumulation is a result of the movement in the exchange (BS, 2024).

Figure 4 shows the effect of the shock of total domestic debt on economic variables. In Graph b, it is found that *tgd* shock increases the *gfecra*. Nevertheless, the increase has a diminishing marginal return over time. While increasing *tgd* may initially contribute to higher GFECRA levels, policymakers need to assess the efficiency of this allocation over time. The diminishing marginal returns observed imply that the effectiveness of using *tgd* to build GFECRA reserves diminishes as the level of debt increases. Therefore, policymakers should evaluate the optimal allocation of resources between debt reduction and reserve accumulation to maximize the benefits of GFECRA use.

Figure 5 shows the shock gold and foreign exchange contingency reserve accounts for economic variables. In Graph b, it is found that this results in a fall that shapes in the first 5 months and thereafter stabilizes at a lower level. These results are similar to those of Gill (2018), Adiwibowo and Sihombing (2019), De Santis (2020), Trinh et al. (2020), Zakari and Umar (2020), Osadume and Ovuokeroye (2021) and Rahmawati and Suriani (2022). Policymakers should recognize the potential of GFECRA shocks to influence government debt dynamics. The observed decline in *tgd* following the GFECRA shock suggests that leveraging reserves can contribute to debt reduction efforts in the short term. Understanding the short-term effects of GFECRA shocks on *tgd* is crucial for budget planning and forecasting. Policymakers need to anticipate the impact of GFECRA-related decisions on government debt levels and adjust

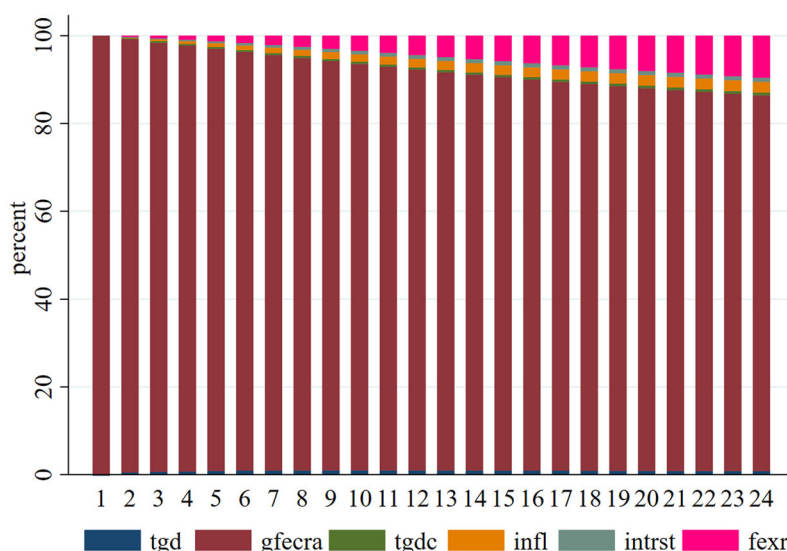


Figure 3. Variance deception in the economy varies on the gold and foreign exchange contingency reserve account.

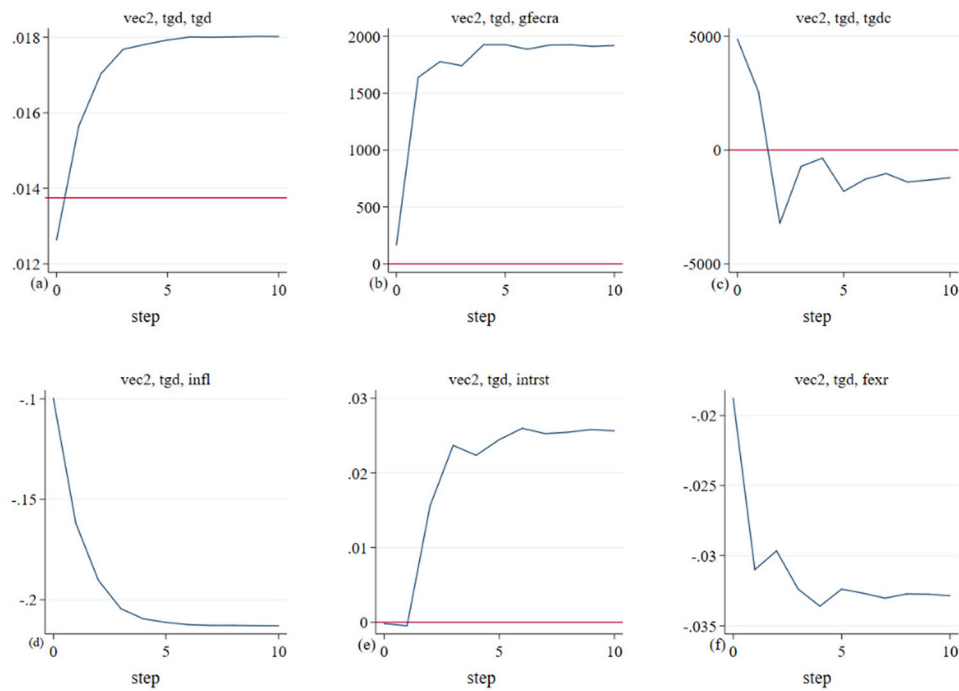


Figure 4. Shock total domestic debt on economic variables.

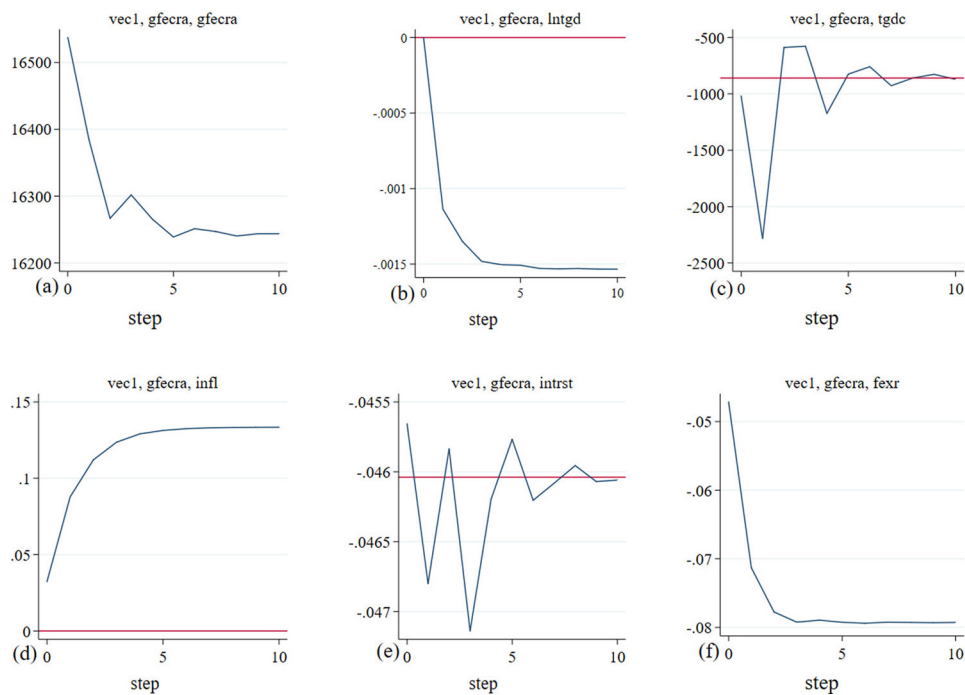


Figure 5. Shocked gold and foreign exchange contingency reserves account for economic variables.

budget allocations accordingly. This includes considering the timing and magnitude of GFECRA utilization to optimize its effectiveness in debt reduction efforts.

5. Conclusion

This study investigated the role of leveraging the Gold and Foreign Exchange Contingency Reserve Account (GFECRA) in managing total domestic debt in South Africa. Using time series data spanning January 1, 1990, to October 1, 2023, and employing a VEC model, valuable insights into fiscal policy

implications and debt management strategies have been offered. The findings underscore the potential effectiveness of GFECRA use as a strategic tool for debt management, particularly during periods of fiscal strain. The empirical analysis revealed a negative lag effect of the GFECRA on current government debt levels, indicating that increases in GFECRA reserves lead to subsequent reductions in total domestic debt. This highlights the importance of leveraging GFECRA as a mechanism for debt reduction.

Moreover, the study has shed light on both the short- and long-term dynamics of GFECRA use on total domestic debt. While shocks to the GFECRA result in immediate decreases in debt levels, the long-term impact becomes more pronounced over time, emphasizing the gradual effectiveness of the GFECRA in managing and stabilizing government debt dynamics. Additionally, diminishing marginal returns of leveraging total domestic debt on GFECRA have been observed, underscoring the need for policymakers to evaluate the optimal allocation of resources between debt reduction and reserve accumulation. Furthermore, external factors such as exchange rates and inflation have been identified as significantly influencing GFECRA dynamics. Fluctuations in exchange rates and inflation levels affect GFECRA accumulation decisions, highlighting the importance of considering external economic factors in debt management strategies.

5.1. Discussion and implications

Moving forward, policymakers should consider strategically leveraging GFECRA reserves to mitigate government debt levels, especially during periods of fiscal strain. GFECRA can serve as a valuable tool for debt reduction efforts, offering a mechanism for stabilizing government finances. Understanding the short-term and long-term dynamics of GFECRA use is crucial for effective risk management in debt management decisions. Policymakers must anticipate the impact of GFECRA-related decisions on government debt levels and adjust budget allocations accordingly. Additionally, policymakers must strike a balance between short-term debt reduction goals and long-term fiscal sustainability objectives.

5.2. Limitations and future research

Despite the insights provided by this study, several limitations should be acknowledged. First, the analysis is based on data from South Africa, and the findings may not be directly applicable to other countries. Future research could explore similar dynamics in different contexts to enhance generalizability. In addition, the study focuses primarily on the role of GFECRA in managing total domestic debt, overlooking other potential factors and strategies that may influence debt dynamics. Future research could investigate these factors in greater detail to provide a more comprehensive understanding of debt management strategies. Moreover, longitudinal studies tracking the impact of GFECRA utilization on fiscal stability and economic resilience over time could provide further insights into its effectiveness as a debt management tool. Finally, exploring the nuanced relationships between GFECRA utilization, debt dynamics, and external economic factors in greater detail could enhance our understanding of the complex interactions shaping fiscal policy outcomes.

Notes

1. The decision to leverage the GFECRA is underpinned by its intrinsic ability to provide liquidity during periods of financial exigency, thereby enabling the government to fulfill its fiscal obligations without resorting to external borrowing.
2. Currency mismatches refer to situations in which an entity, such as a government, corporation, or financial institution, holds assets and liabilities in different currencies. If the value of assets and liabilities denominated in one currency changes relative to another, it can lead to losses or gains for the entity.
3. The eight-quarter horizon strikes a balance between having enough data to observe significant trends and avoiding a potential decline in the predictive power of the VEC model. Extending the forecast too far can introduce noise and reduce the reliability of the results, whereas a shorter horizon might not capture the full impact of the variables under study.

Authors' contributions

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

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Data availability statement

The data used in this study can be provided upon request.

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