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Public Debt and Monetary Policy Neutrality: Evidence from Causality Analysis of the Money Supply-Interest Rate-Exchange Rate (MIE) Index

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ABSTRACT:

This study examines the causal relationship between public debt and monetary policy interactions, as captured by the Money Supply–Interest Rate–Exchange Rate (MIE) Index, in five Southern African countries (Botswana, Namibia, South Africa, Zambia, and Zimbabwe) using panel data from 2011 to 2025. Unlike conventional studies that examined money supply, interest rate, and exchange rates separately, this study introduces a MIE composite index that captures the joint monetary policy stance within a single empirical framework, thereby providing a more comprehensive assessment of fiscal-monetary neutrality. Grounded in the fiscal–monetary neutrality debate, the study employs PVECM together with Granger causality analysis to distinguish short run dynamics and long run equilibrium adjustments. The results reveal no significant bidirectional causality between public debt and the MIE index in the short run, providing empirical support for both monetary policy neutrality and public debt neutrality within the sampled economies. These findings suggest that monetary policy instruments do not systematically drive public debt dynamics, nor does debt accumulation significantly constrain monetary conditions. Instead, public debt trajectories appear to be influenced more by fiscal policy decisions, structural factors, and external shocks. The study contributes to the literature by offering context-specific evidence on fiscal–monetary independence in emerging Southern African economies. Policy implications emphasize the importance of strengthening fiscal discipline, improving revenue mobilization, and enhancing debt management frameworks, while allowing monetary authorities to pursue stabilization objectives without direct fiscal constraints. Further research is recommended to explore potential long-run or non-linear dynamics in fiscal–monetary interactions.

Keywords: Public debt, money supply, exchange rate, interest rate, and interactions

JEL: F34, H6, and P27.

1. INTRODUCTION

Public debt constitutes the aggregate stock of outstanding government liabilities owed to domestic and external creditors (Berisha, 2026). These liabilities arise through the issuance of sovereign securities—treasury bills, bonds, and other debt instruments—as well as multilateral and bilateral borrowing. Within modern macroeconomic frameworks, public debt functions as a central instrument of intertemporal fiscal policy, enabling governments to smooth consumption, finance capital accumulation, and respond to cyclical downturns or exogenous shocks. When deployed efficiently, debt-financed expenditure can enhance productive capacity and generate growth-enhancing externalities. However, excessive or poorly structured debt accumulation may generate macroeconomic distortions, elevate sovereign risk premia, and constrain future policy space (Ayesu et al., 2026).

Beyond its fiscal dimension, public debt occupies a critical position within the broader fiscal–monetary nexus. Theoretical debates surrounding monetary policy neutrality and fiscal dominance hinge on whether public debt dynamics systematically interact with monetary aggregates and price-stabilization instruments (Yahaya, 2026). In particular, the interactions among money supply, interest rates, and exchange rates—

captured in this study through the Money Supply–Interest Rate–Exchange Rate (MIE) Index—constitute the primary transmission channels of monetary policy. From a standard crowding-out perspective, higher public borrowing requirements may exert upward pressure on interest rates, alter liquidity conditions, and influence exchange rate dynamics. Conversely, under a regime of monetary accommodation, central banks may adjust policy rates or expand money supply to mitigate debt-servicing pressures, thereby internalizing fiscal conditions within monetary operations (Dambatta, 2026).

The neutrality proposition, however, challenges the inevitability of such fiscal–monetary interdependence. Monetary policy neutrality posits that monetary variables do not exert persistent real effects and may operate independently of fiscal imbalances (Ofonso, 2026). Symmetrically, public debt neutrality implies that debt accumulation does not systematically induce adjustments in monetary policy instruments, particularly in institutional environments characterized by central bank independence and inflation-targeting frameworks (Riois, 2026). Empirically, the extent to which public debt and monetary interaction effects are causally linked remains ambiguous, especially in emerging and developing economies where fiscal vulnerabilities, exchange rate volatility, and external shocks frequently coexist.

Existing empirical literature has largely examined bilateral relationships—such as debt–growth, debt–interest rate, or debt–inflation linkages—thereby abstracting from the systemic and endogenous interplay among core monetary variables (De Giorgi & Gambetti, 2026). Such partial-equilibrium approaches risk overstating or understating fiscal–monetary feedback effects. A more rigorous assessment requires treating public debt and monetary interaction variables as jointly endogenous within a dynamic multivariate system. In particular, testing for Granger causality within a Panel Vector Error Correction Model (PVECM) framework permits an empirical evaluation of whether debt dynamics precede and predict changes in monetary conditions, whether monetary interaction effects drive debt accumulation, or whether the relationship is statistically neutral in both directions.

Despite these important contributions, three important gaps remain. First, existing studies predominantly analyse monetary variables individually rather than capturing their combined interaction as a unified monetary policy stance. Second, limited evidence exists on fiscal–monetary neutrality in Southern African economies, despite their diverse exchange-rate arrangements and monetary policy frameworks. Third, previous studies rarely examine public debt and monetary interactions within a unified endogenous panel framework capable of distinguishing short-run causality from long-run equilibrium relationships. This study addresses these gaps by constructing the composite MIE Index and employing a Panel Vector Error Correction Model (PVECM) with Granger causality analysis to provide a comprehensive assessment of fiscal–monetary neutrality.

Against this backdrop, this study investigates fiscal–monetary neutrality by examining the causal relationship between public debt and the MIE index using a PVECM model and Granger causality techniques. By modelling money supply, interest rates, exchange rates, and public debt as endogenous variables within a unified system, the analysis captures dynamic interdependencies and short-run feedback mechanisms. The objective is to determine whether public debt Granger-causes monetary interaction effects, whether monetary dynamics Granger-cause debt accumulation, or whether empirical evidence supports bidirectional neutrality.

The findings contribute to the theoretical discourse on fiscal–monetary independence and provide policy-relevant evidence for emerging economies seeking to preserve macroeconomic stability and debt sustainability. Establishing the presence or absence of causality between public debt and monetary interaction effects has direct implications for institutional design, policy coordination, and the management of sovereign risk. The remainder of the paper proceeds as follows: section 2 reviews the relevant literature, section 3 presents the methodological framework and model specification, section 4 discusses the empirical findings, and section 5 concludes with policy implications and recommendations for further research.

2. LITERATURE REVIEW

The relationship between public debt and monetary policy has long occupied a central position in macroeconomic theory, particularly within the Debt Dynamics framework, which models the evolution of public debt as a function of economic growth, interest rates, and primary fiscal balances (Kiangi et al., 2026). Empirical applications of this model predominantly focus on solvency conditions, debt-to-GDP thresholds, and sustainability benchmarks, often treating macroeconomic variables such as growth and interest rates as weakly exogenous determinants of debt outcomes. For instance, Carrasco Tovar-García (2026) identifies inflation, GDP growth, and the nominal exchange rate as significant drivers of public debt in Mexico, though the exchange rate effect weakens when post-transition euro area countries are excluded. Similarly, Chalwe & Likando (2026), using a Vector Error Correction Model (VECM) for Zambia, report a negative but statistically insignificant long-run relationship between public debt and economic growth, with short-run dynamics influenced by macroeconomic volatility and debt-servicing pressures. While informative, these studies largely conceptualize macroeconomic variables as determinants of debt rather than as part of a jointly endogenous fiscal–monetary system, leaving open the question of whether debt and monetary interaction effects are causally interdependent or neutral.

The Fiscal Theory of the Price Level (FTPL) advances the argument that fiscal policy, through public debt issuance, can influence price-level determination and thus interact directly with monetary policy. Empirical contributions within this tradition often examine inflation dynamics and the degree of fiscal–monetary coordination. Adewale et al. (2026), employing a Vector Autoregressive (VAR) model with Johansen cointegration and Forecast Error Variance Decomposition (FEVD) for Nigeria, find that government expenditure and transfer payments significantly contribute to long-run inflation persistence, while taxation exerts a limited effect and public debt has a modest but increasing influence. Although these findings underscore the role of fiscal instruments in shaping nominal stability, the literature remains predominantly inflation-centred and frequently assumes implicit coordination between

fiscal and monetary authorities. Less attention has been devoted to testing whether public debt and core monetary transmission channels—money supply, interest rates, and exchange rates—exhibit empirical causality, or whether they operate independently under institutional regimes characterized by central bank autonomy.

The Debt Sustainability Analysis (DSA) framework, widely adopted by international financial institutions, evaluates sovereign debt trajectories by forward-looking projections of growth, interest rates, and exchange rate movements. While DSA provides structured solvency diagnostics, it is fundamentally accounting-based and does not empirically assess causal dynamics between debt and monetary variables. The framework assumes macroeconomic projections as inputs rather than testing whether debt accumulation itself alters monetary conditions. Consequently, the empirical direction of influence between public debt and monetary aggregates remains underexplored. By contrast, a Vector Autoregressive (VAR) approach combined with Granger causality testing allows for the treatment of debt and monetary interaction variables as jointly endogenous, enabling a direct empirical evaluation of fiscal–monetary neutrality.

Behavioural and financial market theories further inform the debate. Ricardian Equivalence posits that debt issuance does not affect real economic variables because rational agents internalize future tax liabilities (Auntu&Pilinkiene, 2026). In contrast, the Crowding Out hypothesis predicts that increased public borrowing raises interest rates and suppresses private investment (Bolukbsai, O. F., & Çolak, 2026). Empirical evidence remains mixed. Wabiga& Muhumuza (2026), applying ARDL and NARDL models to Uganda, find that rising public borrowing—particularly domestic debt—negatively affects private investment in both the short and long run, supporting crowding-out effects. Yet such studies typically isolate single transmission channels, focusing on interest rates or investment without simultaneously incorporating exchange rate and liquidity dynamics. This partial equilibrium treatment limits understanding of whether broader monetary interaction effects respond endogenously to debt accumulation or remain neutral.

Finally, the Intergenerational Equity perspective emphasizes the long-term distributional implications of public debt, highlighting concerns regarding sustainability and the burden on future generations (Seghini, 2026). Although normatively compelling, this framework offers limited empirical assessment of the dynamic fiscal–monetary mechanisms through which debt influences macroeconomic stability. Bridging these strands of literature, the present study contributes by empirically testing fiscal–monetary neutrality through the causal analysis of public debt and the Money Supply–Interest Rate–Exchange Rate (MIE) Index. By modelling these variables within a unified VAR system, the study moves beyond threshold, projection-based, or single-channel analyses to evaluate whether public debt and monetary policy transmission mechanisms exhibit bidirectional causality or operate independently. In doing so, it advances the empirical discourse on fiscal–monetary independence and provides context-specific evidence on whether neutrality characterizes debt–monetary interactions in emerging economies.

Most existing studies analyse monetary variables independently rather than through an interaction-based index. By constructing the composite MIE Index, this study captures the joint monetary policy stance within a single empirical construct. This provides a broader representation of monetary conditions than isolated indicators and offers a more comprehensive framework for evaluating fiscal–monetary neutrality.

3. METHODOLOGY

To explore causality from PD to MIE and vice versa, the study used Granger Causality following a methodology proposed by Mauto *et al*., (2026). The causality model from MIE Index to PD is specified in equation (1).

$$\Delta PD_{it} = \varrho_i + \sum \beta_{k=1}^{K} \Delta PD_{(i,t-k)} + \sum ¥_{k=1}^{K} \Delta MIE_{(i,t-k)} + \varepsilon_{it} \quad (1)$$

The causality from PD to the MIE is outlined in equation 2.

$$\Delta MIE_{it} = \tilde{n}_i + \sum \theta_{k=1}^{K} \Delta MIE_{(i,t-k)} + \sum \varrho_{k=1}^{K} \Delta PD_{(i,t-k)} + V_{it} \quad (2)$$

Where Δ represents change by first differencing, ΔPD_{it} and $\Delta MIE_{it}$are the first differences of variables Y and X for individual i at time t, ϱ_i and $\tilde{n}_i$ are individual-specific fixed effects, $\sum \beta_{k=1}^{K}$, $\sum \theta_{k=1}^{K}$, and $\varrho_{k=1}^{K}$ are coefficients to be estimated, ε_{it} and V_{it} are error terms, and K is the number of lags. i represents country i at time t.

> The optimal lag length for the Panel VAR and Granger causality estimations was selected using standard information criteria, including the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and Hannan–Quinn Criterion (HQ). These criteria consistently indicated that a two-lag specification provided the best balance between model fit and parsimony while preserving degrees of freedom given the relatively small panel sample. Consequently, two lags were adopted throughout the PVECM and Granger causality estimations.

This study focuses on the causality between PD and MIE in selected African countries. The study adopts a positivist paradigm to objectively quantify and statistically verify the causal relationship between macroeconomic variables interactions and public debt. The population comprises all African countries, but the sample is strategically limited to Zimbabwe, Botswana, South Africa, Namibia, and Zambia, chosen for their diverse economic profiles, regional representation, and data availability. The World Bank database is utilized as the primary data source due to its comprehensive, standardized, and internationally comparable macroeconomic indicators, ensuring reliability and facilitating cross-country analysis. This selection enables the study to provide robust, generalizable insights into the complex dynamics driving public debt in Africa, informing evidence-based policy decisions.

Although the selected countries belong to Southern Africa, they differ substantially in exchange-rate regimes, monetary policy frameworks, and fiscal institutions. Zimbabwe has experienced prolonged episodes of hyperinflation and exchange-rate instability, South Africa operates an inflation-targeting framework with relatively deep financial markets, whereas

Namibia maintains a currency peg through the Common Monetary Area and Botswana follows a managed exchange-rate arrangement. These structural differences are acknowledged when interpreting the panel estimates, which represent average regional relationships rather than identical country-specific responses. Future research should estimate separate subpanels for Common Monetary Area (CMA) and non-CMA economies to examine heterogeneous fiscal–monetary transmission mechanisms.

The variables employed in this study are meticulously calculated to capture the causal effect and direction between change in public debt and macroeconomic variables interactions. Public debt (PD_{it}) refers to the total amount of debt owed by the government in the current period. The ΔMIE index (ΔMIE) was calculated (MIE_{it} -MIE_{it-1})/ MIE_{it}, where MIEit is a composite index constructed using the geometric mean of money supply, interest rate, and exchange rate, given as follows:

$$\text{MIE Index}_{it} = [MS_{it} \times INTR_{it} \times \text{Exchange Rate}_{it}]^{1/3} \quad (3)$$

The study constructed the Money Supply–Interest Rate–Exchange Rate (MIE) Index using an equal weighting scheme, assigning identical weights to money supply, interest rates, and exchange rates to avoid subjective bias and preserve analytical transparency in examining fiscal–monetary neutrality. Given that the objective is to test causal interdependence between public debt and aggregated monetary interaction effects across countries, equal weighting ensures neutrality in index construction. However, this approach may obscure heterogeneous contributions of individual monetary variables and may be sensitive to multicollinearity and cross-country structural differences. Future research could improve index construction through data-driven techniques such as Principal Component Analysis (PCA) or Dynamic Factor Models, which are particularly suitable in panel settings where cross-sectional heterogeneity exists.

Because the study employs panel data, a rigorous panel diagnostic framework was implemented to ensure econometric validity. Outliers were detected using Z-scores to minimize distortion across cross-sectional units. Stationarity was assessed using panel unit root tests, including Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS), and Fisher-type ADF and PP tests, to account for both common and individual unit root processes. First differencing was applied where necessary to eliminate non-stationarity and avoid spurious regression in the panel VAR framework. Cross-sectional dependence was examined using Pesaran's CD test and Breusch–Pagan LM statistics, which are crucial in macro-panel studies involving interconnected economies. Multicollinearity among MIE components was evaluated using Pearson correlation analysis. Long-run relationships were tested using the Kao panel cointegration test to determine whether public debt and monetary interaction effects share a stable equilibrium relationship across countries. Heteroscedasticity diagnostics were conducted to ensure efficiency and consistency of estimators. These panel-based diagnostic procedures ensure that the subsequent Panel Vector Error Correction Model (PVECM) and Granger causality estimations are robust, thereby strengthening the empirical assessment of fiscal–monetary neutrality across Southern African economies.

4. RESULTS PRESENTATION AND ANALYSIS

The descriptive statistics indicate substantial volatility and non-normality in both ΔPD (change in public debt) and ΔMIE (change in the monetary interaction index). The mean of ΔPD (-0.268) suggests a slight average contraction in debt changes over the sample period, while the large standard deviation (19.249) and wide range (from -41.37 to 88.39) reflect significant fluctuations in debt dynamics across countries and time. The high positive skewness (2.225) and extreme kurtosis (11.621) indicate a heavily right-skewed and leptokurtic distribution, implying the presence of large positive shocks and extreme outliers in public debt adjustments. Similarly, ΔMIE has a near-zero mean (0.008), suggesting overall stability in monetary interaction effects, but its kurtosis (12.280) also indicates fat tails and potential extreme monetary episodes. The Jarque–Bera statistics for both variables are highly significant ($p = 0.000$), rejecting the null of normality. This non-normal distribution is common in macro-panel data and justifies the use of robust panel VAR techniques and careful diagnostic testing to ensure reliable inference in examining fiscal–monetary neutrality.

Table 1. Descriptive statistics.

Statistic	ΔPD	ΔMIE
Mean	-0.268	0.008
Median	-1.700	0.01
Maximum	88.39	2.46
Minimum	-41.37	-2.55
Std. Dev.	19.249	0.617
Skewness	2.225	0.018
Kurtosis	11.621	12.280
Jarque-Bera	294.120	269.116
Probability	0.000	0.000
Observations	75	75

Sources: Author's Analysis (2026).

Table 2. Outlier detection and transformations

Variable	|Z Values| ≥ 2	2≤ |Z Values |≤2	Outcome
PD	√	-	Data transformed
MIE Index	√	-	Data transformed

Source: Author's Analysis (2026).

The outlier detection analysis reveals that all variables (PD and MIE Index) have extreme values ($|Z\ Values| \geq 2$), indicating the presence of outliers. To address this, data transformation was undertaken. The first differencing approach was employed, which ensured that the variables became stationary and reduced the impact of outliers, making the data more suitable for subsequent analysis and modelling. This

transformation likely improved the robustness of the results and mitigated potential biases caused by extreme values.

Table 3. Multicollinearity results.

Variable	ΔPD	ΔMIE
ΔPD	1	
ΔMIE	-0.078	1

Source: Author's Analysis (2026).

The multicollinearity results indicate a very weak linear association between changes in public debt (ΔPD) and changes in the monetary interaction index (ΔMIE), with a correlation coefficient of -0.078. This value is close to zero, suggesting negligible correlation between the two variables. From an econometric perspective, this implies that multicollinearity is not a concern in the model, as problematic multicollinearity typically arises when correlation coefficients exceed 0.7 or 0.8 in absolute terms. The weak negative association also provides preliminary descriptive evidence consistent with the study's broader findings of fiscal–monetary neutrality, indicating that variations in public debt are not linearly associated with changes in monetary interaction effects. Consequently, both variables can be included in the Panel VAR framework without risk of inflated standard errors or unstable coefficient estimates due to collinearity.

Table 4. Heteroscedasticity results.

Test	t value	p value
Bruesch Pagan Test	1.21	0.227
White test	2.56	0.321

Source: Author's Analysis (2026)

The Breusch-Pagan and White's tests for heteroscedasticity show no evidence of non-constant variance, with p-values of 0.227 and 0.321, respectively, indicating the residuals have constant variance, supporting the validity of the model's inference and estimates.

Table 5. Normality test results.

Test	χ^2 value	p value
Jarque Bera test	28.638	0.000

Source: Author's Analysis (2026)

The Jarque-Bera test strongly rejects normality (χ^2 = 28.638, p = 0.000), indicating the residuals are not normally distributed. This suggests potential issues with model specification or the presence of outliers, and may impact inference and forecasting reliability, warranting further investigation or transformation.

The panel unit root results show that public debt (PD) is non-stationary at levels but stationary after first differencing (I(1)), while the macroeconomic interaction effects (MIE) exhibit mixed integration (I(0) and I(1)). This mixed order of integration suggests that traditional VAR in levels could produce spurious results. Therefore, to examine long-run relationships and causal dynamics, it is appropriate to first test for cointegration; if a long-run equilibrium exists, a PVECM can be used to capture both short- and long-run effects, while standard Granger causality can be applied in a VECM or ARDL framework depending on integration properties. This ensures valid inference despite the mixed stationarity of the variables.

Table 7. Cointegration test results.

Kao Cointegration Test		
Test	**Statistic**	**P-Value**
Augmented Dickey-Fuller Test	-2.853	0.017

Source: Author's Analysis (2026)

The Kao cointegration test results show an ADF t-statistic of -2.853 with a p-value of 0.017, indicating that the null hypothesis of no cointegration between public debt (PD) and macroeconomic interaction effects (MIE) can be rejected at the 5% significance level. This provides statistically significant evidence of a long-run equilibrium relationship, suggesting that PD and MIE—comprising money supply, interest rates, and exchange rate interactions—move together over time. Economically, this implies that changes in these macroeconomic variables are systematically linked to public debt dynamics, reflecting interconnected fiscal-monetary effects. Methodologically, the confirmation of cointegration justifies the use of a PVECM to capture both short-run adjustments and long-run equilibrium relationships, allowing analysis of how deviations from long-run balance between PD and MIE are corrected over time.

Table 6. Panel Unit Root Test Results.

Variables	Individual Unit Root Process						Order OF Integration
	Levels			1st Difference			
	Lm, Pesaran & Shin W-Stat	ADF-Fisher Chi-Square	PP-Fisher Chi-Square	Lm, Pesaran & Shin W-Stat	ADF-Fisher Chi-Square	PP-Fisher Chi-Square	
PD	0.944	0.977	0.976	0.000	0.000	0.000	I (1)
MIE	0.145	0.111	0.000	-	0.000	0.000	I(0) and I(1)

Source: Author's Analysis (2026).

Table 8. Cross-sectional dependency test results.

Test	Statistic	P-value
Pesaran's CD	0.895	0.623
Friedman's	1.725	0.365
Frees'	0.908	0.312
Breusch-Pagan LM	Chi squared = 0.355	0.623

Source: Author's computations (2026).

The cross-sectional dependency tests (Pesaran's CD, Friedman's, Frees', and Breusch-Pagan LM) all indicate no significant cross-sectional dependence ($p > 0.05$), suggesting the panel data is free from common shocks or unobserved factors affecting multiple units, supporting the use of standard panel estimation techniques.

Table 9. Granger causality test results.

Null Hypothesis	Observations	F Statistic	Probability
ΔMIE does not Granger cause ΔPD	65	0.059	0.982
ΔPD does no Granger cause ΔMIE		0867	0.426

Source: Eviews 12 Results (2026)

The effective sample declined from 75 to 65 observations after incorporating lagged variables required by the Panel VECM estimation. The reduction reflects the loss of initial observations resulting from lag construction and does not indicate missing data.

4.1. Interpretation of Findings

The panel Granger causality results indicate the absence of statistically significant bidirectional causality between changes in public debt (ΔPD) and changes in the monetary interaction index (ΔMIE), with p-values of 0.982 and 0.426 respectively. At conventional significance levels (1%, 5%, and 10%), both null hypotheses cannot be rejected, implying that past values of the MIE index do not systematically predict changes in public debt, nor do past changes in public debt predict movements in the monetary interaction index. In econometric terms, the short-run dynamics of fiscal indebtedness and monetary interactions appear statistically independent within the sample period. This suggests that fiscal authorities' borrowing behaviour does not respond contemporaneously to shifts in liquidity conditions, interest rate adjustments, or exchange rate movements, and that central banks do not systematically adjust monetary conditions in reaction to short-run debt fluctuations. The empirical evidence therefore supports a neutrality proposition in the short run, in which the fiscal and monetary spheres operate without significant predictive feedback effects. Importantly, this finding does not imply the absence of macroeconomic interactions in a structural sense; rather, it indicates that such interactions are not sufficiently systematic or temporally aligned to generate Granger-causal predictability within the specified PVAR framework.

4.2. Economic Transmission Mechanisms

From a macroeconomic transmission perspective, the absence of causality suggests that traditional monetary channels—liquidity expansion, interest rate adjustments, and exchange rate management—are not the primary short-run determinants of debt dynamics in the sampled economies. Public debt accumulation may instead be driven predominantly by fiscal imbalances, structural budget deficits, countercyclical expenditure responses, weak revenue mobilization, or exogenous shocks such as commodity price volatility and capital flow reversals. In many emerging and developing economies, borrowing decisions are often shaped by fiscal rigidities and development financing needs rather than by marginal changes in policy rates or exchange rate movements. Conversely, the lack of causality running from debt to the MIE index implies that central banks do not systematically monetize debt or adjust policy rates in direct response to fluctuations in debt ratios. This weakens the argument for automatic fiscal dominance in the short run. The evidence therefore points to segmented policy transmission channels, in which fiscal operations and monetary interventions operate through distinct mechanisms. Such segmentation may reflect institutional arrangements that preserve central bank autonomy, limit direct monetary financing, and insulate short-term policy instruments from immediate fiscal pressures.

4.3. Theoretical Underpinning

The findings can be theoretically situated within the neutrality debate in macroeconomics, particularly the notions of monetary policy neutrality and public debt neutrality in the short-run. Under monetary neutrality propositions, variations in monetary aggregates or interest rate adjustments do not systematically alter real fiscal variables such as debt trajectories beyond transitory fluctuations (Serebriakova et al., 2026). Similarly, public debt neutrality suggests that debt changes do not automatically distort monetary policy conduct, especially when central banks operate under rule-based or inflation-targeting frameworks (Khamari & Das, 2026). While the Fiscal Theory of the Price Level (FTPL) posits strong fiscal–monetary interdependence in determining price levels and debt valuation, the current results indicate that such coordination may not manifest in short-run predictive causality. Moreover, standard Debt Dynamics models emphasize the role of interest rates and growth in shaping debt sustainability, yet these models often assume structural relationships rather than testing short-run temporal causality. The absence of Granger causality therefore refines these theories by suggesting that, within the observed institutional context, fiscal and monetary variables may interact in equilibrium conditions without exhibiting short-run directional predictability. This supports a framework of policy compartmentalization rather than fiscal dominance or monetary accommodation.

The Southern African context provides a plausible explanation for these findings. The sampled countries exhibit considerable institutional diversity, including inflation-targeting regimes, managed exchange-rate systems, currency pegs, and episodes of exchange-rate instability. Furthermore, public borrowing is frequently driven by infrastructure financing,

commodity price cycles, and external development financing rather than short-run monetary policy adjustments. These structural characteristics may weaken the direct transmission mechanisms predicted by conventional fiscal dominance theories, thereby explaining why fiscal and monetary variables appear statistically independent in the short run. Consequently, the results reinforce the importance of institutional and structural context when interpreting fiscal–monetary neutrality in emerging economies.

4.4. Comparative Positioning and Novelty

These findings diverge from a substantial body of empirical literature that documents significant bidirectional linkages between public debt and monetary variables, particularly in high-debt or crisis-prone economies. Studies grounded in fiscal dominance or active monetary stabilization frameworks often conclude that interest rate rules are crucial for stabilizing debt paths, and that rising debt constrains monetary autonomy. In contrast, the present evidence reveals statistical decoupling, thereby challenging generalized assumptions of automatic fiscal–monetary feedback. This helps clarify contradictions in prior research by demonstrating that the strength and direction of monetary–debt interactions are highly context-dependent, shaped by institutional credibility, financial market depth, exchange rate regimes, and policy coordination structures. The novelty of this study lies in its use of an interaction-based MIE index rather than isolated monetary variables, allowing a systemic assessment of monetary conditions. By testing causality within an integrated panel VAR framework, the study extends knowledge beyond single-channel analyses and shows that even when monetary variables are jointly considered, they may not exert short-run predictive influence on debt dynamics. This contributes a more nuanced understanding of fiscal–monetary neutrality in emerging economies.

4.5. Policy Implications

The policy implications are significant. First, the absence of causality implies that debt sustainability strategies should primarily focus on structural fiscal reforms—improving revenue mobilization, rationalizing expenditure, strengthening public financial management, and enhancing institutional credibility—rather than relying on monetary accommodation. Second, the findings reinforce the importance of central bank independence, as monetary authorities appear capable of pursuing inflation stabilization and exchange rate management without being systematically constrained by short-run debt developments. This supports a framework of policy specialization, where fiscal and monetary authorities operate within clearly defined mandates. Third, the results caution against overestimating the effectiveness of monetary tightening or liquidity management as tools for controlling debt accumulation. Finally, the evidence underscores the need for broader structural reforms—economic diversification, improved governance, and enhanced resilience to external shocks—to address underlying debt drivers. While short-run neutrality prevails, policymakers must remain vigilant regarding long-run sustainability conditions, as neutrality in predictive causality does not preclude structural interdependence over extended horizons.

Table 10. Panel VECM Robustness Results: Causality from changes in MIE Index to public debt to changes.

Variable	after Adjustments	Error Term	t-value
ΔPD (-1)	-0.310	0.125	-2.488
ΔDP (-2)	0.077	0.074	-1.048
ΔMIE	-2.253	2.267	-0.944

Source: Eviews 12 Results (2026).

The PVAR robustness results indicate that changes in the monetary interaction index (ΔMIE) do not exert a statistically significant effect on changes in public debt (ΔPD). Although the coefficient of ΔMIE is negative (-2.253), its t-value (-0.944) is far below conventional critical thresholds, implying that the effect is not statistically different from zero. This suggests that short-run fluctuations in the combined dynamics of money supply, interest rates, and exchange rates do not meaningfully explain variations in public debt. In contrast, the first lag of public debt, ΔPD (-1), is statistically significant (t = -2.488), indicating that past changes in debt have a measurable influence on current debt movements. This points to short-run persistence or inertia in debt dynamics, where previous borrowing patterns continue to shape present outcomes. However, the second lag, ΔPD (-2), is statistically insignificant, suggesting that this persistence effect weakens beyond the immediate past period.

Table 11. Causality from changes in Public Debt to changes in ΔMIE.

Variable	after Adjustments	Error Term	t-value
ΔMIE (-1)	-0.636	0.127	-4.994
ΔMIE (-2)	0.011	0.127	0.086
ΔPD	-0.007	0.005	-1.411

Source: Eviews 12 Results (2026).

The results in Table **11** show that changes in public debt (ΔPD) do not have a statistically significant effect on changes in macroeconomic interactions (ΔMIE). The coefficient for ΔPD is very small (-0.007), and its t-value (-1.411) is below conventional significance thresholds, indicating that variations in public debt do not meaningfully influence the combined dynamics of money supply, interest rates, and exchange rate captured by ΔMIE. In contrast, the first lag of ΔMIE (-0.636, t = -4.994) is highly significant, suggesting that the current state of the MIE index is primarily driven by its own past behaviour rather than by fluctuations in public debt. The second lag of ΔMIE is insignificant, indicating that the persistence effect diminishes after the first period. Overall, these findings reinforce the conclusion that ΔMIE is largely self-determined in the short run, and public debt changes do not act as a significant driver, highlighting the dominance of internal momentum in the dynamics of macroeconomic variables over the influence of debt adjustments.

5. CONCLUSION

This study examined the short-run causal relationship between public debt and the interactions of money supply, interest rates, and exchange rates (MIE index) across five Southern African countries from 2011 to 2025 using panel data. Employing Granger causality tests and PVAR robustness checks, the analysis consistently found no significant bidirectional causality between public debt and the MIE index. The dynamics of MIE are primarily driven by their own past values, while public debt exhibits some persistence but is largely unaffected by macroeconomic interactions. These results indicate that changes in public debt do not significantly influence monetary policy variables, and vice versa.

The findings provide empirical support for the concepts of monetary policy neutrality and public debt neutrality. Monetary authorities appear able to implement stabilization measures, such as interest rate adjustments or exchange rate interventions, without being constrained by public debt levels. Similarly, fiscal authorities cannot rely on monetary variables to directly influence debt accumulation. This independence highlights the context-specific nature of debt–monetary interactions, particularly in emerging economies with distinct institutional and macroeconomic structures.

Compared to prior studies documenting strong monetary–fiscal linkages, especially in high-debt or macroeconomically unstable countries, this research clarifies inconsistencies in the literature by demonstrating a decoupling between public debt and MIE dynamics in Southern Africa. The results emphasize that fiscal policy decisions, external shocks, and domestic economic conditions are more influential in shaping debt trajectories than short-run fluctuations in money supply, interest rates, or exchange rates.

The findings should nevertheless be interpreted alongside the study's limitations. Although the Panel VECM captures both short-run and long-run dynamics, the relatively small regional sample and structural heterogeneity across Southern African economies may limit broader generalisation. Future research should estimate separate CMA and non-CMA panels, apply alternative estimators such as Panel ARDL and System GMM, and investigate nonlinear fiscal–monetary interactions under different exchange-rate regimes.

The study also demonstrates the usefulness of the composite MIE Index as an alternative empirical measure of the joint monetary policy stance, providing a broader framework for analysing fiscal–monetary interactions than conventional single-variable approaches. From a policy perspective, the study suggests that fiscal authorities should prioritize expenditure management, revenue mobilization, and institutional reforms to ensure debt sustainability. Central banks, in turn, can pursue independent objectives such as inflation targeting and growth stabilization without significant cross-policy interference. Overall, this study contributes robust empirical evidence to the debate on fiscal–monetary interdependence, highlighting the importance of context in designing coherent policies that promote macroeconomic stability and sustainable public debt management.

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