Economic Journal of Emerging Markets, 18(1) 2026, 67-78

Check for updates

EJEM
Econ.J.Emerg.Mark.

Economic Journal of Emerging Markets
Available at https://journal.uii.ac.id/jep

Public debt dynamics and real exchange rate volatility: Evidence from South Africa

Yonela Tyani*, Chuma Mbaleki, Asive Nodo

Department of Business Management and Economics, Faculty of Economics and Financial Science, Walter Sisulu University, Mthatha, South Africa
*Corresponding Author: tyaniyonela@gmail.com

Article history:
Received 11 February 2026
Accepted 03 April 2026
Published 30 April 2026

JEL Classification Code:
F31, H63, F41, C32, O55

Authors' emails:
cmbaleki@wsu.ac.za
anodo@wsu.ac.za

DOI:
10.20885/ejem.vol18.iss1.art6

Abstract

Purpose — This paper examines the relationship between South Africa's rising public debt and real exchange rate (RER) volatility. Over the past two decades, the country has experienced an alarming increase in external and domestic debt levels, accompanied by episodes of exchange rate instability and deteriorating economic performance.

Method — Using annual data from 2000 to 2024, we estimate an ARDL model to assess the nexus between debt and exchange rate volatility.

Findings — The results suggest that public debt is a significant driver of exchange rate volatility and rand depreciation. However, interest rates, inflation, and trade openness are key factors responsible for significant fluctuations in the exchange rate in South Africa. Similar results are obtained in both the short-run and long-run estimation.

Implications — The paper recommends firm government controls designed to prevent sharp capital movements (inflows or outflows) that could destabilise the rand. This can be achieved by maintaining a favourable trade balance, targeting inflation, and adjusting monetary policy. Secondly, the government can diversify the composition of its debt currency. This helps reduce volatility in debt-servicing payments and further stabilises government budgets and fiscal planning.

Originality — There is little empirical literature on the direct relationship between public debt and real exchange rate volatility in South Africa. This study aims to fill the gap by providing a novel empirical assessment of the long- and short-run dynamics between rising public debt and real exchange rate volatility.

Keywords — Public Debt, Real Exchange Rate Volatility, South Africa, Economic Growth, ARDL Model

Introduction

Despite its evident signs of resistance, South Africa has faced a deteriorating macroeconomic situation over the past decade. From the persistent accumulation of debt stock level, widening deficit and exchange rate volatility. Between 2008 and 2023, public debt increased from approximately 27% to over 70% of GDP, while debt-servicing costs grew as a share of total government liabilities. The country's domestic currency, the rand, is amongst the world's most volatile currencies, frequently responding to global risk sentiment, commodity price shocks, and domestic fiscal dynamics.

P ISSN 2086-3128 | E ISSN 2502-180X

Public debt refers to a government's overall debt to domestic and international creditors, including residents, foreign governments, and domestic and foreign financial institutions (Usman, 2025). On the other hand, the real exchange rate is the relative value of a nation's goods and services compared to those in foreign markets (Mbali, 2021). Dynamics in public debt can destabilise the value of a domestic currency, thereby increasing the cost of servicing debt (IMF, 2025). Governments with a high public debt burden face greater uncertainty, lower investor confidence, and higher borrowing costs (Koçak, 2025). These variations increase import costs, contribute to inflationary pressures, reduce the competitiveness of domestic firms involved in global trade**,** and erode purchasing power (Khomo & Aziakpono, 2020). Although many factors drive exchange rate volatility in South Africa, the role of public debt as a single driver has received less attention. Empirical evidence suggests that fiscal stress increases sovereign risk premia and triggers exchange-rate instability (Manguzvane & Biyase, 2023). Yet a comprehensive analysis explicitly focusing on the South African case remains limited.

Rising public debt in developing countries has significant implications for macroeconomic stability. A study by Olaoye et al. (2022) shows that high debt accumulation tends to suppress economic growth and worsen macroeconomic stability, especially when it exceeds optimal levels. These impacts are further complicated when linked to exchange rate dynamics, as demonstrated by Kuranga et al. (2025). He found a two-way relationship between public debt and the exchange rate. Exchange rate depreciation increases the debt burden, while increased debt can depress the exchange rate by increasing economic uncertainty.

Moreover, as public debt increases, interest rates rise, leading to capital inflows that contribute to real exchange rate appreciation. These findings are confirmed in empirical literature. Specifically, Sang et al. (2025) demonstrate that fiscal expansions financed by debt lead to an appreciation of the real exchange rate. This case applies to both advanced and emerging markets. Similarly, Donnat, (2025) demonstrates that higher public debt increases domestic interest rates, attracting capital inflows, which, in turn, leads to real exchange rate appreciation. Nyoro and Njaramba (2025) further demonstrate that high public debt is associated with real exchange rate depreciation and volatility. Ormaechea (2020) demonstrates that public debt, predominantly denominated in foreign currency, leads to exchange-rate depreciation, particularly in emerging markets. These studies hint at a negative relationship between public debt and the real exchange rate, an important aspect for South Africa, which is characterised by high public debt that has since been exacerbated by loans from the IMF and the World Bank.

A larger pool of empirical evidence suggests that macroeconomic variables have a significant impact on the real exchange rate (David, 2024). Changes in macroeconomic factors such as GDP, interest rates, inflation, external debt, and the balance of trade are major causes of exchange rate fluctuations (Ghauri et al., 2024). On the contrary, Armah et al. (2023) show that interest rates and inflation are unrelated to exchange rates. However, disaggregated studies targeting individual variables yielded mixed outcomes. For example, Özen et al. (2020) found that inflation and interest rates have a significant impact on exchange rates in both developed and emerging economies. Fluctuations in exchange rates and inflation substantially affect economic growth in the Southern African Development Community (SADC), particularly given the region's historical connections and economic clustering. Empirical literature demonstrates that exchange rate volatility and inflation are inversely correlated with economic growth. Olamide et al. (2022) demonstrate that exchange rate volatility worsens the inflation growth relationship in SADC economies. Patel and Mah (2018) and Rapetti (2020) found that real exchange rate appreciation is negatively and significantly associated with exports and economic growth in the long run. In contrast, money supply and foreign direct investment exert a positive and significant influence on the real exchange rate.

Exchange rate fluctuations continue to pose a serious threat to economic growth, as ongoing instability undermines competitiveness and complicates trade-related policy decisions (David, 2024). Whilst international trade is found to negatively affect the exchange rate by empirical results (Yussif et al., 2022), suggesting that greater trade exposure may increase currency volatility, a positive correlation is also found. For example, Moloi (2023) and Mehtiyev et al. (2021) show that, in certain situations, exchange rate volatility can promote trade by creating profit opportunities for both importers and exporters. Nicita (2013) found that fluctuations in exchange rates generally have little impact on international trade flows, with the notable exception of situations involving currency unions or fixed exchange rate systems, where volatility can play a more significant role.

This study contributes to the literature by estimating the impact of public debt on real exchange rate volatility in South Africa using the ARDL model. South Africa offers an excellent case study due to direct participation in global capital markets, relatively high levels of external debt, and well-developed financial markets (Mbaleki, 2024). Although the relationship between public debt and real exchange rate volatility has attracted significant global attention, empirical evidence from developing economies, such as South Africa, remains relatively limited. Motivated by these gaps, this study examines the relationship between public debt dynamics and real exchange rate volatility in South Africa, utilising time-series data spanning from 2000 to 2024. The data is obtained from the South African Reserve Bank (SARB) online statistical query and the World Bank. The study also controls for macroeconomic variables, namely: inflation, real interest rates, foreign direct investment (FDI), and the trade balance.

Methods

Empirical Framework

Nuru and Gereziher (2021) examined how innovations in public expenditure affect the volatility of the real exchange rate in South Africa, utilising a vector autoregressive impulse response model. The baseline Linear Programming model can be defined in the following manner:

$$x_{t+h} = \alpha_h + \varphi_h(L)y_{t-1} + \beta_h\ innovation_t + linear\ trend + \varepsilon_{t+h} \quad (1)$$

In this framework, x denotes government expenditure and exchange rate variations. Y encompasses the lagged values of government spending, exchange rate instability, real GDP, and public income. The expression φh(L) represents a polynomial in the lag operator, with the intercept βh reflecting the response of x at time t + h. The model incorporates a stationary (αh). We calibrate from this model by including public debt and controlling for macroeconomic variables such that:

$$RER_t = \beta_0 + \beta_1 PD_t + \beta_2 INF_t + \beta_3 RINTR_t + \beta_4 EXP_t + \beta_5 IMP_t + \beta_6 FDI_t + \varepsilon_t \quad (2)$$

Where RER_t denotes the real exchange rate in time t, based on the real effective exchange rate adjusted for trade weights. β_1 to β_6 Represents coefficients of the independent variables. INF_t Signifies inflation, measured by the yearly variation in the consumer price index. $RINTR_t$ Indicates real interest rates represented as a percentage of investment. EXP_tcorresponds to exports as a share of GDP, IMP_t While it reflects imports. FDI_t Represents Foreign Direct Investment based on net inflows (% of GDP). ε_t Encompasses all other factors influencing real exchange rate volatility that are not accounted for in the equation.

The study employs the ARDL approach to investigate the impact of public debt on real exchange rate volatility in the South African context. The chosen approach is more efficient since it captures both I(0) and I(1) variables, presents both long-run and short-run elasticities. Furthermore, ADRL corrects endogeneity and autocorrelation simultaneously, as stated by Pesaran et al. (2001). The specified ARDL model is as follows:

$$RER_t = \alpha_0 + \sum_{i=1}^{p} \psi_i RER_{t-i} + \sum_{i=0}^{q_1} \beta_{1,i} PD_{t-i} + \sum_{i=0}^{q_2} \beta_{2,i} INF_{t-i} + \sum_{i=0}^{q_3} \beta_{3,i} RINTR_{t-i} + \sum_{i=0}^{q_4} \beta_{4,i} EXP_{t-i} + \sum_{i=0}^{q_5} \beta_{5,i} IMP_{t-i} + \sum_{i=0}^{q_6} \beta_{6,i} FDI_{t-i} + \epsilon_t \quad (3)$$

Where p , represents the ideal count of lags for RER, q_1 to q_6 represent the ideal lags for every independent variable. α_0: The constant component. ψ_i: The short-term coefficients for the lagged dependent variable (RER). $\beta_{1,i}$ to $\beta_{6,i}$: The short-term coefficients for both current and lagged independent variables. ϵ_t: The residual term.

This study conducts a cointegration analysis using the ARDL Bounds test to examine the long-term relationship among the variables (Pesaran et al., 2001). The test relies on the F-statistic. In this examination, the null hypothesis of no cointegration is rejected if the calculated F-statistic exceeds the upper-bound critical value, suggesting a long-term relationship between the variables. Conversely, the null hypothesis is not rejected if the F-statistic is below the lower bound critical value, which indicates that there is no long-term connection between the variables. If the F-statistic falls between the lower and upper critical values, the test fails to yield a clear result and requires additional analysis to assess cointegration. Once the cointegration is identified, an Error Correction Model (ECM) is presented to show the speed at which the system reverts to equilibrium. The re-specified Error Correction Model (ECM) format of this ARDL model:

$$\Delta RER_t = \alpha_0 + \sum_{i=1}^{p-1} \psi_i^* \Delta RER_{t-i} + \sum_{i=0}^{q_1-1} \beta_{1,i}^* \Delta PD_{t-i} + \sum_{i=0}^{q_2-1} \beta_{2,i}^* \Delta INF_{t-i} + \sum_{i=0}^{q_3-1} \beta_{3,i}^* \Delta RINTR_{t-i} + \sum_{i=0}^{q_4-1} \beta_{4,i}^* \Delta EXP_{t-i} + \sum_{i=0}^{q_5-1} \beta_{5,i}^* \Delta IMP_{t-i} + \sum_{i=0}^{q_6-1} \beta_{6,i}^* \Delta FDI_{t-i} + \lambda ECT_{t-1} + \epsilon_t \quad (4)$$

Where ΔRER_t: The short-run changes in the real exchange rate. ΔPD_{t-i} to ΔFDI_{t-i}The first-differenced independent variables represent their short-run changes. ECT_{t-1}: The error correction term is the lagged residual from the long-run cointegrating regression. λ: The coefficient of the error correction term. ψ_i^* and $\beta_{1,i}^*$ to $\beta_{6,i}^*$: Short-run coefficients on the first-differenced variables.

The long-run relationship is embedded in the ARDL model and can be recovered by solving for the dependent variable (RER_t) when all variables are at their steady-state (or long-run) values. The long-run coefficients are the ratio of the cumulative coefficients of the independent variables to the cumulative coefficient of the lagged dependent variable.

$$RER_t = \alpha_0^{**} + \beta_1^{**} PD_t + \beta_{2,}^{**} INF_t + \beta_{3,}^{**} RINTR_t + \beta_4^{**} EXP_t + \beta_5^{**} IMP_t + \beta_6^{**} FDI_t \, \epsilon_t \quad (5)$$

The long-run coefficient for the j-th independent variable. α_0^{**}: The long-run intercept. ϵ_t: The long-run error term.

The estimation process for the ARDL model involves a series of steps, including testing for stationarity and establishing a long-run association using the bounds test. The process also involves running the long- and short-run regressions, as well as diagnostic tests and model stability checks. To test for stationarity, both informal and formal unit root tests are used.

Data Sources

The study uses time-series data from 2000 to 2024. The data has been obtained from the South African Reserve Bank (SARB) and the World Bank online database. The summary of the variables is presented in Table 1. This research examines the impact of public debt on real exchange rates in South Africa, with the real interest rate as the dependent variable and public debt as an explanatory variable, alongside inflation, real interest rates, foreign direct investment, exports, and imports.

Table 1. Variable description

Variable	Symbol	Source
Public debt	PDT	SARB
Real exchange rate	$RERT$	World Bank
Real interest rate	$RINTRT$	World Bank
Inflation	$INFT$	World Bank
Foreign direct investment	$FDIT$	World Bank
Imports	$IMPT$	Word Bank
Exports	$EXPT$	World Bank

Firstly, unit root tests for stationarity and integration are conducted using graphical analysis, and formal unit root tests are utilised to evaluate the stationarity of the model variables by applying the Augmented Dickey-Fuller and Phillips-Perron tests to assess whether a sequence of data over time series exhibits stationarity or non-stationarity. Secondly, the study determined the suitable lag length using the Schwarz Criterion (SC). The SC is a commonly employed standard for selecting lag length in econometric models, derived from the Bayesian information criterion (BIC). The ARDL bound test for cointegration is presented and scrutinised. Thirdly, after identifying the cointegration, an error correction model is presented. Both short-run and long-run estimates are interpreted. Lastly, diagnostic checks are utilised to check the model's stability.

This study conducted various tests to assess the model's reliability, including the Jarque-Bera test for normality of residuals, White's test, the ARCH test for heteroskedasticity, and the Breusch-Godfrey test for autocorrelation. The CUSUM and CUSUM Q tests are utilised to evaluate the stability and specification of the model.

Results and discussion

Table 2. Correlation matrix

	RERT	PDT	INFT	RINTRT	FDIT	EXPT	IMPT
RERT	1.000						
PDT	-0.700	1.000					
INFT	-0.433	-0.089	1.000				
RINTRT	0.152	-0.060	-0.012	1.000			
FDIT	-0.133	0.171	0.150	-0.381	1.000		
EXPT	-0.750	0.625	0.519	-0.034	0.287	1.000	
IMPT	-0.516	0.245	0.438	0.111	-0.056	0.787	1.000

The study utilises a correlation matrix to assess the relationships among variables, with the findings presented in Table 2. The results reveal that public debt, foreign direct investment, exports, and imports are negatively correlated with real exchange rates. In contrast, inflation and real interest rates are positively correlated with real exchange rates.

The summary statistics for each variable used in the study are presented in Table 3 below. This table provides insights into normality, measures of dispersion, central tendency, and other relevant findings.

Table 3. Descriptive Statistics

	RERT	PDT	RINTRT	INFT	FDIT	EXPT	IMPT
Mean	85.317	43.868	4.381	5.244	1.714	27.732	26.910
Median	80.826	38.045	4.546	5.338	1.064	27.575	26.938
Maximum	104.604	76.355	8.047	9.909	9.660	33.371	33.719
Minimum	69.832	24.044	0.472	-0.692	0.205	22.757	21.808
Std.Dev	11.496	16.444	1.727	2.146	1.998	2.834	3.362
Skewness	0.340	0.732	0.144	-0.281	2.851	0.349	0.222
Kurtosis	1.679	2.252	2.991	4.526	11.409	2.560	2.106
Jarque-Bera	2.299	2.819	0.086	2.759	107.558	0.711	1.039
Probability	0.316	0.244	0.957	0.251	0.000	0.701	0.594
Sum sq.Dev.	3171.949	6490.244	71.641	110.568	95.841	192.801	271.394
Observations	25	25	25	25	25	25	25

Table 4. Unit root test

Test	ADF		PP		Order of integration
Variable	Level	First difference	Level	First difference	ADF & PP
RERT	0.296	0.001	0.241	0.001	I(1)
PDT	0.999	0.038	0.996	0.043	I(1)
RINTR	0.058	0.004	0.092	0.000	I(0)
INF	0.719	0.000	0.330	0.000	I(1)
FDIT	0.001	0.000	0.001	0.000	I(0)
EXPT	0.214	0.000	0.214	0.000	I(1)
MPT	0.065	0.001	0.092	0.000	I(1)

Table 4 provides an overview of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests conducted at the level and after differencing. The results indicate that foreign direct investment is stationary in levels. In contrast, all other independent variables included in this study become stationary after first differencing. This study has a mixed order of integration, which includes I(0) and I(1) variables, enabling the use of an ARDL model.

Once the order of integration is identified through the unit root test, this research chooses the maximum lag of 1 based on the Schwarz Criterion (SC). Commonly referred to as the Bayesian Information Criterion (BIC), it favours simpler models, which are essential for minimising over-parameterisation and improving the efficiency of estimates in limited samples. The ARDL model analyses the long- and short-run relationships between public debt and real exchange rates in South Africa, and an ARDL bound test is utilised to detect cointegration.

Table 5. Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-401.093	N/A	1387446.	34.007	34.351	34.098
1	-300.931	133.548*	23494.73*	29.744*	32.493*	30.473*

The research selects the Schwarz Criterion (SC) to determine lag, demonstrating that lag 1 is the best choice. The SC is a commonly employed standard for selecting lag length in econometric models, derived from the Bayesian information criterion (BIC). This is especially beneficial for analysing economic time series, as extended lags can lead to overfitting and subpar performance on out-of-sample data (Kilian & Lütkepohl, 2017; Lütkepohl & Schlaak, 2019).

Table 6. Bounds test for Co-integration

T statistic	Value	K
F Statistic	12.118	6
Critical value bounds (Actual sample size = 24)		
Significance	I(0) Bound	I(1) Bound
10%	2.12	3.23
5%	2.45	3.61
2.5%	2.75	3.99
1%	3.15	4.43

Table 6 shows that the computed F-statistic (12.118) exceeds the upper critical threshold, indicating the presence of long-run cointegration among the variables. Therefore, the null hypothesis of no cointegration is rejected. This aligns with research by (Georgescu et al., 2024), which similarly identified evidence of co-integration among macroeconomic variables.

Table 7: Results from the long-run estimation

Dependent Variable: Real exchange rates				
Variable	Coefficient	Standard errors	t-statistic	p-value
PDT	-1.478	0.374	-3.943	0.001
RINTRT	-3.032	1.574	-1.925	0.074
INFT	-8.793	2.383	-3.689	0.002
FDIT	-0.057	0.949	-0.060	0.952
LEXPT	9.934	3.886	2.556	0.022
IMPT	-4.866	1.835	-2.652	0.018

Table 7 presents empirical results of the long-term relationship between public debt (PDT), real interest rate (RINTRT), inflation (INFT), foreign direct investment (FDIT), exports (EXPT), imports (IMPT), and the real exchange rate in South Africa. The results show that an increase in public debt results in a negative exchange rate in the long run. Essentially, a 1% increase in public debt leads to a -1.47 Rand depreciation. The results are statistically significant. The channel through which this relationship operates is currency depreciation and capital flows. Debt sustainability theories suggest that as debt increases, the country is at greater risk; as a result, investors are likely to channel their investments elsewhere in fear of default and inflationary financing. Therefore, as investors lose confidence in a specific economy, the currency depreciates. On the other hand, capital outflow increases volatility. This is supported by Nyoro and Njaramba (2025). Specifically, they find that elevated public debt levels can lead to a decline in a nation's currency's value.

Additionally, an increase in inflation (INFT) results in depreciation of the domestic currency. Specifically, a 1% increase in inflation results in a -3.0 depreciation in the rand. These results are statistically significant. This is supported by basic macroeconomic expectations in which rising inflation is poised to erode the rand's purchasing power, leading to its depreciation (Magubane, 2025). Another mechanism by which this relationship operates is through higher import costs, diminished investor trust, and slower economic growth.

The results show a negative, statistically significant relationship between imports and the exchange rate, whereas exports are positively related to it. A rise in imports leads to currency depreciation. Rising imports may lead to rand depreciation due to heightened demand for foreign currencies (Matlasedi, 2017). Conversely, an increase in exports results in an appreciation in domestic currency. This is due to increased demand for the rand in the foreign exchange market and, subsequently, to an improvement in the current account balance. Higher demand for the rand from increased exports can boost the currency (Ganelli & Rankin, 2020). Improvements in exports attract foreign investors, increase capital inflows, and strengthen the rand. It is clear, therefore, that Trade openness is one of the major drivers of the exchange rate fluctuations. Stronger exports relative to imports result in rand appreciation, whereas a negative trade balance causes rand depreciation.

Table 8. Short-run estimates and ECM

Dependent Variable: Real exchange rates				
Variable	Coefficient	Standard errors	t-statistic	p-value
C	30.992	21.028	1.473	0.162
PDT	-0.715	0.130	-5.490	0.000
RINTRT(-1)	-1.467	0.060	-2.439	0.028
INFT	-4.255	0.700	-6.073	0.000
FDIT	-0.027	0.458	-0.061	0.952
EXPT(-1)	4.807	1.308	3.675	0.002
IMPT	-2.355	0.572	-4.115	0.001
D(RINTRT)	1.093	0.424	2.577	0.021
D(EXPT)	2.591	1.048	2.471	0.026
CointEq(-1)	-0.483	0.043	-11.008	0.000

Table 8 presents the findings from a short-run estimation and error-correction model. The findings from the short-run estimation and error-correction model reveal a negative, statistically significant relationship between public debt, real interest rates, inflation, imports, and the real exchange rate. However, exports exhibit a positive, statistically significant relationship with the real exchange rate. A rise in public debt leads to a depreciation of the rand. An increase in the real interest rate leads to a decline in the domestic currency. These results are supported by Goonawardhana and Dissanayake (2023). They state that a rise in real interest rates leads to a decline in the real exchange rate, weakening the rand, as higher interest rates might attract foreign investment.

Furthermore, rising inflation reduces the real exchange rate, contributing to a decline in the rand's value. Elevated inflation may erode the currency's purchasing power and lower its value relative to other currencies (Priyatna et al., 2025). An increase in imports leads to a decline in the real exchange rate, resulting in a depreciation of the rand. Increased imports can create higher demand for foreign currency, which, in turn, weakens the rand (Mohr, 2020). Conversely, an increase in exports results in an appreciation of the domestic currency. This aligns with a study by

Kandil (2015), which found that an increase in exports leads to a rise in the real exchange rate, strengthening the rand.

The CointEq(-1) coefficient (-0.484) implies that approximately 48% of the divergence from the long-term equilibrium is adjusted in each period. The negative ECT coefficient of -0.483 confirms a stable long-run relationship where exchange rate volatility corrects toward equilibrium following a debt shock. This value indicates that approximately 48.4% of any divergence from the long-term trend is adjusted within a single period. The relatively high speed of adjustment suggests the system is responsive, clearing nearly half of the equilibrium error almost immediately. Consequently, it would take roughly two periods for the full impact of a shock to dissipate and for the exchange rate to stabilise. This result highlights a robust corrective mechanism that prevents permanent deviations from the established economic fundamentals. The coefficient on the error term is both statistically significant and negative, indicating that the model adjusts for deviations from the long-term equilibrium.

Table 9. Diagnostic tests

Test	Null Hypothesis	test-Statistic	p-value	Decision
Jarque-Bera	Residuals are normally distributed.	4.286	0.117	Residuals are normally distributed.
Arch test	The time series is homoscedastic.	0.115	0.910	The time series data presented in the study exhibit homoscedasticity.
Breusch-Godfrey serial correlation LM test	There is no serial correlation in the residuals.	0.406	0.467	There is no serial correlation in the residuals of the time series data used in this research paper.

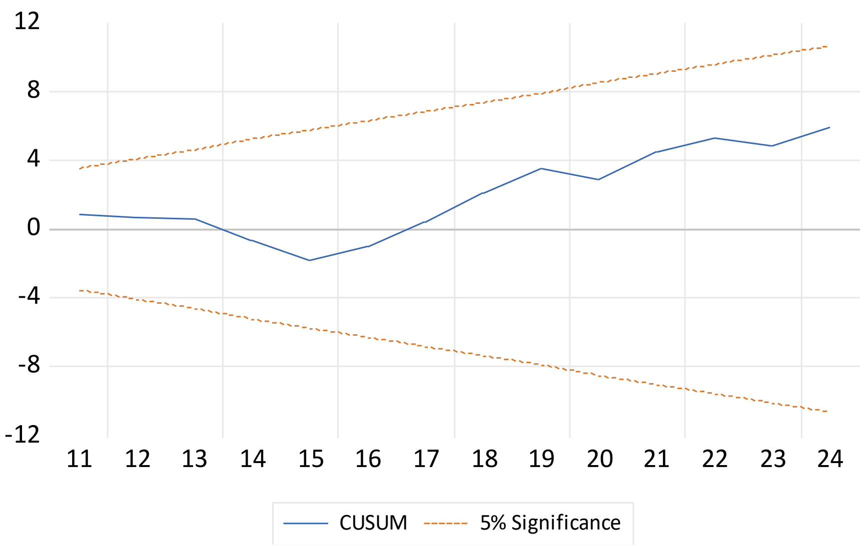

Figure 1. CUSUM Test

We use the Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Squares (CUSUM Q) tests to assess structural stability and specification. Figure 1 shows that the CUSUM chart indicates the line remains within the 5% significance level, indicating that the model's parameters are consistent over time. This uniformity indicates that the model can be dependably utilised for policy guidance and projections.

Based on the CUSUM of squares plot, the line stays within the 5% significance level, indicating that the model's parameters are consistent over time. This consistency implies that the model can be reliably used for policy recommendations and predictions. The lack of substantial deviations from the expected path suggests that the relationships among the model variables are robust and do not often drive significant structural breaks.

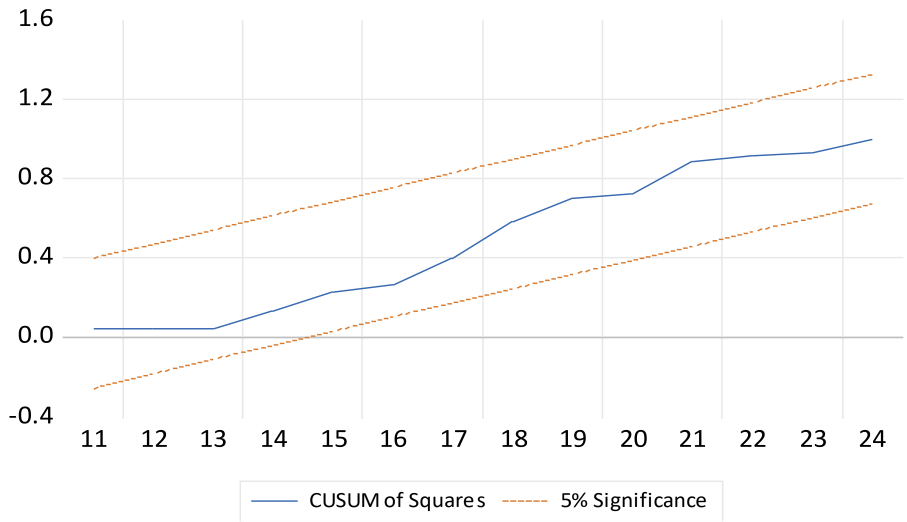

Figure 2. CUSUM of Squares

Conclusion

The study examined the relationship between public debt and real exchange rate volatility in South Africa using time-series data spanning from 2000 to 2024. South Africa is a unique case study in this instance as a country with a growing public debt, a volatile exchange rate, and a heavily import-reliant developing economy. The findings show that public debt is a significant driver of exchange rate volatility. This is the case in both the short- and long-run. This finding supports debt sustainability theories suggesting that rising public debt beyond sustainable levels scares investors due to anticipated default or inflationary financing. This may result in capital outflows, currency depreciation, and increasing exchange rate volatility. Furthermore, the study finds that interest rates, inflation, and trade openness are key macroeconomic factors driving significant fluctuations in South Africa's exchange rate. These fluctuations are more prevalent in the long run than in the short run.

Lastly, the paper recommends firm government controls designed to prevent sudden capital movements (inflows or outflows) that could destabilise the rand. This can be achieved by maintaining a favourable trade balance, targeting inflation, and adjusting monetary policy. Secondly, the government can diversify the composition of its debt currency. This helps reduce volatility in debt-servicing payments and further stabilises government budgets and fiscal planning.

Area for Future Research

Future research could extend this work by exploring threshold effects (non-linearities) in more detail and by examining the real economic costs (e.g., trade, investment) of volatility generated by public debt. It can also decompose debt to capture the exact effect of debt components on the real exchange rate.

Acknowledgment

Not applicable

Author contribution

All authors contributed to the conception and design of the study, data collection, analysis and interpretation of the results, and the writing of the manuscript. All authors read and approved the final version of the manuscript.

Use of AI tools declaration

Artificial intelligence tools were used to assist with language editing and to enhance the clarity and readability of the manuscript. The authors remain fully responsible for the content and conclusions of this study.

Conflict of interest
The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article. Author A is a Master of Commerce student in Economics at Walter Sisulu University; Authors B and C are Lecturers at Walter Sisulu University. No specific grants were received from any funding agency in the public, commercial, or not-for-profit sectors for this research.

References

Armah, M. K., Ofori, I. K., & Andoh, F. K. (2023). A re-examination of the exchange rate — Interest rate differential relationship in Ghana. *Heliyon*, *9*(4), e14605. https://doi.org/10.1016/j.heliyon.2023.e14605

David, O. S. (2024). Impact of macroeconomic variables on exchange rate in south africa. *International Journal of Development and Economic Sustainability*, *12*(3), 26—35. https://doi.org/10.37745/ijdes.13/vol12n32635

Donnat, G. (2025). *Real exchange rate and external public debt in emerging and developing countries*. http://195.220.190.85/GREDEG-WP-2025-15.pdf

Ganelli, G., & Rankin, N. (2020). Fiscal deficits as a source of boom and bust under a common currency. *Journal of International Money and Finance*, *104*, 102149. https://doi.org/10.1016/j.jimonfin.2020.102149

Georgescu, I. A., Oprea, S.-V., & Bâra, A. (2024). Investigating the relationship between macroeconomic indicators, renewables and pollution across diverse regions in the globalization era. *Applied Energy*, *363*, 123077. https://doi.org/10.1016/j.apenergy.2024.123077

Ghauri, S. P., Ahmed, R. R., Streimikiene, D., Qadir, H., & Hayat, A. (2024). Macroeconomic factors driving exchange rate volatility and economic sustainability: case study of Pakistan. *Amfiteatru Economic*, *26*(66), 612—628. https://doi.org/10.24818/EA/2024/66/612

Goonawardhana, V. U. W., & Dissanayake, D. M. U. H. (2023). The Effect of Financial Development on Economic Growth; Incorporation with Impact of the COVID-19 Pandemic: Evidence from Asian Frontier Financial Markets. *South Asian Journal of Business Insights*, *3*(2), 69—89. https://doi.org/10.4038/sajbi.v3i2.58

IMF. (2025). *GLOBAL FINANCIAL STABILITY REPORT Shifting Ground beneath the Calm*. https://www.imf.org/-/media/files/publications/gfsr/2025/october/english/text.pdf

Kandil, M. (2015). On the benefits of nominal appreciations: Contrasting evidence across developed and developing countries. *Borsa Istanbul Review*, *15*(4), 223—236. https://doi.org/10.1016/j.bir.2015.06.003

Khomo, M. M., & Aziakpono, M. J. (2020). The behaviour of the real effective exchange rate of South Africa: Is there a misalignment? *Cogent Economics & Finance*, *8*(1), 1760710. https://doi.org/10.1080/23322039.2020.1760710

Kilian, L., & Lütkepohl, H. (2017). *Structural vector autoregressive analysis:* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781108164818

Koçak, M. (2025). Evaluation of public debt management practices in turkey from a historical perspective. *Üçüncü Sektör Sosyal Ekonomi Dergisi*, *60*(2), 1997—2010. https://doi.org/10.63556/tisej.2025.1555

Kuranga, A. O., Afolabi, A. C., Jimoh, M. M., & Ojuolape, M. A. (2025). Public Debt Dynamics and Exchange Rate in Nigeria. *Sri Lankan Journal of Business Economics*, *14*(1), 50—70. https://mgt.sjp.ac.lk/bec/wp-content/uploads/2025/06/SLJBE-Vol.-14-1-May-2025-Artical-04.pdf

Lütkepohl, H., & Schlaak, T. (2019). Bootstrapping impulse responses of structural vector autoregressive models identified through GARCH. *Journal of Economic Dynamics and Control*, *101*, 41—61. https://doi.org/10.1016/j.jedc.2019.01.008

Magubane, K. (2025). Determinants of Financial Stability and Development in South Africa: Insights from a Quantile ARDL Model of the South African Financial Cycle. *Journal of Risk and Financial Management*, *18*(9). https://doi.org/10.3390/jrfm18090495

Manguzvane, M. M., & Biyase, M. (2023). *Exchange rate risk and sovereign debt risk in south africa: a regime dependent approach*. Economic and Well-being Research Group. https://www.uj.ac.za/wp-content/uploads/2022/01/manguvzane-biyase-exchange-rate-risk-and-sovereign-debt-risk-in-south-africa-a-regime-dependent-approach.pdf

Matlasedi, T. N. (2017). The influence of the real effective exchange rate and relative prices on South Africa's import demand function: An ARDL approach. *Cogent Economics & Finance*, *5*(1), 1419778. https://doi.org/10.1080/23322039.2017.1419778

Mbaleki, C. (2024). Decomposing south africa's fiscal dynamics through successive policy regimes in the post-apartheid dispensation. *Journal of Public Administration*, *59*(2), 210—222. https://doi.org/10.53973/jopa.2024.59.2.a4

Mbali, A. (2021). *Public debt and economic growth: empirical evidence from South Africa*. http://hdl.handle.net/11427/35872

Mehtiyev, J., Magda, R., & Vasa, L. (2021). Exchange rate impacts on international trade. *Economic Annals-XXI*, *190*(5-6(2)), 12—22. https://doi.org/10.21003/ea.V190-02

Mohr, P. (2020). *Economics for south african students* (6th ed.). Van Schaik Publishers.

Moloi, V. M. M. (2023). The impact of exchange rate, interest rate, and international trade in selected Southern African Development Community (SADC) countries: an ARDL approach. *Eurasian Journal of Economics and Finance*, *11*(3—4), 144—158. https://doi.org/10.15604/ejef.2023.11.0304.004

Nicita, A. (2013). Exchange rates, international trade and trade policies. *International Economics*, *135—136*, 47—61. https://doi.org/10.1016/j.inteco.2013.10.003

Nuru, N. Y., & Gereziher, H. Y. (2021). *The impacts of public expenditure innovations on real exchange rate volatility in South Africa*.

Nyoro, N., & Njaramba, S. G. (2025). Dynamic relationship between public debt and exchange rate misalignment in kenya. *American Journal of Industrial and Business Management*, *15*(11), 1771—1790. https://doi.org/10.4236/ajibm.2025.1511091

Olamide, E., Ogujiuba, K., & Maredza, A. (2022). Exchange Rate Volatility, Inflation and Economic Growth in Developing Countries: Panel Data Approach for SADC. *Economies*, *10*(3). https://doi.org/10.3390/economies10030067

Olaoye, O. O., Tabash, M. I., Omokanmi, O. J., Ogunjumo, R. A., Ojelade, M. O., & Ishola, J. A. (2022). Macroeconomic implications of escalating stock of public debt: Evidence from sub-Saharan African economies. *African Development Review*, *34*(4), 527—540. https://doi.org/https://doi.org/10.1111/1467-8268.12677

Ormaechea, S. A. (2020). Public debt dynamics and intra-year exchange rate fluctuations. *IMF Working Papers*, *20*(261). https://doi.org/10.5089/9781513561585.001

Özen, E., Özdemir, L., & Grima, S. (2020). The relationship between the exchange rate, interest rate, and inflation: the case of Turkey. *Scientific Annals of Economics and Business*, *67*(2), 259 — 275. https://www.ceeol.com/search/article-detail?id=913840

Patel, D., & Mah, G. (2018). Relationship between Real Exchange Rate and Economic Growth: the case of South Africa. In *Journal of Economics and Behavioral Studies* (Vol. 10, Number 1). https://doi.org/10.22610/jebs.v10i1(J).2098

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289—326. https://doi.org/10.1002/jae.616

Priyatna, H. N., Suryadi, I., & Ersanti. (2025). Facing global inflation: economic strategies to strengthen people's purchasing power. *MSJ : Majority Science Journal*, *3*(1), 73—81. https://doi.org/10.61942/msj.v3i1.312

Rapetti, M. (2020). The real exchange rate and economic growth: a survey. *Journal of Globalization and Development*, *11*(2), 20190024. https://doi.org/10.1515/jgd-2019-0024

Sang, D. J., Nganai, S., & Kemboi, I. (2025). *Selected Monetary and Fiscal Factors and Exchange Rate Volatility: An Empirical Analysis of Money Supply, Inflation, Foreign Reserves and External Debt in East Africa Partner States*. https://doi.org/10.51244/IJRSI

Usman, K. (2025). A new analytical framework for investigating the debt-growth nexus in E7 economies. *Journal of Applied Economics*, *28*(1), 2600821. https://doi.org/10.1080/15140326.2025.2600821

Yussif, A.-R. B., Onifade, S. T., Ay, A., Canitez, M., & Bekun, F. V. (2022). Modeling the volatility of exchange rate and international trade in Ghana: empirical evidence from GARCH and EGARCH. *Journal of Economic and Administrative Sciences*, *40*(2), 308—324. https://doi.org/10.1108/JEAS-11-2020-0187