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# THE ASYMMETRICAL INFLATION-DEBT NEXUS IN SOUTH AFRICA

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## ABSTRACT

*Many African countries borrow to address high levels of unemployment, poverty and low economic growth, yet they are faced with high inflation rates and South Africa is not an exception ranking third in Africa among countries with high debt levels. The primary objective of this research was to investigate and analyse whether the impact of public debt on inflation is symmetrical or asymmetric in South Africa. The novelty of the study is the use of autoregressive and nonlinear autoregressive distributed lag methods) to examine this intricate relationship using annual data from 1990 to 2022 sourced from the World Bank portal. The findings revealed that public debt had a positive effect on inflation, although the relationship is asymmetric. It was recommended that there is need for introduction of inflation-indexed bonds to reduce interest burden, debt payment plans and coordination between fiscal policy and central bank's inflation targeting.*

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**KEYWORDS:** Financial Institution; Fiscal Policy; Inflation; Sustainable Development Goals.

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**JEL Codes:** E31; E62; H63

## 1. INTRODUCTION

A number of African economies, such as South Africa, Egypt, Zimbabwe and Angola, suffer from high public debt levels, which accumulate because they borrow to address macroeconomic challenges such as unemployment, poverty, and low levels of economic growth (Ncanywa and Masoga, 2018; Ndoricimpa, 2020). Inflation control and public debt servicing are essential for meeting an economy's monetary and fiscal policy objectives. Public debt, often known as government debt, is the total amount of bonds and other securities that the government of a nation has outstanding (Gill and Pinto, 2005). This debt can be external or internal; the former entails the government owing international financial institutions, other governments, and other commercial banks (Gill and Pinto, 2005). Conversely, internal debt refers to the amount the government owes to domestic lenders. Inflation refers to the general increase in the price of goods and services over a year (International Monetary Fund, 2024a).

South Africa ranks third in Africa among countries with high debt levels owed to the International Monetary Fund (IMF) (International Monetary Fund, 2024b). It has been facing increasing public debt and other macroeconomic challenges, such as rising prices and slow economic growth. South Africa's public debt is concerning because government spending has outpaced revenue over the last 15 years, and the country is forecast to borrow R533 billion annually (South African Government News Agency, 2023). This extra borrowing caused gross debt to increase from R4.8 trillion in 2023/24 to R5.2 trillion the next fiscal year, with public debt expected to exceed R6 trillion by 2025/26 (South African Government News Agency, 2023). Statistics reveal that debt servicing costs would increase from 20.7% of income in 2023/24 to 22.1% in 2026/27 (South African Government News Agency, 2023). These statistics show that South Africa's debt costs affect the economy's capacity to provide health, education and infrastructure development and attain diverse Sustainable Development Goals (SDGs) (Gumede, 2023). Gumede (2023) indicated that South Africa's R1 billion per day interest bill is unsustainable.

The primary objective of this research was to investigate and analyse whether the impact of public debt on inflation is symmetrical or asymmetric in South Africa. Another objective was to review and describe inflation and public debt levels in South Africa.

There has been a steady rise in government debt since 2008, and as of 2017, it surpassed 50% of gross

domestic product (GDP) (Bhuthlezi and Nyatanga 2023; Mellet 2012). At R48 942 per person as of 2018 Q2, the nation's debt per capita remained significantly greater than the average of nations with comparable economic standing (Brandmeir et al., 2017; Mothibi and Mncayi, 2019). Hlongwane and Daw. (2022) cited that macroeconomic variables like slow economic growth, high unemployment, and rising inequality have contributed to South Africa's rising public debt in 2020/21, the gross borrowing requirement reached R618.3 billion, a R202.5 billion increase from 2019/20 (South Africa National Treasury, 2021). This increase was attributed to the economic demands that arose due to the COVID-19 pandemic. Therefore, this research examined both the symmetric and asymmetric effects of South Africa's public debt on inflation, both in the short and long run.

This research is important because inflation adversely affects the economy, businesses, and people in general. In business, many companies may incur losses due to increased prices (Belanova, 2023). Economically, an understanding of the public debt-inflation nexus is crucial for policy formulation since these two factors can affect macroeconomic goals, such as achieving high economic growth. Furthermore, a comprehensive knowledge of the relationship influences interest rate decisions. If high debt levels result in higher inflation, interest rates may increase, harming investment and economic growth. In terms of investment, investors may not be keen to invest in an economy with ever-increasing prices. For people in general, increased inflation rates imply that some may not be able to afford certain necessities since inflation erodes individuals' purchasing power, and they are exposed to poverty.

Public debt can also lead to an economy being less resilient to shocks (Burriel et al., 2009). The study focused on South Africa because it is an economy with a significant inequality gap, and high public debt can limit government expenditure on social programmes and services that help impoverished communities, as resources may be diverted toward debt servicing and repayment. This may lead to a further increase in poverty levels; hence, SDG 1 (poverty reduction) may not be achieved. The study therefore provided valuable insights that will aid policymakers, economists, and financial institutions in making informed decisions to manage public debt and inflation levels, fostering economic stability.

This paper is structured as follows: Section 2 presents the literature review, followed by the research methodology under section 3. Section 4 presents the results of the study, and the first part is

based on autoregressive distributed lag, followed by nonlinear autoregressive distributed lag output. Policy recommendations and conclusions are presented under sections 5 and 6, respectively.

## 2. LITERATURE REVIEW

### 2.1. Theoretical Literature Review

This section briefly presents the theoretical underpinnings and previous studies that investigated the public debt-inflation nexus. The study reviewed two theories of the determinants of inflation, namely the monetarist and fiscalist. Monetarists assert that inflation arises from an excess of money relative to available goods, a concept encapsulated by the assertion that inflation is “always and everywhere a monetary phenomenon” (Friedman, 1966a). Consequently, they posit that monetary aggregates singularly dictate inflation dynamics, arguing that variations in the price level emanate from changes in the nominal money supply (Silva, 2008). Monetarists argue that excessive government borrowing, particularly if supported by the central bank printing money (monetary financing), can increase the money supply (Li and Liu, 2022). This theory is crucial to this study because, according to monetarists, the relationship between public debt and inflation depends on how the debt is financed. Inflation may occur if debt causes an increase in the money supply.

In contrast, fiscalists advocate for the importance of fiscal variables, such as government expenditure, debts, and taxes, as drivers of inflation (Tiedemann et al., 2024). While traditional monetarists claim a central bank’s commitment to price stability is sufficient, proponents of the fiscal doctrine dispute this view. They argue that achieving price stability necessitates not only an appropriate monetary policy but also a complementary fiscal policy (Cochrane, 2000; McCallum, 1998). Consequently, they posit that fiscal policies play a crucial role in influencing inflation. Recognising fiscal policies’ pivotal role in determining the price level, it became known as the Fiscal Theory of the Price Level (FTPL) (Woodford, 1994). This theory is pertinent to this study because fiscalists claim the accumulation of large debt without an established plan to deliver future surpluses raises expectations that the government will eventually monetise the debt. This expectation can lead to inflation since money’s value may decrease in reaction to expected future devaluation.

### 2.2. Review Of Related Literature

Some previous studies support the existence of a positive relationship between public debt and

inflation (Afonso and Ibraimo, 2018; Romero and Marin, 2017; Sims, 2014), and others found a negative relationship between these two variables (Taghavi, 2000; Wheeler, 1999). While many studies have explored the relationship between public debt and inflation in different countries (Afonso and Ibraimo, 2018; Meyer et al., 2018; Redda, 2020; Romero and Marin, 2017; Sims, 2014), this section reviews some of the studies conducted globally and in South Africa to highlight the gaps that the current study aimed to close.

Inflation and public debt are challenges that affect both developing and developed economies. Hansel (2024) researched the relationship between public debt and inflation in developed economies using data from 1950 to 2020. According to research findings, public debt can influence inflation, particularly when people use it to insure against personal financial risks. It was also determined that increases in government debt could boost the “natural” or “neutral” interest rate, resulting in inflation if the central bank does not appropriately adapt its policies. The findings suggest that high public debt levels can lead to high inflation rates.

Dumitrescu et al. (2022) used panel data from 22 emerging economies to examine the nonlinear effects of public debt on inflation, using data from 2006 to 2015. Their study revealed that an increase in public debt led to higher inflation in countries where the shadow economy exceeded 24.3% of GDP. This shows a positive relationship between public debt and inflation levels. As such, it implies emerging economies must control their debt levels to avoid price increases.

Another study by Aimola and Odhiambo (2021) used the NARDL technique to analyse the asymmetric relationship between public debt and inflation in Gambia. That study covered the timeframe 1978 to 2019. An asymmetric relationship between total public debt and inflation (both in the short and long run) was established.

Furthermore, Nguyen (2015) used a Generalised Method of Moments to analyse the relationship between public debt and inflation in developing countries, including Asia, Latin America and Africa, from 1990 to 2014. The findings indicate that public debt has a significantly positive impact on inflation. These findings imply that when a government increases its public debt level, inflation may increase, and this affects the economy’s stability. These research findings align with those of Dumitrescu et al. (2022), since both studies found public debt had a positive effect on inflation levels.

Akingbade and Nicholas (2021) used an ARDL

model to examine Nigeria's public debt and inflation nexus from 1983 to 2018. Research findings indicated that public debt did not have any impact on inflation, both in the short and long run. Their findings conform to the Ricardian Equivalence Theorem, which outlines that public debt levels in an economy do not have any impact on the price levels of goods and services (Abel, 1991). However, these research findings are contrary to those of Aimola and Odhiambo (2021), who established an asymmetric relationship between public debt and inflation in Gambia.

Adusei (2013) researched inflation in South Africa and used data from 1956 to 2006. The research used Fully Modified Ordinary Least Squares, and the results suggest that inflation is a structural and monetary challenge in South Africa and that money supply is a determinant of inflation (Adusei, 2013). The adverse effects of inflation harm consumers, businesses, and the government. High inflation can lead to the closure of businesses and the retrenchment of workers. This reduces government revenue, and the state may not have enough money to service its debts (Redda, 2020). On a different note, the government can end up borrowing money from financial institutions to address unemployment.

Sangweni and Ngalawa (2023) investigated inflation dynamics in South Africa by examining the role of public debt. Their study employed a New Keynesian dynamic stochastic general equilibrium (NKDSGE) model. The findings demonstrated that inflation rises sharply in reaction to economic shocks when fiscal authorities place little emphasis on controlling the public debt. The study further indicated that there is a positive relationship between public debt and inflation.

Fourie and Blom (2022) examined the challenges and strategies for managing public debt in South Africa. The research findings indicated that the government should implement debt management strategies that address debt in the long term. It was also established that the government must use fiscal surpluses to reduce debt. Their research focused on public debt, but no focus was placed on inflation, so there is a need to examine the dynamics of inflation and public debt in South Africa.

A common feature of the listed studies is that their results assume a symmetric relationship between public debt and inflation. Meanwhile, the relationship between these variables might be asymmetric. Thus, the novelty of the current study is its investigation of whether the impact of public debt on inflation is symmetrical or asymmetric in South Africa. Also, previous studies did not cover the latest

time frames, which is important because they capture significant events in South Africa, such as the COVID-19 pandemic, which affected the economy and increased government borrowing and spending. According to our knowledge, no study in South Africa investigated the linear and nonlinear effects of public debt on inflation using the ARDL and NARDL techniques, respectively. Thus, the lack of previous studies on the subject matter illustrates this study's addition to the literature.

### 3. METHODOLOGY

The variables included in the model are guided by the theoretical and empirical literature reviewed above. Inflation was the dependent variable, and it was measured using the GDP deflator. The GDP deflator was chosen because it gives a comprehensive measure of inflation that incorporates changes in all domestically produced goods and services (Church, 2016). It is also particularly valuable for macroeconomic analysis. Furthermore, unlike the Consumer Price Index (CPI), the GDP deflator is not based on a set basket of goods and services, so it naturally adjusts for the changing composition of production as consumers and businesses switch to alternative commodities when relative prices vary (Garcia-Macia, 2023). Finally, the GDP deflator's broad coverage makes it a more accurate depiction of overall price increases in the economy than smaller indices such as the CPI, which focuses solely on goods and services purchased by consumers (Dey-Chowdhury, 2023; Pesce, 2010). Based on the arguments provided above, the study employed the GDP deflator to measure inflation.

The following four control variables were also used in the study: public debt (PD), money supply (MS), economic growth (EG), and interest rate (IR).

In this study debt service to exports ratio was used as a proxy for state debt. Traditionally, authors such as (Aisen & Veiga, 2006; Reinhart & Rogoff, 2010) used gross government debt to GDP to assess a country's indebtedness. However, the debt service to exports ratio focuses on a country's ability to service its debt using export earnings, which is especially important for developing and middle-income economies with significant external borrowing and exchange rate volatility (Panizza, 2008; Clements et al., 2003). Furthermore, this indicator captures not just the stock of debt but also its repayment responsibilities in relation to a significant revenue stream, providing a more complex picture of debt sustainability. As a result, using the debt service to exports ratio can reveal elements of susceptibility and financial stress that may have a greater direct

impact on South Africa's inflation-debt relationship than the traditional debt-to-GDP measure.

Money supply was added as a control variable because it is an important determinant of inflation. When there is more money in the economy, both consumers and companies have more purchasing power. If the demand for goods and services exceeds the economy's capacity for producing them, price increases can occur, contributing to inflation (Redda, 2020). The interest rate was added as a control variable because it also impacts inflation levels (Kozlov, 2023). This is explained from the viewpoint that when interest rates are low, borrowing becomes more affordable and consumers are more inclined to take out loans for large purchases like homes and cars as a result. Increased consumer spending and company investment can raise demand for goods and services, potentially leading to demand-pull inflation (Eke et al., 2023).

Economic growth was added as a control variable because it impacts inflation levels. When an economy expands, consumer and business demand for goods

$$\Delta Y_{it} = \alpha_1 + \sum_{i=1}^p \beta_i \Delta Y_{i,t-i} + \sum_{i=0}^q \delta_i \Delta X_{i,t-i} + \varphi_1 Y_{i,t-1} + \varphi_2 X_{i,t-1} + \varepsilon_{it} \quad (1)$$

Where  $\Delta Y_{it}$  represents a vector of (k x 1) representing inflation (INFL)

$\Delta$  captures differences in operator,  $X_1, y_1$  are the independent variables for every  $i = 1$ , which were: public debt (PD), money supply (MS), economic growth (EG), interest rate (IR),  $\beta_i$  and  $\delta_i$  represent the short-run coefficients of the model explaining the short-run relationships between the variables,  $\varphi_1, \varphi_2$  represent the long-run relationship, p and q represent the lags of the dependent and the independent variables, respectively, and  $\varepsilon_{it}$  is the error term.

NARDL was developed by Shin et al. (2014) and is useful for capturing asymmetric and non-

$$\ln INFL_t = \alpha_0 + \alpha_1 \ln PD_{t+} + \alpha_2 \ln PD_{t-} + \alpha_3 \ln MS_t + \alpha_4 \ln EG_t + \alpha_5 \ln IR_t + \varepsilon_t \quad (2)$$

where  $\ln$  is the natural logarithm,  $PD_{t+}$  and  $PD_{t-}$  are the partial sum of positive and negative changes in public debt levels,  $INF$  is inflation,  $MS$  is money supply,  $EG$  = economic growth,  $IR$  = interest rate.

Table 1 summarises the data set used in the study.

and services typically rises. If demand exceeds supply, prices may increase, resulting in demand-pull inflation (Jain and Kumar, 2022). On this basis, economic growth was added as a control variable.

### 3.1. Econometric Model

To examine if the impact of public debt on inflation is symmetrical or asymmetric in South Africa, the study adopted ARDL and NARDL techniques, which were developed by Pesaran and Smith (1995) and Shin et al. (2014), respectively. Annual time series data spanning from 1990 to 2022 were used. The ARDL and NARDL techniques offer various advantages, including their ability to lessen the likelihood of spurious regression (Gholami et al., 2005). These techniques are applicable whether the variables are integrated of order 1 or 0 (Giles, 2013; Mamvura and Sibanda, 2020). The ARDL technique is also robust for studies with a small sample size, and this research covered a 33-year period, which is considered small (Kripfganz and Schneider, 2018).

**The general ARDL model is stated below:**

asymmetric relationships between the variables used in the study (Sarkodie and Owusu, 2020). NARDL is a useful econometric model to test the impact of positive and negative shocks on dependent variables (Allen and McAleer, 2020; Pal and Mitra, 2016). The NARDL model enables the simultaneous estimate of short- and long-term asymmetries between inflation and public debt in South Africa, which explains why we used the NARDL model in this study. Finally, NARDL can account for nonlinear interactions between variables, making it appropriate for analysing public debt's effect on inflation in South Africa (Ghazi Al khatib, 2023).

**The NARDL model is specified below:**

The variables are listed in the first column, the indicator in the second column, while the variable description is in the third column. The unit of measurement and data source are in columns 4 and 5, respectively.

**Table 1: Summary Of Variables.**

Variable	Indicator	Variable Description	Unit of Measurement	Source of Data
Inflation (INFL)	GDP deflator	Inflation, as measured by the annual growth rate of the GDP implicit deflator, shows the rate of price change in the economy as a whole.	Annual Percentage (%)	World Bank (2024)

Public Debt (PD)	Debt service to exports ratio	Total debt service to exports of goods, services and primary income. Total debt service is the sum of principal repayments and interest actually paid in currency, goods, or services on long-term debt, interest paid on short-term debt, and repayments (repurchases and charges) to the IMF.	Percentage (%)	World Bank (2024)
Economic growth (EG)	EG	Refers to an increase in an economy’s GDP value on a yearly basis.	Annual Percentage (%)	World Bank (2024)
Money Supply	MS	Broad money is the sum of currency outside banks; demand deposits other than those of the central government; the time, savings, and foreign currency.	% GDP	World Bank (2024)
Interest rate	IR	Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.	Annual Percentage (%)	World Bank (2024)

#### 4. RESULTS

This section presents the results of the study, starting with an analysis of public debt and interest rate trends for South Africa. For Figures 1 and 2, the

following periods were used for analysis: Period 1 refers to 1990–2000; period 2 is 2001–2010; and period 3 is 2011–2022. These periods were used for easy analysis of the trends.

##### 4.1. Public Debt Trends

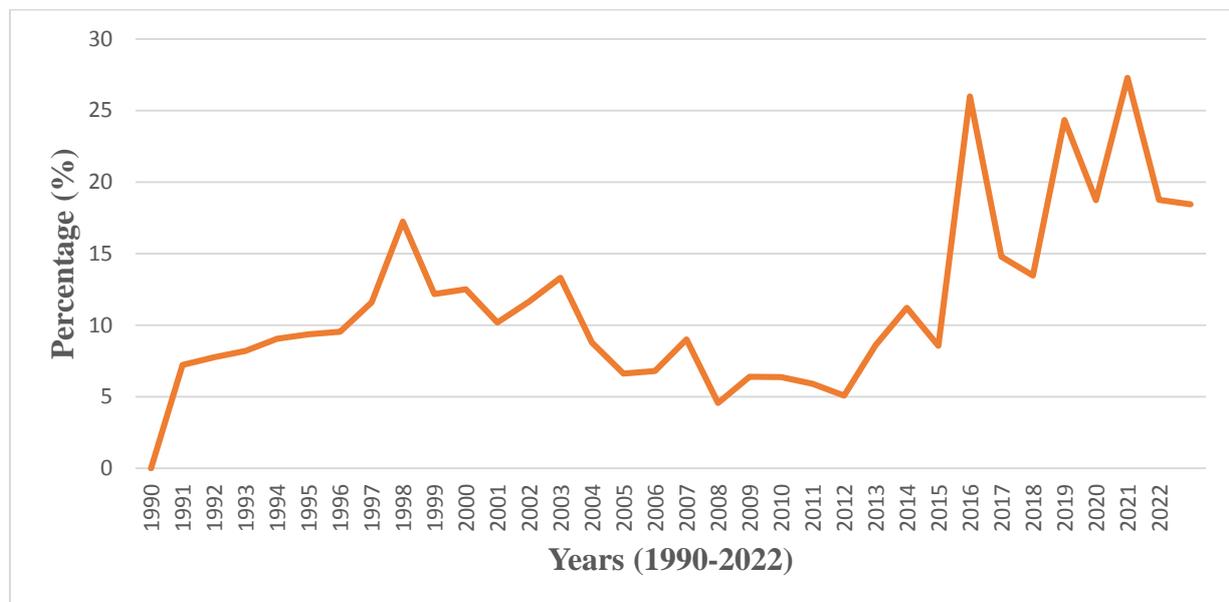
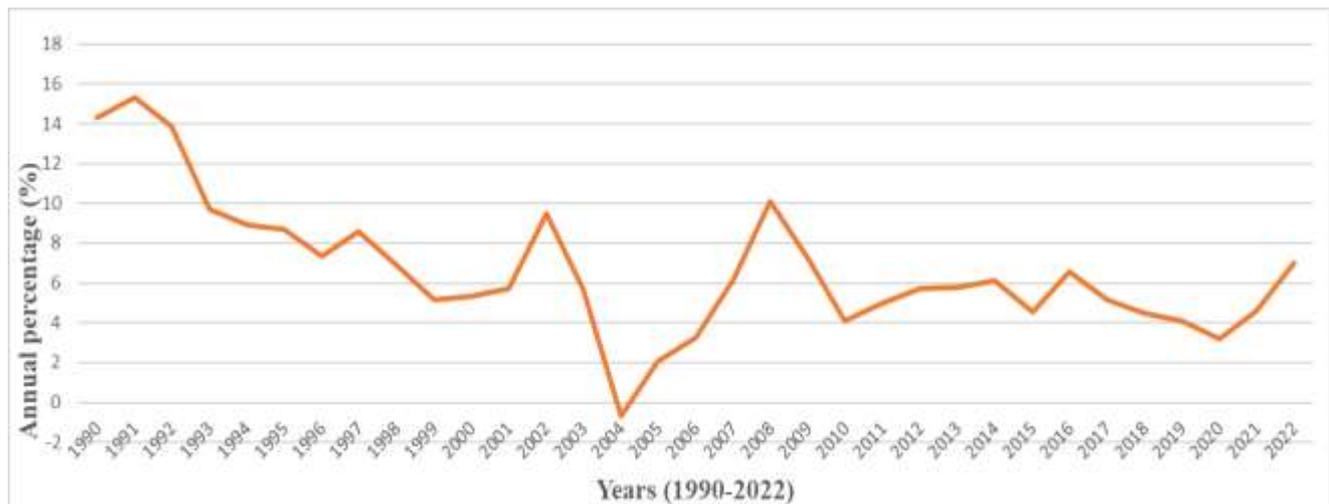


Figure 1: Public Debt Trends In South Africa (1990–2022).  
Source: Researcher’s Construct Based on World Bank Data (2024).

In period 1, a sharp increase in public debt levels in South Africa was caused by cyclical factors (Calitz et al., 2010). However, at the end of period 1, there were some fluctuations. In period 2, more fluctuations in public debt levels were recorded. In 2010, at the end of period 2, public debt levels were at 6.37%. In period 3, South Africa recorded an increase in public debt levels, and there were major fluctuations from 5.91% in 2011 to 25.99% in 2016 and 18.76% in 2022. Particularly in 2014, the rise in public

debt levels was caused by significant deficit expenditure that was necessitated by the slowdown in growth and the rise in social spending attributed to unemployment (Schoeman, 2015). Overall, South Africa recorded an increase in public debt levels from periods 1–3 that was also characterised by fluctuations.

##### 4.2. Inflation Trends



**Figure 2: Inflation Trends In South Africa (1990–2022).**  
 Source: Researcher’s Construct Based on World Bank Data (2024).

In period 1, South Africa recorded a sharp decline in inflation levels from 15.34% to 5.33%. This can signal the South African Reserve Bank’s ability to implement an inflation control mechanism. In period 2, there were major fluctuations again, from 5.70% in 2001 to 10.07% in 2010. The removal of sanctions and the gradual loosening of regulations were linked to a drop in inflation between 1990 and 2001, as well as an increase in real interest rates (Nowak and Ricci, 2006). A stronger rand, which increased from R7,56/\$ in 2003 to R6,45/\$ in 2004, was the primary factor impacting the decline in inflation in that year

(Statistics South Africa, 2024). In 2010, inflation dropped to 4.08%. Finally, in period 3, there were minor fluctuations in inflation levels, and the lowest recorded rate was 3.21% in 2020.

**4.3. Descriptive Statistics**

Table 2 shows the descriptive statistics. It depicts inflation had a mean, median, maximum, and minimum of 6.65%, 5.78%, 15.33%, and -0.69%, respectively.

**Table 2: Descriptive Statistics.**

Variables	INFL	PD	MS	EG	IR
Mean	6.65	11.80	58.86	2.05	5.07
Median	5.78	9.54	64.98	2.48	4.64
Maximum	15.33	27.28	73.96	5.60	12.69
Minimum	-0.69	4.56	41.51	-5.96	0.50

Overall, for the period 1990–2022, inflation was relatively high. Public debt had a mean, median, maximum, and minimum of 11.80%, 9.54%, 27.28%, and 4.56%, respectively. The money supply had a mean, median, maximum, and minimum of 58.86%, 64.98%, 73.96%, and 41.51%, respectively. Economic growth had a mean, median, maximum, and

minimum of 2.05%, 2.48%, 5.60%, and -5.96%, respectively. Lastly, the interest rate had a mean, median, maximum, and minimum of 5.07%, 4.64%, 12.69%, and 0.50%, respectively.

**4.3.1. Correlation Analysis**

**Table 3: Correlation Analysis**

	INFL	PD	MS	EG	IR
INFL	1				
PD	-0.23	1			
MS	-0.47	0.25	1		
EG	-0.34	-0.36	-0.06	1	
IR	0.04	-0.03	0.44	0.15	1

Table 3 shows that the relationship between public debt and inflation was negative at 23%

contradicting the fiscal theory of a positive relationship between fiscal policy and inflation.

Money supply and economic growth were negatively correlated with inflation at 47% and 34%, 34%, respectively. Interest rate was positively correlated with inflation at 4% confirming the monetarist theory, and money supply was positively correlated with public debt at 25%. Economic growth and interest rate were negatively correlated with public debt at 36% and 3%, 3%, respectively. Economic growth was negatively correlated with money supply at 6%. Interest rate was positively correlated with money supply at 44%. Finally, interest rate was positively correlated with economic growth at 15%. It can be concluded that there was no

severe multicollinearity, as all values were below 0.7 (Duda, 2022). While the correlation results support one theory and contradicts the other, it is important to note that correlation simply shows how variables are related and not how they impact one another. The ARDL and NARDL results will provide more insights to this.

**4.3.2. Unit Root Tests**

The Augmented Dickey-Fuller and Phillips-Perron tests were used to test for unit root in the research.

**Table 4: Unit Root Test Results.**

Variable	ADF test		PP test	
	Level	1 <sup>st</sup> Diff	Level	1 <sup>st</sup> Diff
INFL		0.00 (-5.23)		0.00 (-5.12)
PD		0.00 (-9.63)		0.00 (-10.11)
MS		0.00 (-4.57)		0.00 (4-57)
EG	0.0 (-4.03)		0.00 (-4.03)	
IR		(0.00) (-5.83)		0.00 (-7.07)

**(i) Represents T-Statistics Value**

Table 4 shows that only economic growth was stationary at level, while the other variables became stationary after the first difference. This meets the criteria for executing an ARDL and NARDL, which require variables to be stationary at the level and first difference. All unit root tests performed in this

investigation confirmed that the series were stationary.

**4.3.3. Lag Length Selection**

The vector autoregressive (VAR) model was used to determine the optimal lag length in this study. The results are presented below.

**Table 5: VAR Model for Optimal Lag Selection.**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-422.24	NA	643686	27.54	27.79	27.63
1	-326.22	154.87	6751.92	22.98*	24.36*	23.43*

The Akaike criterion was used for decision-making purposes on the appropriate lag length. Table 5 shows that lag 1 was selected because it had the lowest AIC value of 22.98.

**4.4. Cointegration Test**

The Bounds Test was used to test for cointegration. The results are presented below.

**Table 6: Ardl Bounds Test.**

Test statistics	Value
F- statistic	1.13
I(1)	2.08

Table 6 shows that the F-statistic of 1.13 was less than the I(1) value of 2.08, and it was concluded that there was no long-run relationship between inflation, public debt, money supply, economic growth, and the interest rate, and a short-run ARDL was estimated.

**4.4.1. Auto-Regressive Distributed Lag Results**

This section presents the results of the ARDL model short-run results. Since this is a short-run analysis, there is no one period lag error correction term.

**Table 7: Auto-Regressive Distributed Lag Short-Run Results.**

Variable	Coefficient	T-statistic	Probability
PD	0.19	1.76	0.09*
MS	1.05	2.67	0.01***

EG	0.55	2.35	0.03**
IR	-0.54	-1.98	0.06***

\*\*\*, \*\* And \* Stand for Significance at the 1%, 5% And 10% Levels, Respectively

Table 7 shows that public debt, money supply, economic growth, and interest rate were statistically significant in the model. A 1% increase in public debt is associated with a 19% increase in inflation in the short run. This shows a positive relationship between inflation and public debt levels in South Africa and therefore supports the fiscalist. These results are on par with those of Afonso and Ibraimo (2018), Romero and Marin (2017), and Sims (2014). This implies that the fiscalist theory applies to South Africa, and the country must address both public debt and inflation in order to achieve its macroeconomic objectives.

When the money supply increases by 1%, inflation rates will increase by 1.05% in the short run, which also shows a positive relationship between these variables. These results thus align with the monetarist theory and the views of Doan (2020), implying that the money supply should be controlled by the South African Reserve Bank to escape unnecessary inflationary pressures on the entire economy. Moreover, a 1% increase in economic growth is associated with a 55% increase in inflation in the short run, illustrating a positive relationship

#### NARDL Bounds Test

Table 8: Nardl Bounds Test.

Test statistics	Value
F- statistic	8.01
I(1)	2.39

Table 8 shows that the F-statistic of 8.01 was greater than the I(1) value of 2.39, and it was concluded that there was a long-run relationship between inflation, public debt, money supply, economic growth, and the interest rate. An error correction model was estimated, and the results are presented below.

Table 9: Conditional Error Correction Regression Results.

Variable	Coefficient	T-statistic	Probability
C	-40.32	-3.39	0.02**
PD (pos)	2.20	5.33	0.00*
PD (neg)	3.42	5.56	0.00*

\*\*\*, \*\* And \* Stand for Significance at the 1%, 5% And 10% Levels, Respectively

This means that the focus was on public debt and inflation only, justified by the fact that the study examined the relationship between these variables. A 1% increase in public debt positively affects inflation by 2.20%, while a 15% decrease in public debt negatively affects inflation by 3.42%. These results demonstrate that the impact of a 3.42 negative

between inflation and economic growth in South Africa. The results are consistent with New Keynesian ideas, which suggest that rising inflation can temporarily boost real GDP, a view supported by Agarwal and Baron (2023) and Ekinci et al. (2020).

Lastly, a 1% increase in interest rate is associated with a 54% decline in inflation rate levels. This depicts a negative relationship between interest rates and inflation in South Africa. The result is in line with economic principles since high interest rates discourage borrowing from financial institutions (Kozlov, 2023). Restricted borrowing implies that the money supply in circulation is reduced; hence, inflation is bound to drop. These results are generally consistent with the fiscalist and monetarist views, therefore implying that South Africa must incorporate both the fiscal and monetary factors to combat rising inflation.

#### 4.4.2. Nonlinear Autoregressive Distributed Lag

This section presents the NARDL results as well as the analysis.

#### 4.4.3. Conditional Error Correction Regression

The table below shows the error correction regression results, and the discussion centres on the most salient variables of the study.

coefficient of public debt is greater than a positive coefficient of 2.20, and this shows the existence of an asymmetry effect between inflation and public debt in South Africa.

The tables below depict the NARDL short-run and long-run results.

**Table 10: NARDL Short-Run Results.**

Variable	Coefficient	T-statistic	Probability
PD (pos)	2.02	7.42	0.00***
PD (neg)	2.72	8.08	0.00***
MS	0.52	2.48	0.04**
EG	1.26	4.30	0.00***
IR	-0.39	-2.56	0.03**

This discussion focused on the salient features only, that is, public debt. A 1% increase in public debt is associated with a 2.02% increase in inflation, and when public debt decreases by 1%, inflation will decrease by 2.72% in South Africa. The partial sum of positive changes of 2.02 is smaller than the partial sum of negative changes of 2.72, indicating a significant short-run asymmetry between public debt and inflation. Inflation is thus more sensitive to changes in public debt levels in South Africa for the

period 1990–2022. MS, EG, and IR were also statistically significant. This implies that the relationship between the fiscal policy variable and inflation is larger than that of monetary policy variables and inflation. Hence, the government must adjust its policy in favour of a low and stable inflation rate, since the country follows more of the fiscalist theory than the monetarist theory, based on the findings of the NARDL.

**Table 11: NARDL Long-Run Results.**

Variable	Coefficient	T-statistic	Probability
PD (pos)	1.21	-2.51	0.06*
PD (neg)	-1.88	-2.62	0.05**
MS	-0.77	-2.91	0.04**
EG	-1.71	-3.02	0.03
IR	-0.11	-0.80	0.46

\*\*\*, \*\* And \* Stand for Significance at the 1%, 5% And 10% Levels, Respectively

A 1% increase in public debt is associated with a 1.21% increase in inflation, whereas a 1% drop in public debt suggests a 1.88% decrease in inflation in South Africa in the long run. The partial sum of positive changes in public debt of 1.21 exceeds the partial sum of negative changes in inflation of 1.88, demonstrating a considerable long-run symmetry between the two variables.

#### 4.4.4. Wald Test

Shin et al. (2014) suggest using a Wald test to confirm or reject the null hypothesis of symmetric adjustment. The empirical findings of a Wald test with symmetric adjustment follow.

**Table 12: Wald Test Results.**

Test-Statistic	Value	P-value
T-statistic	6.04	0.00***
F-statistics	36.55	0.00***
Chi-square	36.55	0.00***

\*\*\*, \*\* And \* Stand for Significance at the 1%, 5% And 10% Levels, Respectively

The Wald test results in Table 12 show that the p-value is less than 5% significance level; hence, it can be concluded that the null hypothesis of symmetry is rejected. This implies an asymmetric and nonlinear relationship between inflation and public debt in South Africa.

#### 4.4.5. Post-Estimation Tests

The table below shows the post-estimation test results.

**Table 13: Post-Estimation Test Results.**

Estimation Type of Test	ARDL P-value	NARDL P-value
Breusch Godfrey Serial Correlation LM test	0.23	0.10
Breusch-Pagan Godfrey test	0.53	0.98
Jarque-Bera test	0.62	0.45

**4.4.6. Serial Correlation Test**

The model was tested for serial correlation using the Breusch Godfrey Serial Correlation LM test, and p-values of 0.23 and 0.10 were obtained, as shown in Table 13. It was concluded that the ARDL and NARDL models were free from serial correlation since the p-values of 0.23 and 0.10 were above the 5% level.

**4.4.7. Heteroskedasticity Test**

The Breusch-Pagan Godfrey test was used to test for heteroskedasticity. The p-values of 0.53 and 0.98 were greater than 0.05, so it was concluded that there was no heteroskedasticity in the ARDL and NARDL models.

**4.4.8. Normality Test**

A normality test was employed to verify whether the sample data came from a normally distributed population. The p-values of 0.62 and 0.45 were achieved, indicating that the data were normally distributed in all models.

**4.4.9. Stability Tests**

To test for parameter stability, the cumulative sum (CUSUM) of recursive residuals and the CUSUM of square (CUSUMSQ) tests were used (Pesaran and Pesaran, 1997). The results are presented below.

**4.4.10. Cusum Tests**

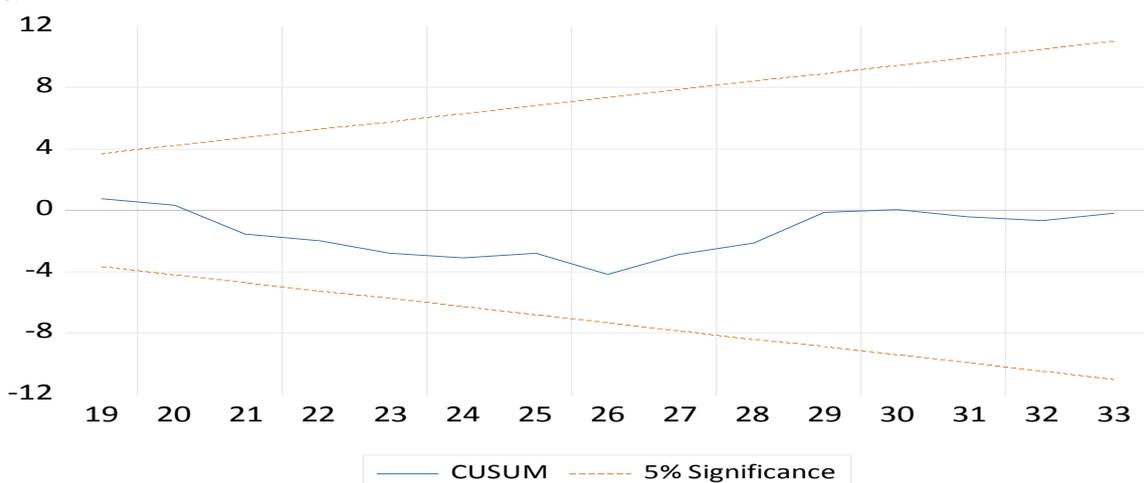


Figure 3: CUSUM.

Figure 3 above shows structural deviation from 5%, and the ARDL model was relatively stable

afterwards. Overall, the plot of CUSUM lies within the 5% boundary.

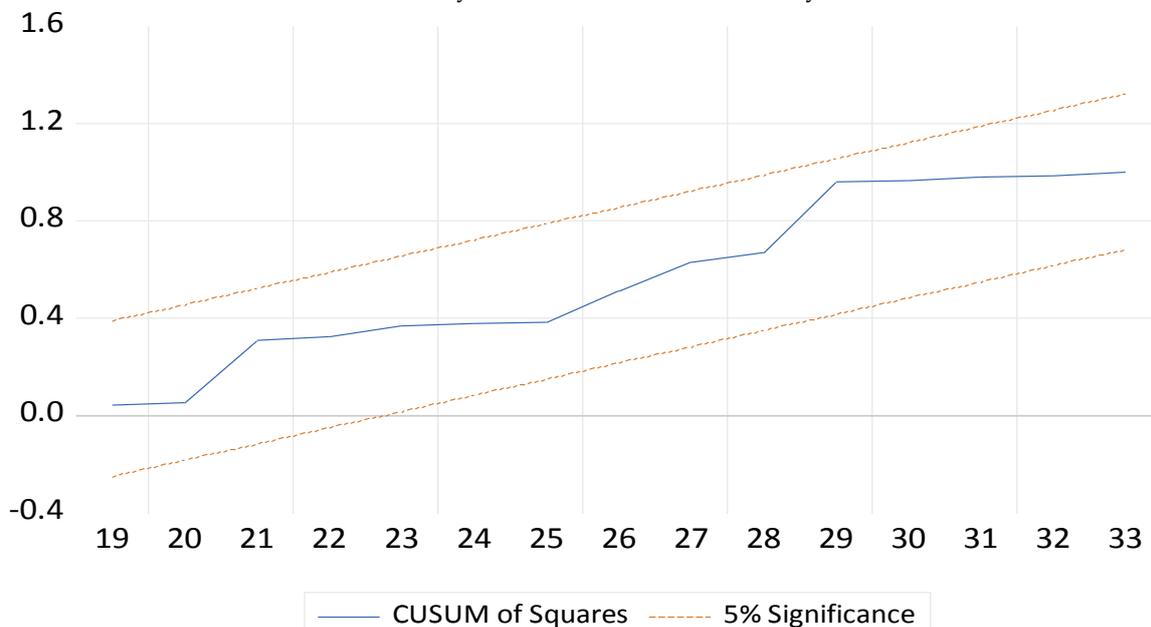


Figure 4: ARDL CUSUM Of Squares Test.

Figure 4 shows there were fluctuations, though the CUSUM of squares lies within the 5% boundary; hence, there was some stability. Finally, based on these stability tests, it can be concluded that there is some stability in the coefficients as all the plot lies within the 5% confidence level.

**4.4.11. Nardl Cusum Tests**

This section presents the NARDL post-estimation tests.

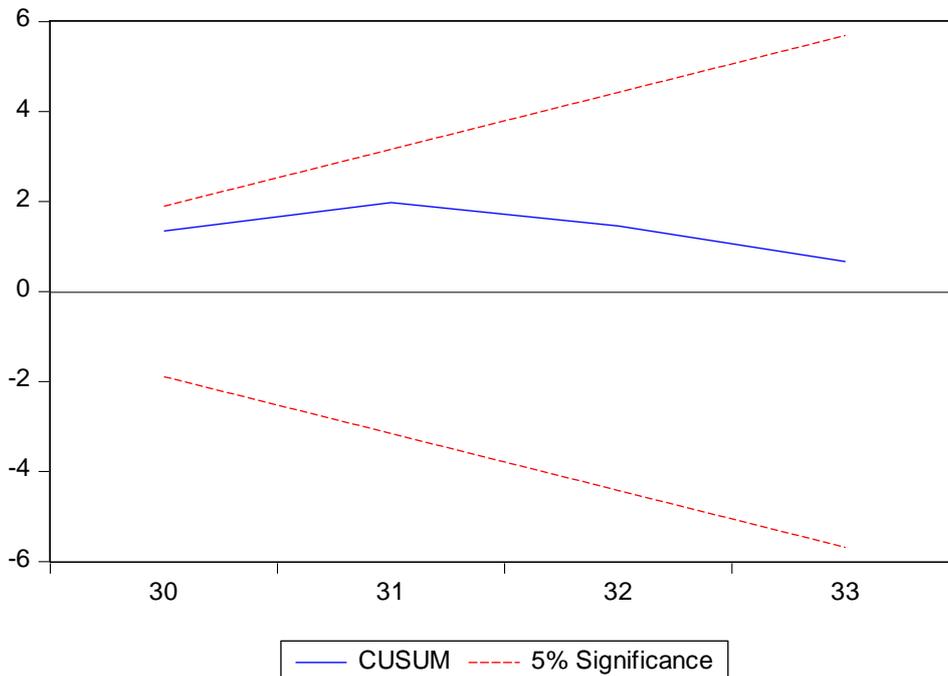


Figure 5: NARDL CSUM Tests Results.

Figure 5 shows that the NARDL model depicted an increase and a gradual decrease, and it can be concluded that it was stable because the CUSUM lay

within the 5% boundary.

**4.4.12. Nardl Cusum Squares**

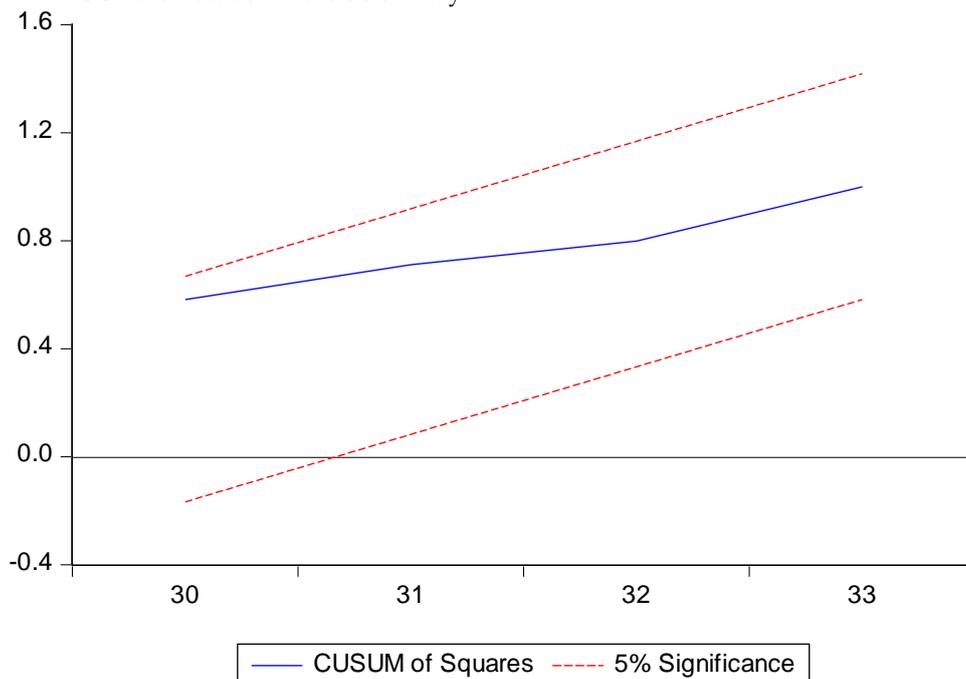


Figure 6: Nardl Cusum Squares.

Figure 6 shows that the CUSUM of squares depicted a slight increase, and it lay within the 5% boundary; hence, it can be concluded that the NARDL model was also stable.

## 5. CONCLUSION

The study examined the relationship between public debt and inflation in South Africa. ARDL and NARDL techniques were used to examine the short- and long-run effects of public debt on inflation. Inflation and public debt trends were analysed, and it was established that, overall, South Africa's debt levels must be reduced. According to the ARDL findings, public debt had a 19% positive impact on inflation. Inflation was affected by the money supply, economic growth, and interest rate at 11.05%, 55%, and 54%, respectively. Regarding NARDL, the findings showed a proven asymmetry between public debt and inflation in both the short and long horizons. Although the results show that South Africa follows both the monetarist and fiscalist theories, findings further depict that the inflation rate responds more to changes in fiscal policy variables than to changes in monetary policy variables. Thus, inflation in South Africa is more responsive to the monetary policy factors and supports the monetarist theory.

## 6. POLICY RECOMMENDATIONS

It is crucial for South Africa to reduce public debt levels and inflation rates since high public debt continues to drain the fiscal resources of the state. These can be channelled towards supporting the National Development Plan 2030 and the provision of public and merit goods. The high public debt ultimately limits South Africa's capacity to attain some of the selected SDG goals, such as poverty reduction. High inflation affects fixed-income earners such as pensioners and erodes the value of money, which ultimately exposes people to poverty and inequality challenges. Thus, addressing public debt and inflation should be prioritised.

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In light of this, the following policy recommendations are suggested: South Africa needs to establish a debt payment plan that should be supported by sufficient financial resources. In order to finance debt repayment and rescue the nation from a debt trap, it is imperative that the government implement an efficient resource mobilisation plan. By enabling the repayment of contracted debt and funding budgetary deficits, revenue improvement strategies will guarantee long-term debt sustainability. Targeting both domestic and foreign investment through stable and beneficial economic policies is one way to implement revenue improvement strategies. On the other hand, policymakers could implement credible fiscal rules such as expenditure ceilings, which should be backed by legislation. Not only will this rule restrict excessive borrowing, but it will eventually have a positive effect on inflation by curbing it.

There is a need for South Africa to monitor and control inflation rates so that they do not increase and affect the economy's capacity to meet its macroeconomic objectives. Inflation-targeting policies must be well crafted to align with debt payment and other economic development policies.

Based on the findings of the study, where inflation responds to changes in both the fiscal and monetary policy variables, we therefore confirm that both the fiscalist and monetarist theories apply to South African inflation. Therefore, a formal policy coordination between the Treasury and the Reserve Bank should be established. This will assist in ensuring that the implementation of the fiscal policy does not undermine the inflation targeting of the South African Reserve Bank.

Areas of further research could be to investigate how inflation expectations moderate the debt-inflation relationship, or incorporate external shocks (commodity price, exchange rate volatility) as exogenous variables. Other future studies could also expand research to a panel of Southern African countries for regional comparison.

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