Is external debt an impediment to the South African economy?

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Abstract

The purpose of this study is to test whether the relationship between external debt and economic growth is symmetric or asymmetric in South Africa using annual time series data from 1985 to 2021. The study employed NARDL bounds and Breitung nonparametric cointegration estimation methods. Breitung, Bierens nonparametric, and ZA unit root test are used to check for the order of integration of the variables. The results from NARDL bounds and Breitung nonparametric cointegration test confirm a long run relationship between the variables. The results indicate that the responsiveness of GDP to positive shocks of external debt is less than that to negative shocks. An increase in external debt is associated with a decrease in GDP, while a decrease in external debt is associated with an increase in GDP. The study suggests that South African economy should keep its external debt sustainable so as not to harm economic growth.

Keywords: economic growth, external debt, asymmetry, fiscal policy, South Africa

1 INTRODUCTION

There is still a controversial debate about whether external debt is detrimental to economic growth in developing and developed countries. External debt is one of the major sources of income especially in developing countries since they are more likely to be faced with fiscal deficit and being vulnerable to external shocks. When a country faces a fiscal deficit, it often borrows money externally or domestically to balance its budget and satisfy social and economic priorities. According to Adebusola, Salau and Obayelu (2007) countries in Africa have an insufficient internal capital formation because of low productivity, low income, and low savings. This tends to lead to financial aid being sought from developed countries or financial institutions like the World Bank, International Monetary Fund, and foreign governments.

Economic growth takes place when government and businesses devote money to capital investments that encourage production and raise income levels. If a country has a huge foreign debt that needs to be paid back, it has less money to invest on development projects such as infrastructure, military, healthcare facilities, and research and development. This will be detrimental to the economy in the future. The biggest problem with foreign debt is that it often puts a country in a debt cycle. The debt cycle is the repeated process of borrowing money, making payments, and eventually not being able to pay (Dietz, 1989).

Furthermore, the burden of external debt can be shifted from one generation to another. However, Lerner (1961) argued that the external debt burden is shifted from one generation to another without the latter receiving any benefits if the debt is only used to finance current spending to boost consumption. Current spending is the money spent on cash payments for operating activities. Furthermore, Lerner (1961) suggested that if the external debt is used for capital spending, for example, building roads, railways and airports, then the next generation will still bear

the burden of external debt but also enjoy benefits from the external debt that was taken on. This brings the benefit principle of public debt into the argument, since the next generation should not only bear the burden of external debt but also receive benefit from the external debt taken by the previous generation.

South Africa has been experiencing gradually increasing rates of external debt from 2006 until 2021. It was estimated by the minister of finance (Mr Godongwana) in the 2022/23 Budget Review that government debt will stabilise in financial year 2025/26. If South Africa's government debt continues to increase after the stabilisation point, the debt will harm economic growth. This will in turn result in there being less money to spend on infrastructure investment, less saving, low production, devaluation of domestic currency, all of it resulting in South Africa losing international market access. This is in line with a debt Laffer curve, which states that as the face value of debt increase the market value of debt also increase until a certain point (that is a threshold). Therefore, after this point the debt will be detrimental to the wealth of the nation. This is when it is difficult for the government to service its debts, because the debt is draining a lot of money that is supposed to be used for current and capital spending.

Public debt consists of domestic and external debts; however, the focus of this study is on external debt. This is because servicing external debt is more challenging as compared to domestic debt since external debt is mostly affected by external shocks that could lead to a devaluation of domestic currency. As a results, when the domestic currency depreciates then the interest payments become more expensive. Furthermore, the external debt burden is more likely to be transferred to the future generation which makes it suitable for the scope of this study. Figure 1 shows the long run trends of external debt as a percentage of GDP and gross domestic product measured at market price in South Africa from 1985 to 2021. Figure 1 shows that external debt and gross domestic product moved together from 1985 to 2021 but in opposite directions: when external debt increases, gross domestic product decreases. Therefore, this indicates that external debt is one of the drivers of economic growth in South Africa. Figure 1 shows that external debt decreased sharply from 40.1% in 1985 to 19.3% in 1994. During the period of 1985 to 1994 the highest external debt percentage of 40.1% was recorded in 1985. This spike was supported by the debt crises that took place in South Africa in 1985 (Hirsch, 1989).

During the period of 1995 to 2004, the external debt fluctuated steadily between 17.6% to 26.3%. It reached a peak of 26.3% in 2002. This spike was supported by foreign borrowing by the national government through bond issuing, and debts that were made to support military purchase programme (SARB, 2003). The external debt to GDP ratio increased sharply from 16.9% in 2005 to 50.5% in 2020, then relatively decreased to 38.3% in 2021. This rise of external debt to GDP was fuelled by countercyclical fiscal policies that were implemented in 2009 to overcome the huge impacts of local and global recessions (National Treasury, 2010). The 2010 FIFA World Cup also contributed to the rise of external debt to GDP of

South Africa during this period because spending on infrastructure had to increase. During this period the highest ratio of external debt to GDP was recorded at 50.5% in 2020, which resulted from debts that were incurred to support public health and economic measures aimed at containing and mitigating the COVID-19 outbreak. As per the trends observed in South Africa's external debt, it is evident that the share of external debt in the country's GDP is increasing. From 2005 to 2021, the percentage of external debt in GDP has increased by 21.4%, from 16.9% to 38.3%. This suggests that in the coming years, external debt may account for a larger share in comparison to domestic debt, although the percentage share of domestic debt in GDP is still greater than that of external debt. Therefore, South African policymakers must make sure that they manage external debt in a good manner and ensure fiscal sustainability.

FIGURE 1

Gross domestic product at market price and external debt as % of GDP trends in SA
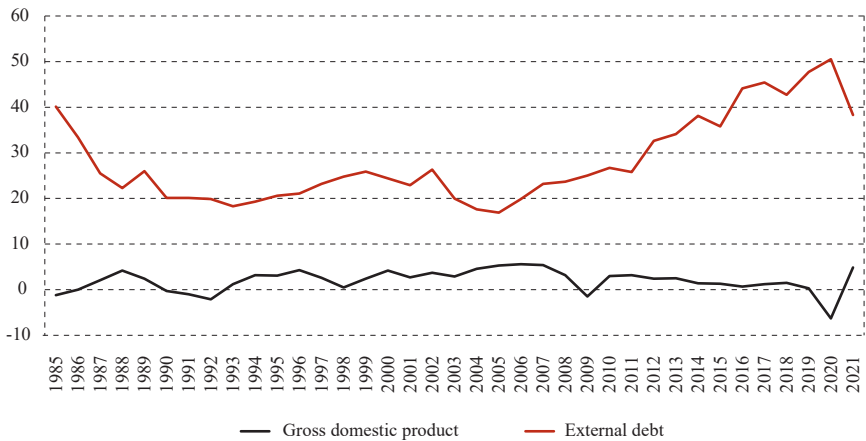
Source: Author's own computation from data from South African Reserve Bank.

Previous empirical studies such as Lin and Sosin (2001), Ayadi and Ayadi (2008), Senadza, Fiagbe and Quartey (2017), Ighodalo Ehikioya et al. (2020), and Manasseh et al. (2022) were based on linear and threshold modelling when investigating the impact of external debt on economic growth in South Africa. These studies did not analyse whether there is an asymmetric relationship between South Africa's foreign debt and economic growth. Therefore, there are only limited studies investigating the asymmetric relationship between foreign debt and economic growth in South Africa in the same way as NARDL. According to Shin, Yu and Greenwood-Nimmo (2014) NARDL is "capable of simultaneously and coherently modelling asymmetries both in the underlying long-run relationship and in patterns of dynamic adjustments" as compared to other nonlinear models. Investigating the relationship between foreign debt and economic growth in a linear regression could lead to misleading statistical inferences, because linear regression is unable to fit complex datasets accurately. In real life situation, the relationship

between foreign debt and economic growth cannot be linear, and straight line cannot fit the dataset properly. Due to this, it is essential to investigate the nonlinear relationship that exists between economic growth and external debt. Furthermore, the goal of this study is to investigate the asymmetric influence of foreign debt on South African economic growth. This study uses a nonlinear autoregressive distributed lag model (NARDL) to investigate this relationship. This technique is different to those of previous empirical studies based on the South African case. The Nonlinear-ARDL model has an advantage of testing whether the external debt has an asymmetric or symmetric impact on economic growth in South Africa. This study, on the other hand, provides solutions to the following three issues concerning the relationship between foreign debt and economic growth. The first problem is whether the relationship between external debt and economic growth is asymmetric or symmetric. The second problem is the reaction of economic growth to positive and negative values of external debt. Finally, this study seeks to provide an insight into whether increasing or decreasing external debt would accelerate or decelerate economic growth in South Africa, and to give an understanding about how quickly or slowly the South African economy will converge to the long run equilibrium due to external debt structural changes. This study is structured as follows: section 2 reviews the theoretical and empirical literature, section 3 presents the methodology of the study, section 4 discusses the empirical results, and section 5 provides the conclusion of the study.

2 LITERATURE REVIEW

Debts are incurred by the government to help pay for public goods to enhance people's standard of living and improve the economy (Ogunmuyiwa, 2011). Foreign debt is one of the factors that play a significant role in building a country's capital investment (Ayadi and Ayadi, 2008). External debt is also taken on to help the economy in times of economic crisis and natural disasters. However, future debt servicing is harmful to the economy since a big amount of national revenue is spent on repaying the debt. There are two underpinning theories for this study: the Debt Laffer Curve and Debt Overhanging Hypothesis. The Debt Laffer Curve was devised by Sachs (1989) who claimed that an increase in debt contributes positively in the economy until it reaches a stabilisation point, if a debt continues to increase after this point it becomes harmful for the economy. Krugman (1988) proposed the Debt Overhanging Hypothesis, which states that a nation is affected by debt overhanging when the present value of the transfers it is expecting to receive in the future is less than the debt itself. This situation could put lenders in a state whereby they are no longer confident of recovering their money. The empirical literature is grouped into three parts; the first part consists of country-specific studies, which are studies that use time-series econometric methodology, the second part focuses on studies using panel data econometric methodology, and the last part consists of South African studies.

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2.1 COUNTRY SPECIFIC STUDIES

There is an intensive literature that investigate the impact of external debt on economic growth using the time-series methodology. Amongst others, Shahnawaz, Hayat and Hayat (2010) investigated the link between Pakistan's foreign debt and economic growth. The study used yearly data from 1972 to 2005. The findings indicated an inverse connection between foreign debt and economic growth. Ajayi and Oke (2012) analysed how Nigeria's foreign debt affects GDP growth. The study used an ordinary least square (OLS) estimation method. The findings demonstrated that a high level of foreign debt has a negative impact on economic growth. For the period since 1990, Kharusi and Ada (2018) examined how the external debt of Oman affected economic growth, utilizing yearly data. The study investigated the short run association between foreign debt and economic growth using autoregressive distributed lag model. The findings revealed a negative link between foreign debt and economic growth.

Using time series data from 1970-2017, Matuka and Asafo (2018) investigated the effect of Ghana's foreign debt on GDP growth. In this analysis, the study used Johansen cointegration test and the vector error correction model. The results found a positive correlation between external debt and economic growth. Shkolnyk and Koilo (2018) investigated the link between foreign debt and economic growth in Ukraine and other developing countries from 2006 to 2016. To study this association, the authors used the ARDL model. The study showed varying findings, indicating that the link is positive in certain nations and negative in others.

The study conducted by Govdeli (2019) aimed to examine the effects of external debt stock, openness, and the consumer price index on the Turkish economy. The study utilised a time series dataset spanning the years 1970 to 2016. The study used the ARDL bounds estimation method. The bounds test confirmed a cointegrating relationship between the variables. Turkey's foreign debt was determined to have a favourable effect on the country's economic growth.

Using time series data from 1980 to 2018, Makun (2021) examined the connection between Fiji's economic expansion and foreign debt. To determine this connection, the study used neoclassical growth and ARDL models. The results from the linearity measure indicated that foreign debt negatively affects economic growth, while nonlinearity results showed that foreign debt affects economic growth differently. The threshold results show that external debt positively affects economic growth until it reaches a threshold level, then after the threshold level external debt starts to harm economic growth.

2.2 CROSS-COUNTRY STUDIES

The studies that used panel data approach are presented in this section of the study. Among others, Asafo, Matuka and Dominic (2019) examined the connection between foreign debt and economic growth in 48 SSA nations from 1970 to 2017. The authors used a two-step generalised methods of moments (GMM) estimation technique. The findings revealed that foreign debt has a negative influence on economic growth.

Lau, de Alba and Liew (2022) estimated the relationship between external debt and economic growth using a panel of 16 Asian countries over a period of 1980 to 2016. The study used the Johansen and Juselius cointegration test and error correction model. The results demonstrated that external debt harms economic growth in many countries.

Özyilmaz (2022) analysed the effect of external debt on economic growth using a panel of E7 countries over a period of 1992 to 2020. The study used Westerlund cointegration test, then used common correlation effects estimator (CCE) and augmented mean group estimator (AMG) for coefficient estimation. The results showed a long run relationship between the variables, and that there is a negative relationship between external debt and economic growth for E7 nations.

Alemu, Choramo and Jeldu (2023) investigated the effect of external debt and institutional quality on economic growth in a panel of East African countries for the period from 1998 to 2019. The study used a panel autoregressive distributed lag (PARDL) model estimation technique. The results showed a positive relationship between external debt and economic growth up to a threshold level of 62.9%, then beyond this threshold external debt becomes harmful to economic growth.

There is an extensive empirical literature that exists on the relationship between external debt and economic growth in various nations. Various studies from specific and cross-country studies have discovered a negative association between external debt and economic growth. Previous studies have found a long run association between foreign debt and economic growth. Although there may be various ways in which external debt affects economic growth, available evidence indicates that foreign debt has an immediate influence on economic growth.

2.3 SOUTH AFRICAN STUDIES
The issue of whether the foreign debt has a detrimental or favourable effect on economic growth has received significant attention in both developed and developing countries, however, in South Africa there are few empirical studies. Among others, Lin and Sosin (2001) used a panel of 77 nations during the period spanning from 1970 to 1992 to analyse the connection between foreign debt and economic growth. The countries were divided as follows: African countries including South Africa (N = 24), Latin American countries (N = 18), Asian and other developing countries (N = 17), and industrialised countries (N = 18). The study used a cross-sectional regression for this purpose. The results indicated that in African countries the external debt is negatively and statistically significant related to economic growth, while for industrialised and Latin American countries it is negative but statistically insignificant to explain its effect on economic growth. The results from the subsample of Asian and other developing countries showed a positive and insignificant relationship between external debt and economic growth.

Ayadi and Ayadi (2008) studied the influence of high external debt on economic growth in South Africa and Nigeria. The study used OLS and non-linear Elbadawi's estimation methods for this purpose. External debt has a detrimental impact on economic growth in South Africa and Nigeria. Furthermore, the results showed that South Africa has the advantage of using external debts to derive development as compared to Nigeria. The results also showed that foreign debt contributes positively towards the development in Nigeria until it becomes harmful showing the presence of non-linearity effects. Senadza, Fiagbe and Quartey (2017) analysed the effect of external debt on economic growth in a panel of 39 Sub-Saharan African (SSA) countries and South Africa included for a period of 1990 to 2013. The study used the system generalised method of moments estimation method. The results indicated that foreign debt is negatively related to economic growth in SSA countries. The results also showed the existence of nonlinear correlation between external debt and economic growth.

Ighodalo Ehikioya et al. (2020) used a panel of 43 African nations, including South Africa, to study the relationship between external debt and economic growth from 2001 to 2018. The study analysed the long-term correlation between the variables using the Johansen cointegration test. Parameters were estimated using the system generalised method of moments (GMM). A long-run association between foreign debt and economic growth was established. The findings revealed a quadratic link between foreign debt and economic growth, whereby external debt boosts economic growth to a certain point, beyond which it becomes detrimental to economic growth. Manasseh et al. (2022) studied the influence of foreign debt on economic growth in 30 SSA countries including South Africa from 1997 to 2020. The system GMM estimation approach was employed in the study. The findings indicated a negative link between SSA nation's foreign debt and economic growth.

The current study is different from others that have looked at the relationship between South Africa's foreign debt and economic growth. This study contributes to the body of knowledge in the following ways: Firstly, to provide a policy direction, the study used a time series analysis to evaluate the relationship between foreign debt and economic growth in South Africa. This analysis is different from that of Lin and Sosin (2001), Senadza, Fiagbe and Quartey (2017), Ighodalo Ehikioya et al. (2020), and Manasseh et al. (2022) in which analyses were based on a panel data approach. The major disadvantage of panel data analysis is unobserved heterogeneity due to unmeasured differences between the cross-sectional units. Therefore, this approach could lead to inappropriate and misleading results.

Secondly, the recent study looked at the relationship between South Africa's foreign debt and economic growth using a variety of time series econometric techniques. This approach is different to the study of Ayadi and Ayadi (2008) who used OLS and non-linear Elbadawi's estimation methods while the current study applied the NARDL estimation method. As previously noted by Panopoulou and Nikitas (2004) "autoregressive distributed lag (ADL) models perform better than OLS models both in terms of estimation precision and reliability of statistical inferences". NARDL

model by its nature is powerful because it can be used in small sample sizes. Other advantages of the NARDL model are that it can cater for the variables that are integrated at I(0), I(1), or a mixture of the two. NARDL also corrects serial correlation since the dependent variable is regressed on its previous values.

Thirdly, the study investigated nonlinearity in the foreign debt and economic growth before estimating NARDL to ensure that nonlinearity exists in that specific variable. Nonlinearity test in the variables should be explored to ensure the model is properly specified. Lastly, the study also contributes by including one variable in the adopted model which is exchange rates. It is necessary to include the exchange rate in this study since external debt involves making payments outsides the country. The studies by Ayadi and Ayadi (2008) and Ighodalo Ehikioya et al. (2020) were based on linearity and threshold analysis that do not capture dynamic adjustments, which NARDL can, therefore, they are different to the current study since the focus is on the asymmetric effects of external debt on economic growth using the NARDL approach. This study fills the gap and corrects the limitations of the previous empirical studies by examining the nonlinear effect of external debt on economic growth based on asymmetric approach.

3 METHODOLOGY

This study looks at the asymmetric effect of foreign debt on GDP growth in South Africa from 1985 to 2021. The nonlinear autoregressive distributed lag (NARDL) model, developed by Shin, Yu and Greenwood-Nimmo (2014), is used in this investigation. The variables are exposed to unit root tests to ensure that they are stationary. Nonparametric unit root tests by Bierens and Breitung are employed in this analysis.

3.1 EMPIRICAL MODEL

This paper adopts and modifies the empirical model of Shahnawaz et al. (2010) by including the exchange rate variable to capture the effect of exchange rates since the payments of external debt are transferred to the rest of the world. Then, the study removed debt servicing in adopted model, because external debt is more likely to move together with debt servicing cost. Therefore, this may lead to multicollinearity problems in the model. The empirical model is written as follows:

$$GDP_t = \alpha_0 + \alpha_1 ED_t + \alpha_2 EXR_t + \mu_t \qquad (1)$$

Where GDP_t represents the gross domestic product at market price, ED_t stands for external debt as a percentage of GDP, EXR_t represents foreign exchange rate (rand per US$), and μ_t is an error term from population regression.

$$LGDP_t = \alpha_0 + \alpha_1 LED_t + \alpha_2 LEXR_t + \varepsilon_t \qquad (2)$$

ε_t represents a stochastic error term. α_0 is the intercept, and α_1 and α_0 represent slope parameters. The equation 2 is a revised version of equation 1 where the model is expressed in percentages. The variables are already explained in equation (1). A rise

in external debt levels is expected to have a negative impact on economic growth, as it leads to an increase in debt payment expenses. This, in turn, reduces the amount of funds available for private and state investment, resulting in long-lasting adverse effects on the gross domestic product (GDP). Furthermore, there is an expected negative relationship between the exchange rate and economic growth. It is anticipated that when the domestic currency appreciates this will lead to a decrease in exports and an increase in imports. This implies a current account deficit in the BoP; therefore, this would eventually lead to declining economic growth since the money is going out of the economy.

3.1.1 ESTIMATION TECHNIQUE: NONLINEAR AUTOREGRESSIVE DISTRIBUTED LAG MODEL

This study employed the NARDL model by Shin, Yu and Greenwood-Nimmo (2014) which is the nonlinear form of the autoregressive distributed lag (ARDL) model of Pesaran, Shin and Smith (2001). The NARDL approach is favoured because it allows for asymmetries caused by negative and positive shocks in macroeconomic variables. This method is also better than others since it may be used regardless of whether the order of integration is I (0), I (1), or a mix of both.

The NARDL model is not applicable if there is a variable that is integrated of I(2), therefore, it is essential to investigate the unit root in a series. Therefore, before estimating nonlinear ARDL model, the study performs Bierens nonparametric, Breitung nonparametric, Zivot-Andrews unit root tests to determine whether the variables are not integrated at I(2).

The previous equations are estimated with the perspective that external debt has a linear effect on economic growth. However, the main purpose is to determine whether the external debt has an asymmetric impact on economic growth. External debt (ED) is divided into two components, one of which captures positive shocks on external debt stock (ED_t^+) and the other part of which captures negative shocks in external debt (ED_t^-):

$$ED_t^+ = \sum_{j=1}^{t} \Delta ED_j^+ = \sum_{j=1}^{t} Max(\Delta ED_j^+, 0) \tag{3}$$

$$ED_t^- = \sum_{j=1}^{t} \Delta ED_j^- = \sum_{j=1}^{t} Min(\Delta ED_j^-, 0) \tag{4}$$

To obtain non-linear ARDL equations, we replace ED_t with ED_t^+, and ED_t^- in equation 2, therefore, the error correction of the NARDL form may be stated mathematically as follows:

$$\Delta LGDP_t = \alpha_0 + \sum_{k=1}^{p} \alpha_1 \Delta LGDP_{t-k} + \sum_{k=1}^{p} \alpha_2 \Delta LEXR_{t-k}$$
$$+ \sum_{k=0}^{p} \alpha_3 \Delta LED_{t-k}^+ + \sum_{k=0}^{p} \Delta \propto_4 LED_{t-1}^- + \partial_1 LGDP_{t-1} \tag{5}$$
$$+ \partial_2 LEXR_{t-1} + \partial_3 LED_{t-1}^+ + \partial_4 LED_{t-1}^- + \varepsilon_t$$

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$$\Delta LGDP_t = \varnothing_0 + \sum_{k=1}^{p} \varnothing_1 \Delta LGDP_{t-k} + \sum_{k=1}^{p} \varnothing_2 \Delta LEXR_{t-k} \qquad (6)$$
$$+ \sum_{k=0}^{p} \varnothing_3 \Delta LED_{t-k}^{+} + \sum_{k=0}^{p} \Delta L \varnothing_4 ED_{t-1}^{-} + \pi_0 ECM_t + \varepsilon_t$$

whereas Δ denotes the first difference and k represents the lagged values, α_1, α_2, and α_3 and $\varnothing_1, \varnothing_2, \varnothing_3$ and $\varnothing_4$ are short-term coefficients, $\partial_1, \partial_2, \partial_3$, and ∂_4 are the long run coefficients, and ε_t is the stochastic component. The bounds cointegration test is performed to indicate whether there is a long run relationship among the variables. The null hypothesis which indicates no cointegration, is $H_0 : \partial_1 = \partial_2 = \partial_3 = \partial_4 = 0$ which is tested against the alternative hypothesis of $H_1 : \partial_1 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq 0$. The null hypothesis will be rejected if the estimated F statistic is greater than the upper limit critical value I(1) for the number of explanatory variables (k) proposed by Pesaran, Shin and Smith (2001). The null hypothesis cannot be rejected if the F statistic is less than the lower limit critical value I (0). The F statistic being between I (0) and I (1) indicates a lack of certainty regarding cointegration.

After estimating equation "5 and 6, the study performs a Wald test to identify short run ($\alpha_3^{+}/\alpha_1 = \alpha_4^{-}/\alpha_1$) and long run ($\partial_3^{+}/\partial_1 = \partial_4^{-}/\partial_1$) asymmetric effects of ED on GDP."

3.1.2 BREITUNG'S NONPARAMETRIC COINTEGRATION TEST

To check whether the relationship is robust to the method that was used, this study employed two cointegration methods which are the NARDL bounds test and Breitung's nonparametric cointegration test. Breitung's nonparametric cointegration test assumes that $y_t, t = 1, ..., n$, is a 2-dimensional unit root behaviour in the form of:

$$y_t = y_{t-1} + m + u_t \qquad (7)$$

Where u_t "is assumed to be stationary with a constant mean 2-dimesional time series process, and m refer to a 2-dimensional vector of drift parameters. If = 0, then let z_t be the demeaned vector time series y_t. The partial sums of z_t can be computed as follows:"

$$z_t = z_1 z_2 + \cdots + z_t \qquad (8)$$

The matrices A and B of the partial product can be defined as follows:

$$A = z_1 z_1' + z_2 z_2' + \cdots + z_n z_n' \qquad (9)$$

$$B = z_1 z_1' + z_2 z_2' + \cdots + z_n z_n' \qquad (10)$$

Let c_1 and c_2 "be the increasingly ordered generalised eigenvalues of A with respect to B. If y_t is cointegrated with cointegration rank r, then (n^2). $[c_1 + \cdots + c_{2-r}]$ converges in distribution to a function of a standard wiener process, which is free of nuisance parameters, whereas for $k > 2 - r$, (n^2). c_k converges to infinity. Therefore, the Breitung test is tested right sided, starting from the null hypothesis $r = 0$.

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The cointegration rank r corresponds to the first accepted null hypothesis. If none is accepted the cointegration rank r is $r = 0$, which implies that y_t is (trend) stationary."

3.2 DATA SOURCE

The study utilised yearly data from 1985-2021. The reason for starting from 1985 is that, that the study wants capture the debt crisis that hit South Africa in 1985. The data were collected from different sources. The availability of data determined the study period. The statistical software packages used are Stata 16, EViews 13, and EasyREG. Gross domestic product (GDP) as a measure of economic growth is measured as a percentage change at market price. External debt (ED) is proxied as a percentage of GDP and exchange rate (EXR) is measured in rand per US$. Table 1 shows description of the variables. The data for GDP and ED is collected from SARB, while EXR is collected from the World Bank.

TABLE 1
Description of the variables

Variables	Description of the variables	Source
GDP_t	Gross domestic product at market price	South African Reserve Bank
ED_t	External debt as % of GDP	South African Reserve Bank
EXR_t	Exchange rate in dollars	World Bank

Source: South African Reserve Bank; World Bank.

TABLE 2
Descriptive statistics

Variables	Mean ± Standard deviation	Jarque-Bera Statistic
GDP_t	1.989 ± 2,433	16.735***
ED_t	28.170 ± 9.394	5.637
EXR_t	-5.308 ± 12.812	24.773***

Note: Statistically significant at *10%, **5%, ***1%.
Source: Author's own computation.

Table 2 presents a descriptive statistic, where the second column shows standard deviation and mean, while the third column shows Jarque-Bera statistics for normality. The results show that the standard deviation for GDP is very low, providing evidence of low volatility of data around the estimated mean, while ED and EXR have relatively high standard deviations, which indicates a high variability of data around the mean. The Jarque and Bera (1980) test is employed to check the normality in the distribution of the residuals. In the null hypothesis of this test, the residuals are normally distributed. The results indicate that external debt is the only variable that does not accept the null hypothesis of normal distribution.

3.3 NON-LINEARITY TEST

Since the focus of this paper is based on nonlinear modelling, it is necessary to test if the variables are nonlinear. The nonlinearity in the variables is tested using BDS test. The BDS test results are summarised in table 3. The null and alternative hypotheses for BDS test are linearity and nonlinearity, respectively. The null hypothesis of linearity is rejected in favour of nonlinearity as shown in table 3. The findings from BDS test give strong evidence that these variables are nonlinear.

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TABLE 3

BDS test for nonlinearity

Variables	Dimensions	BDS statistics
	2	0.155***
	3	0.201***
ED	4	0.203***
	5	0.193***
	6	0.183***
	2	0.021***
	3	0.015***
GDP	4	0.012***
	5	0.011***
	6	0.009***
	2	1.087
	3	0.025**
EXR	4	0.036**
	5	0.055*
	6	0.410

*Note: Statistically significant at *10%, **5%, ***1%.*
Source: Author's own computation.

3.4 NON-STATIONARITY TESTS

The unit root in the variables is examined using the nonparametric unit root tests by Breitung (2002) and Bierens (1997). The study used another unit root test by Zivot and Andrews (2002) (ZA) to capture the effect of structural breaks since the country is more likely to take external debt during economic crisis, natural disasters, and policy regimes. The null hypothesis for ZA test is unit root, while the alternative gives no unit root with one break. These two nonparametric unit root tests can find unit roots while considering the fact that time series may not be linear. So, they make it less likely that unit root in a variable will be wrongly found because of these nonlinearities. The null hypothesis of nonparametric unit root tests is unit root versus the alternative hypothesis of stationarity with nonlinear trend. These tests are divided into two sections. The first section contains nonparametric unit root tests, and the second section contains unit root test with structural break.

3.4.1 NONPARAMETRIC UNIT ROOT TESTS

The results from nonparametric unit root tests are presented in table 4. The results show that, except external debt (ED) other are integrated at order I(1) at 5% significance level under Bierens and Breitung tests. External debt (ED) has a unit root at I (0) and I (1) under Bierens and Breitung tests.

TABLE 4

Bierens and Breitung nonparametric unit root test

| Variables | Level | | First difference | |
	Bierens	Breitung	Bierens	Breitung
ED	-9.462 (0.610)	0.017 (0.930)	-6.858 (0.860)	0.003 (0.200)
GDP	-28.872 (0.140)	0.008 (0.540)	-1,988.933** (0.020)	0.001** (0.000)
EXR	-43.247 (0.110)	0.002** (0.000)	-286.354** (0.040)	0.001** (0.000)

*Note: Statistically significant at *10%, **5%, ***1%. The probability values are in brackets.*
Source: Author's own computation.

3.4.2 UNIT ROOT TEST WITH STRUCTURAL BREAK

Table 5 demonstrates the results of ZA test for stationarity. The unit root test with structural break results by ZA are shown in table 5. The results reveal that stationarity is confirmed for all the variables at I(0) in the presence of one structural break. Since the stationarity is not confirmed at Level by Bierens and Breitung tests but only confirmed by ZA test, therefore, using the majority rule there is a need to estimate cointegration between the variables.

TABLE 5

Zivot-Andrews unit root test

| Variables | Level | | |
	Intercept	Trend	Intercept and trend
ED	-4.893*** (2012)	-3.940** (2006)	-4.404*** (2003)
GDP	-5.070** (1994)	-5.236*** (2006)	-5.264** (2009)
EXR	-7.269*** (2003)	-4.918 (2005)	-7.144*** (2003)

*Note: Statistically significant at *10%, **5%, ***1%. The break years are in brackets.*
Source: Author's own computation.

4 EMPIRICAL RESULTS

4.1 COINTEGRATION TESTS

The long run association between the variables is performed in this section using two cointegration tests. The study uses the NARDL bounds cointegration test; however, to check the robustness of bounds test the study used the Breitung (2002) nonparametric cointegration test.

4.1.1 NONLINEAR ARDL BOUNDS COINTEGRATION TEST

The results for the long run relationship between the variables using bounds test are shown in table 6. The F-statistics is greater upper bound I(1), which implies that the cointegration is confirmed between the variables. This means that, there is a long correlation amongst the variables.

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TABLE 6

NARDL bounds cointegration test

F-statistics	Critical values					
	1%		5%		10%	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
6.421***	4.428	5.816	3.164	4.194	2.618	3.532

*Note: Statistically significant at *10%, **5%, ***1%.*

Source: Author's own computation.

4.1.2 BREITUNG'S NONPARAMETRIC COINTEGRATION TEST

To check the robustness of bounds test in detecting cointegration, the nonparametric cointegration test of Breitung (2002) is performed and presented in table 7. The results confirm the presence of cointegration at 10% significance level for the combination of GDP and ED, whereas it is confirmed at the 5% level of significance for the combination of GDP and EXR. Therefore, Breitung (2002) nonparametric cointegration test results are consistent with those of the nonlinear bounds cointegration test. This enables the estimation of NARDL long run parameters.

TABLE 7

Breitung's nonparametric cointegration test

Variables		H_0 vs H_1	Simulated T-statistics	Critical value (10%)	Critical value (5%)	Simulated prob-value	r
GDP	ED	r = 0 vs r > 0	701.40*	596.20	713.30	0.0352	1
		r = 1 vs r > 1	57.96	222.40	281.10	0.8430	
GDP	EXR	r = 0 vs r > 0	988.09**	596.20	713.30	0.0053	1
		r = 1 vs r > 1	131.92	222.40	281.10	0.2989	

*Note: Statistically significant at *10%, **5%, ***1%.*

Source: Author's own computation.

4.2 NARDL LONG RUN ESTIMATED PARAMETERS

The results for long run parameters are summarised in table 8. The Akaike information criterion is used to estimate the optimal number of lags, therefore, the NARDL (1, 0, 0) is selected with one lag in the dependent variable and zero lag in the independent variables. The results demonstrate that both positive and negative shocks of external debt are statistically significant at the 1% level of significance. The parameters for positive and negative shocks are -0.171 and -0.267, respectively. However, the sensitivity of GDP to the positive shocks is less than to negative shocks of external debt. Therefore, a 1% rise in foreign debt results in GDP decreasing by 0.171%. These findings match the results found by Ayadi and Ayadi (2008),

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Shahnawaz et al. (2010), Ajayi and Oke (2012), and Asafo, Matuka and Dominic (2019). However, the studies that contradict these results are Matuka and Asafo (2018), Shkolnyk and Koilo (2018), and Govdeli (2019). Moreover, a 1% decline in foreign debt results in GDP rising by 0.267%.

The negative relationship between external debt and economic growth is confirmed. However, these results indicate that economic growth grows faster when the external debt is cut as compared to a situation where the external debt is increased. A decrease in external debt would lead to a low debt servicing cost, but when the country has the high rate of debt, a portion of the national income is used to service debt through its interest and principal repayment. Therefore, a decrease in debt can free up the resources that were supposed to be used for debt servicing, allowing them to be invested in other segments of the economy such as infrastructure, education, and health. The results further reveal that exchange rate is statistically insignificant to explain GDP with a positive coefficient.

4.3 NARDL SHORT RUN ESTIMATED PARAMETERS

The study also estimated the short run parameters after estimating long parameters. Table 9 shows the results for short run parameters. The reason for estimating short run parameters is that it helps to find out if were there any deviations from the long run equilibrium throughout the period of the study. This will assist us to check how fast or how slow it takes disequilibrium to be adjusted to long run equilibrium. The error correction term ECT (-1) indicates the pace of convergence of the dependent variable to the long run equilibrium. The results show that the coefficient for ECT(-1) is negative and significant. The ECT(-1) indicates a quicker convergence to the long run equilibrium. In one year, 83.8% of disequilibrium is corrected. In other words, it would take one year and some few months for South Africa's external debt to be adjusted to long run equilibrium.

4.4 SHORT RUN AND LONG RUN ASYMMETRY

The study also investigated whether there is a long run or short run asymmetry in the coefficients. Table 10 shows the results for asymmetry. The results only found coefficients' asymmetry in the long run not in the short run. The results show that null hypothesis of no asymmetry cannot be accepted at the 10% significance level. Finally, the study confirms that there is nonlinearity, therefore, the coefficients have different impacts on GDP.

4.5 RESIDUALS DIAGNOSTICS AND STABILITY DIAGNOSTICS

Diagnostic tests are undertaken to ensure that no diagnostic test is violated. The study used Glejser (1969) test for heteroscedasticity, Ramsey (1969) RESET test for model misspecification, and Breusch-Godfrey LM test for serial correlation. The results are presented in table 11. The results show that model passed all the diagnostic tests. The model stability is examined through CUSUM test. The graphs for CUSUM is shown in figure 2. Therefore, figure 2 confirms coefficient stability. This is because the CUSUM line fall between the critical bands at 5% significant level.

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4.6 DYNAMIC MULTIPLIER

Figure 3 shows the dynamic multiplier for positive and negative shocks of external debt. In figure 3, the gray shaded rectangle indicates asymmetry at 95% confidence interval. The gray line shows a positive shock, meaning that, it provides an understanding about the response of GDP to positive shocks in the external debt. On the other hand, the yellow line shows a negative response, which indicates the response of GDP towards the negative shocks in the external debt. The figure demonstrates that both positive and negative shocks are stable in the long run. Furthermore, the results indicate that a decrease in external debt has a bigger impact on GDP than an increase.

TABLE 8
Long-run NARDL results

Dependent variable: GDP

Variables	Coefficient	Prob.
EXR	0.013	0.7455
ED_POS	-0.171	0.0044***
ED_NEG	-0.267	0.0080***
INTERCEPT	-3.020	0.1773

*Note: Statistically significant at *10%, **5%, ***1%.*

Source: Author's own computation.

TABLE 9
Short-run NARDL results

Dependent variable: ΔGDP

Variables	Coefficient	Prob.
GDP (-1)	-0.838	0.0000***
EXR	0.011	0.7403
ED_POS	-0.143	0.0079***
ED_NEG	-0.224	0.0117**
Intercept	-2.530	0.1800
ECT(-1)	-0.838	0.0000***
R^2	0.507	
Adjusted R^2	0.443	

*Note: Statistically significant at *10%, **5%, ***1%.*

Source: Author's own computation.

TABLE 10
Long run and short run asymmetry

Variable – External debt	F-statistics	Probability value
Long run ($\partial_3^+ / \partial_1 = \partial_4^- / \partial_1$)	3.412	0.0743*

*Note: Statistically significant at *10%, **5%, ***1%.*
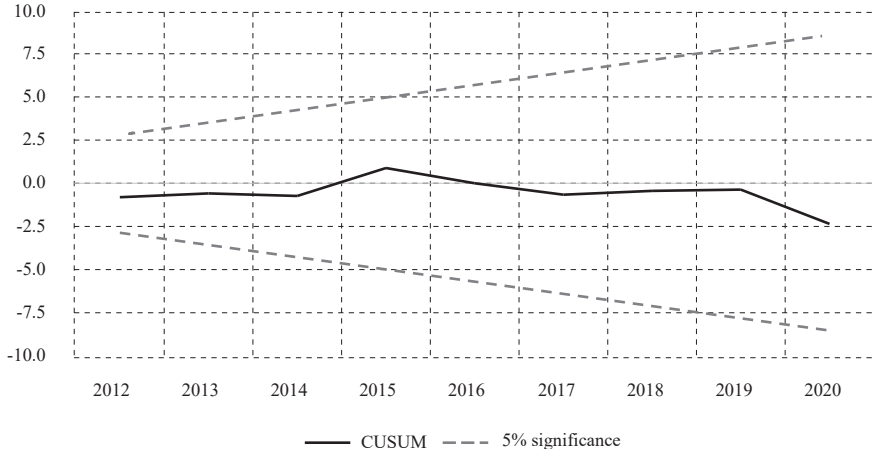
Source: Author's own computation.

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TABLE 11

Diagnostic tests

	Serial-correlation	Heteroscedasticity	RESET test
Statistical test	1.924	5.114	0.766
Probability value	0.382	0.276	0.399

Note: Statistically significant at *10%, **5%, ***1%.

Source: Author's own computation.
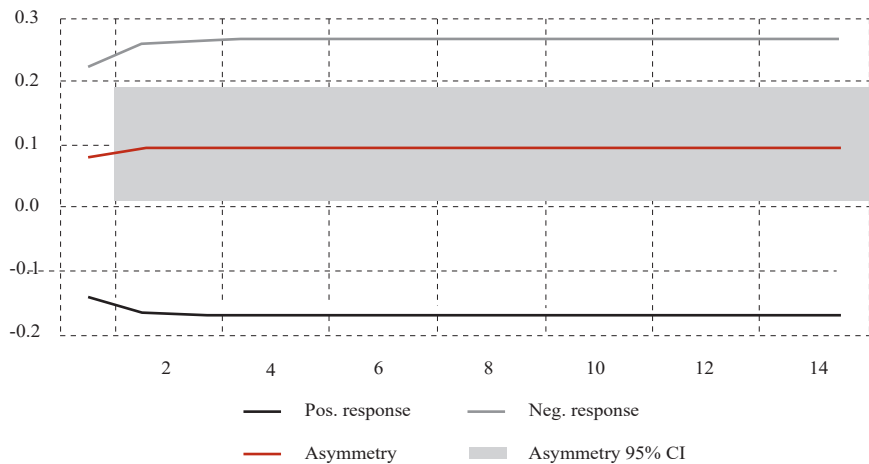
FIGURE 2

CUSUM graph

Source: Author's own computation.

FIGURE 3

Dynamic multiplier graph

EXTERNAL_DEBT on GDP shock evolution

Source: Author's own computation.

5 CONCLUSION

The purpose of this study is to model a long run asymmetric impact of external debt on economic growth in South Africa. The study uses annual dataset for a period of 1985 to 2021. It also uses a nonlinear autoregressive distributed lag model for parameter estimation. The results show that negative shocks of external debt have a big impact as compared to positive shocks on economic growth. The results indicate that an increase in external debt leads to a decrease in economic growth, while a decrease in external debt increases economic growth. The results suggest that for South Africa's economic growth to improve the external debt must decrease. The results also suggest that South Africa should ensure that external debt is managed in a sustainable manner to prevent it from hampering economic growth and that the South African economy must achieve fiscal sustainability. The exchange rate is found to be statistically insignificant to explain economic growth.

This study strictly focused on the immediate impact of external debt on economic growth. However, external debt can also affect economic growth indirectly through its effects on public investment. The amount of public debt does not seem to affect public investment, but the amount of debt servicing does. If in a heavily indebted country a large amount of national income is used to service debt there is less money left for public investment. Therefore, this study recommends that future studies should focus on the indirect impact of external debt on economic through public investment.

Disclosure statement
The author has no conflict of interest to declare.

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