THE CONSEQUENTIAL EFFECTS OF PUBLIC DEBT ON ECONOMIC GROWTH IN SOUTH AFRICA: AN ARDL COINTEGRATION APPROACH

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Abstract: *The study employed the ARDL bound test to estimate the long and short run relationship among several macroeconomic variables real economic growth, domestic debt, external debt, budget deficit, inflation rate and investment. An error correction model was used to analyses the short-run disequilibrium. The results show that there is a short and long run equilibrium relationship between foreign debt, domestic debt, budget deficit, inflation rate and economic growth. The empirical results indicate that external debt negatively affects the real GDP growth in South Africa, both in the short and long-run. Several policy implications emerged from the empirical results. To keep public debt more manageable, South Africa should improve its debt management. Furthermore, the country can make use of debt-to-equity swaps by privatizing underperforming parastatals. This would make them competitive and efficient. This move could attract more foreign direct investment inflows and create more employment thus improve the economic growth of South Africa.*
Keywords: *Public debt, Fiscal policy, Budget deficit.*

Introduction

Recent contributors signposted the issue concerning how public debt affects economic growth. However, there is still much dispute over this issue in many nations in both policymaking and academic circles (Cashell, 2007). The impact of the financial crisis and the subsequent sovereign debt problem, which began in 2007/8, has been of concern to various governments in their effort to stimulate economic growth, more especially in developing countries. Against this background, government debt continues to be high in both developing and less developed countries. Notwithstanding, the consequence of high government debt from different countries, particularly African countries, was attributable due to high government expenditures, high unemployment, and state corruption among other factors. According to Mititi (2013), a sound risk management by the public sector is essential as it induces economic growth and economic balance through mobilizing resources at a lower borrowing cost and concurrently minimizes financial risk, to be consistent with a prudent approach. Furthermore, a stable economic growth in a country is productive if it is aided by an increase in the effective and proficient utilization of resources in the interest of achieving macroeconomic objectives, notably, economic stability, and ultimately revival of the level of employment. In the 2018 national budget speech, it was pointed out that South Africa's rising government debt ratio, accompanied by low or unpredictable growth, is an outcome of the mounting debt costs crowding out social and economic spending. As stated by National Treasury (2018), with state revenue under pressure the former Minister of Finance Mr Malusi Gigaba pointed out that government

seeks to reduce the primary budget deficit over the medium term to balance the budget and keep the percentage of government debt to GDP at a stable level of 56.2% by 2022/23.
Additionally, South Africa came up with a National Development Plan (NDP) outlining the vision for 2030 to ensure economic stability and mitigate economic challenges. The underlying focal point on this vision is progressive fiscal policy which is expected to perform a key role in leading the pace at which the South African economy can grow and the way to subsume the key challenges that may arise in future. This is in line with the findings of Ocran (2009), who suggested that to attain fiscal policy acceleration, there must be a balance and realignment of key areas of government policy to use consumption and investment expenditure to accelerate growth. All of this would be compatible with the economic infrastructure required to support the state's role in setting an appropriate macroeconomic framework. The size of government deficit and the strategy to reduce and maintain it within the threshold remains a serious problem to deal with in many countries including South Africa. Looking at countries like Spain, Greece, Cyprus Ireland, and Portugal they ended up in situations of sovereign debt default due to the financial crisis. Even worse, for these countries to continue functioning, the international financial institutions had to bail them out (Beirne and Fratzscher, 2013). The instruments of fiscal policy in most countries, including South Africa, are used to counter slowdowns in the economy. Swanepoel and Schoeman (2003) argue that countries utilize the instruments of fiscal policy owing to their countercyclical role in dealing with external shocks that could occur due to the vulnerability of an economy amid a worldwide monetary downturn. Furthermore, the effects of fiscal policy contribute enormously to a country's economic outcome, and they are among the key tools benefiting business or economic cycles to promote fiscal stability in a country. Fiscal stability is determined by both the budget revenue side and by the consumption streams. On the income side, most nations are caught in profound budget shortfalls or government obligation and are calling for higher taxes or other revenue from the open segment to manage the subsequent increment in debt.
Such a decision, however, can spark the economic growth rate in a developing economy, which as a result, can ultimately induce the erosion of tax a base and dwindle tax revenue. As such, this could further increase the budget shortfalls, and lead to fiscal instability within the economy. The fiscal policy involves circulation of the resources at different times across society in the economy, as far as expenditure is concerned. Barker, Buckle and Clair (2008) hold a view that there is not autonomy of structures and stability roles played by fiscal policy. However, such structures have significant ramifications concerning sustainability of the fiscus and the adequate stabilization on the role of fiscal policy. For example, the availability of resources that can be spent by the government is determined by the size and structure of the tax base, thus affecting sustainability of the fiscus. In this study, it is important to bring to light the idea that achieving economic growth rate will reduce poverty and inequality by 2030 and that requires the government to deal with a growing public debt amongst other factors. To do this, among other things, the government must address the issue of the escalating public debt. It is noteworthy that several economic factors could limit the likelihood of attaining some of the NDP's goals by 2030. The primary focus of this study, however, is on public debt in order to show how it has affected South Africa's economic growth from 1961 to 2022.

Literature review

In order to produce study evidence-based findings, different theories neither complementing each other nor contradicting each other are considered in this section. Moreover, the empirical studies are carried out to ascertain that the facts and opinions made in this study have back up and support from other studies. Therefore, consideration of the literature will enable this study to identify and narrow the existence of the literature gap pertaining to public debt and economic growth in South Africa.

Theoretical literature review.

The development of the modern public debt theory resulted from the great 1930s depression, which led to an economic crisis. The traditional view outlines the constant unbalanced budget and rapidly public debt (Mah et al, 2015). Furthermore, imperative to the financial stability of the nations, huge public debt is viewed as a national asset rather than a liability, given the continuous deficit spending is significant to the economic property of the nation (assuming it is at full employment). With that said, an increase to the national income would result from the multiple effects caused by a rise in public debt as outlined by Keynes. He further linked an increase in employment and output by relating it to the effects of the public borrowing with deficit financing as well as authorized government spending ultimately affecting an increase in aggregate demand. As stated by Parkin et al (2008), Keynes consumer borrowing is as desirable as borrowing for investment to finance production and technological innovation consequently consumption expenditure would lead to increased investment.

According to the theory of debt overhang, the stock of public debt increases the cost of economic expansion, deterring private investment or changing effective governmental spending. The debt overhang hypothesis, as put out by Reinhart et al. (2012), contends that unsupportable public debt erodes public policy's legitimacy. However, Mohanty and Mishra (2016) emphasize that if a country's ability to service its debt is greater than its anticipated external debt, the debt overhang theory implies rising debt payment costs that hamper investment. The implication of this is that the possibility of government to sacrifice fiscal consolidation results from the ripple effect of pressure caused by public debt further increasing a country’s budget deficit. According to the theory, a huge stock of debt creates different incentives for both creditors and debtors. As a result, debt reduction benefits both the debtor and the creditor. The theory goes on to explain how capital accumulation or productive growth affects growth and how this is thought to be affected nonlinearly by public debt. The likelihood of future debt is based on the assumption that the amount of debt accumulated will be greater than the nation's capacity to pay it back. This theory holds that a country's ongoing increase in debt servicing costs will further deter both local and foreign investments that would have accelerated economic growth. Krugman (1988) argues that potential investors would be more concerned about the heavily taxed production by creditors in the attempt to service public debt at the expense of the investment costs incurred from future output.

Empirical literature review

As reported by Gómez-Puig and Sosvilla-Rivero (2017), the auto-regressive distributed lag was deployed to assess the short- and long-term effect of public debt on the economic

growth of euro countries. The study was conducted using the period from 1961-2013 to limit the approach to testing with annual data spanning. The results of the study revealed different patterns across all these euro countries, which in turn support the viewthat in the longer term, public debt is likely to impact inversely on the performance of the economy in the euro member states, while its short-run effect on other hand may be positive depending on the country. Reinhart and Rogoff (2010), in their study of economic growth and inflation at different levels of government and external debt for 44 advanced and emerging countries over a 200-year period, found that public debt has adverse growth consequences only beyond 90 percent ratio of debt-to-GDP for those countries. Additionally, it was noted in the study that, the threshold of total external debt-GDP seems to be a greater for the emerging markets (60%) that is associated also with adverse growth outcomes. Dritsaki (2013) established the causal nexus of Greece's economic growth, exports, and government debt. The study utilized time series data spanning from 1960-2011of economic growth (proxy real GDP), exports and external debt. In the methodological approach, they employed VECM and Granger causality tests to analyses their results. Their findings displayed the existence of "short-term and long-term relationship" amongst variables under investigation. Moreover, the study found the existence of unidirectional causality of Granger ranging two ways as follows, exports to growth, and from growth to public debt, with non-evidence of short-term causal connection amid exports and public debt. The results further signaled the evidence of a unidirectional Granger causality (long run) that ranges from economic growth to government debt.

Saifuddin (2016) looked at how public debt in Bangladesh can influence its growth, observing time series data for the period 1974 to 2014.The investment model was adopted in this study to determine how public debt could potentially signal indirect influence on economic growth by impacting investment. In addition, the study applied the growth model to observe the direct association of government debt, and economic growth. The estimation of both models was through the regression of two stage least squares (TSLS). As a result, it was found that both investment and economic growth are positively related to public debt. The empirical findings also suggest that through its positive influence on investment, public debt affect growth indirectly, albeit in a positive way. Numerous econometric tests are used in the current study to produce accurate results. Similarly, Munzara (2015) had researched the impact that foreign debt has on Zimbabwe's economic growth, making use of annual time series data, 1980 to 2013. Labor force, capital investment, and trade openness are chosen as control variables. The OLS regression was employed to interpret the data to fulfil the objectives of the study. The results revealed the negative impact of external debt and openness to trade in the economy of Zimbabwe, while the investment on capital and labor force growth yielded positive effects. Furthermore, the study made a strong emphasis in recommending that the country should not heavily rely on foreign borrowing to finance economic growth but instead rather create a conducive environment for alternative sources of foreign funds such as project finance and FDI. Additionally, the country should avert excessive imports of consumables and rather advocate for value-added exports by the manufacturers locally.

The dynamic relationship between accumulated public debt ratio and real GDP growth was analyzed for the South African economy, years 1980-2014 (Baaziz et al, 2015). The study made use of LSTR model with inflation rate and openness trade as two macroeconomic control variables. Furthermore, it was found that, the country's level of indebtedness

informs the type of link that can exist amid public debt and real growth of GDP. In their view, any level of public debt in South Africa that is plethora to 31.37% of GDP jeopardizes growth momentum in the economy. Their findings sent a strong warning to government and policy makers concerning the rational to ameliorate fiscal credibility and enhance countercyclical fiscal policies that could steer the country to safe havens and safeguard the public debt level. Their study was more focused on two macroeconomic variables hence, in the current study more parameters of public debt are added as well as numerous econometrics test are employed. Unlike the study by Baaziz et al (2015), which determined the threshold of public debt on economic growth of South Africa, the current study seek to address the effect of public debt on economic growth. Ncanywa and Masaga (2018) explored how public debts impact on the investments and economic growth of South Africa using quarterly data spanning from 1994-2016. Their objective was achieved through multiple econometrics tests. The incorporated variables were gross domestic product, public debt, investment, and government deficit. Their results for Johansen test of cointegration confirmed the existence of cointegration among variables observed thus, validating long run association. Most importantly their research outcomes were mainly informed by vector error correction model (VECM) accompanied by other econometric tests such as Variance Decomposition and Impulse Response Function and Granger causality. The results of VECM validated the short run association relating public debt and economic growth in the short run. Granger causality results have shown that public debts can Granger cause economic growth, and there is bi-direction association amongst the two variables. The current study used different variables than the ones used by Ncanywa and Masaga (2018) as well as the study period, however, the current study has borrowed much from the above study.

With the aim of examining how public debt influences economic growth, Malaba and Phiri, (2017) employed the ARDL model to scrutinize the short-run and long-run responsiveness of economic growth to public debt in South Africa. Their study used the first quarter of 2002 and fourth quarter of 2016 data to mark their analysis marked. The results showthat, in the long run, there exist a negative relationship between public debt and economic growth. Although economic growth and public debt could link positively in the short run, there is no clear indication of what the short-run effects could look like. The study concluded by stressing that, policy makers must be cautious while acquiring additional unit of debt and they must implement some debt management programmed in stabilizing the level of high debt as this harm the economy.

The empirical literature reviewed above have shown mixed and inconclusive results from different countries regarding how public debt affect economic growth. However, the debt overhang and threshold hypotheses played an important role in the literature, thereby identifying the importance of debt at reasonable levels, which, once exceeded, will infer an adverse impact on economic growth. A mixture of reported results makes it difficult to take a position from the broad literature except to refer to a specific study. In the case of South Africa, the scarce literature suggests a negative association of government debt and economic growth. Debt has continued to grow even though newly fiscal consolidation strategy indicates borrowing for debt-repayment as one of strategies towards resolving the debt crisis. South Africa continues to rely more on debt even though it is already highly indebted.

Methodology

This study employed autoregressive distributed lag (ARDL) modelling. The real GDP is the dependent variable which is transformed into log. The explanatory variables in this study are public debt (proxy by foreign debt and domestic debt), CBD (budget deficit), INF (inflation rate), and GFCF (gross fixed capital formation).

Theoretical model

The theory of debt overhang is hypothetically unrivalled as reviewed in the literature section, making it attractive as the basis modelling. Thus, the examination follows Cunningham (1993) and Akram (2010). The model can be expressed in its auxiliary structure as

$$YY = AAAA\ (KK, LL, DDDDDDD) \quad (1)$$

Where YY is economic growth, KK is the capital stock; LL is the labor force, debt is the public debt and AA presents other constant factors. In the model, the priori expectation is that $KK \geq 0, LL \geq 0, DDDDDDDD \geq 0\ aaaaaa\ KK + LL + DDDDDDDD \leq 1$

Empirical model

Following the theoretical model, the model will take this form:

$$GGDDGG = AA(FFDDFF, DDDDFF, CCCCDD, IIIIFF, GGFFCCFF) \quad (2)$$

Using the regression model, the model takes this form:

$$GGDDGG = \beta\beta_0 + \beta\beta_1 FFDDFF_1 + \beta\beta_2 DDDDFF_2 + \beta\beta_3 CCCCDD_3 + \beta\beta_4 IIIIFF_4 + \beta\beta_5 GGFFCCFF_5 + \mu\mu \quad (3)$$

Where $\beta\beta_0, \beta\beta_1, \beta\beta_2, \beta\beta_3, \beta\beta_4, \beta\beta_5$ denote the coefficients of the explanatory variables. Conspicuously, the possible sway of the omitted variables is denoted by error term $\mu\mu$

FDE= Foreign debt stock (% to GDP)
DDE = Domestic debt stock (% to GDP)
CBD3 = Budget deficit (% to GDP)
INF = Inflation rate
GFCF5 = Gross fixed capital formation (% to GDP)
μ = Error term
β0 = intercept

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Empirical Results and Discussion

Summary statistics.

The empirical examination starts with descriptive insights. Table 1 details the results of descriptive insights on the variables utilized in the investigation. The data demonstrates that there are significant variations for all variables over the review period. The following statistics are derived; mean and standard deviation for each individual series and identify the extreme values.

Table 1 Descriptive analysis

Variables	Mean	Standard deviation	Min	Max
LNGDP	14.266	O.438*	13.306*	14.954
CBD	-3.135	1.678**	-7.100	0.900
INF	8.256	4.592	1.200	18.700
DDE	35.856	6.747	22.300	48.200
FDE	2.677	1.518*	0.600	6.600
GFCF	21.746	4.548	15.150	32.102

Source: *Author's computation. Note: Figures denote level of significance (*, **) at 1% and 5% relatively.*

As can be seen from Table 1, the substantial values of all variables are generally proximate to the mean, signposting the minimal substantial variation. GDP, budget deficit and foreign debt have standard deviations of 0.43, 1.68 and 1.52, respectively, suggesting that the data points are close to the average. Inflation rate, domestic debt, and gross fixed capital formation, on the contrary, have relatively high standard deviation values of 4.59, 6.75 and 4.54, respectively, implying that the data points are spread out. In a nutshell, it can therefore be stated that, the study has a moderate magnitude in terms of variations in the macroeconomic variables data.

Unit root results

Table 2 demonstrates the summary of the findings as yielded by ADF stationarity tests. The technique tests a variable for stationarity to validate or invalidate a null hypothesis that "variable contains a unit root". The level of significance at which this null hypothesis can be rejected it or validated is 5%. The decision to reject / accept the null hypothesis can be guided by comparing t-statistic and critical values. When the former is higher, we reject the null hypothesis, and visa-versa is applicable to the latter. The ADF confirms that stationarity of budget deficit and foreign debt is validated at level, unlike, GDP, inflation rate, domestic debt and gross fixed capital which became stationary when subjected to first difference.

Table 2 Unit root results

Variable	**M.S**	**ADF**		**KPSS**		**Output**
		Level	**1st diff**	**Level**	**1st diff**	
GDP	Intercept	-2.75	-7.43	-6.68	-28.85	I(0)
	Trend	-4.04	-5.38**	-6.85	-29.18	
CBD	Intercept	-3.88	-6.14	-9.33	-11.55	I(0)
	Trend	-1.39	-2.23	-4.52	23.04	
INF	Intercept	-3.80	-4.97	-9.05	-24.57	I(0)
	Trend	-4.78	-5.04**	-8.90	-22.20**	
DDE	Intercept	-2.29	-8.82	-2.44	-10.36	I(1)
	Trend	-3.47	-8.75**	-3.43	-10.28	
FDE	Intercept	-2.56	-3.68	-2.52	-8.13	I(1)
	Trend	-2.77	-5.83	-2.52	-23.08	

GFCF	Intercept	-2.75	-4.43	-2.00	-4.68	I(1)
	Trend	-1.41	-4.40	0.82	1.77*	

Source: Author's computation. Note: Figures denote t-statistics, 1% level of significant* and 5% level of significance**

In contrast to the alternative of a non-stationary process, the null hypothesis of the KPSS test is that a series is in a stationary process. Commenting on the test, the outcome demonstrates that some levels of variables' t-test statistics for the KPSS test are lower than the critical values while others have greater critical values. Due to this, there is not enough statistical support to rule out the unit root, which is the null hypothesis. As the t-test statistics KPSS tests are greater than the critical values, however, we have strong statistical evidence to reject the null hypothesis in the first differences when looking at the data. These results clearly show that some variables under investigation exhibit non-stationarity characteristics in levels, both under ADF and KPSS tests whilst others don't. However, they become stationary in both levels and first difference, and for this reason, we treated these variables as I(0) and I(1) process. Having established this stationarity process, we proceeded to ARDL analysis, and this follows in the next section. As such, the use of ARDL bounds test of cointegration was triggered since variables are integrated of different orders. Prior to applying the model thereof, the optimum lag-length for the specified ARDL model is being estimated and provides the output in Table 3.

Optimal lag length.

A significant part of experimental research with error correction modelling is to select an optimal lag-length. This is because the statistical inference of utilizing a model depends on the determination of a suitable model. The examination then determines the optimal order of lags on the first difference variables after determining the order of integration.

Table 3 The optimal lag-length selection.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-792.349	NA	172344.8	44.915	32.199	35.212
1	-452.024	42.936	50.664	42.509	29.845	24.923*
2	-603.953	66.943*	41.339*	42.953	28.059	29.134
3	-472.942	48.039	50.294	38.501	31.563	20.326
4	-402.483	45.428	55.042	30.852*	25.492	23.242

Source: Author's computations

LR denotes sequential modified LR test statistic (5% level at each test), Final prediction error is denoted by FPE, while AIC, SC and HQ denotes Alkake information criterion, Schwarz information criterion, and Hannan-Quinn information criterion respectively. Considering the findings displayed in Table 3, we choose SIC over AIC for the purpose of this study as AIC is known to suggest more lags than necessary, resulting in loss of degrees of freedom and model overfitting. SIC recommends one lag, supported by HQ, as can be seen in Table 3 AIC recommends four lags.

ARDL Bounds Cointegration.

Table 4 ARDL bounds cointegration

			Bound critical values	
F-statistics	**Lag**	**Significance**	**I(0) Bound**	**I(1) Bound**

10.33**	1	10%	2.94	3.44
		5%	3.24	3.89
		2.5	3.39	4.32
		1%	4.22	5.76

Source: Author's own computation. Note: 1% level of significant*, 5% level of significance**, and 10% level of significance***

The ARDL bound test corroborates the presence of long-run relationship amongst the variables in question. This came because of the 10.33 F-statistic, which is higher than both the lower (3.24) and upper (3.89) boundaries at the 5% level of significant. Therefore, for the alternative hypothesis of cointegration $HH_0 = 0$, the null hypothesis of no cointegration $HH_0 = 0$ is rejected. These findings are consistent with the use of the same cointegration technique by Hassan et al. (2015) and Ahmad and Aworinde (2015). This confirms that variables in the model are stable and have long-run relationship. The results also confirm the use of an ECM to represent the relationship between economic growth and factors contributing to it. Therefore, the study continued to estimate the regression output, and speed of adjustment to balance given the existence of a long-run relationship and the results are presented below.

Long run error correction model.

The rationale for running the regression of the data at levels is to generate the residual to be used in formulating an error correction term to be used to construct short run ECM. The residuals from the estimation were tested for their order of integration. The results indicated an integration of the residual term to be at order zero, hence justifying long-run relationship amid real GDP and its explanatory variables.

Table 5 Long-run dynamics of the ARDL error correction model

Dependent variable: LOGGDP				
Log run coefficients				
Variables	**Coefficients**	**St. Error**	**t-Static**	**p-values**
FDE	-0.723**	0.420	-3.432	0.009
DDE	-0.288	0.104	-3.141	0.018
INF	-0.751**	0.071	-4.823	0.001
CBD	-0.592	0.395	-4.134	0.051
GFCF	0.032	0.082	0.382	0.719
C	22.309**	4.134	4.726	0.000

Source: Author's own computation. Note: 1% level of significant*, 5% level of significance**, and 10% level of significance***

Adjusted R-squared = 0.693 F-statistic = 16.911(0.0009) Durbin-Watson = 5.835

From Table 5, all significant variables have their expected signs. Foreign debt is factually significant at the 5% level, while domestic debt and budget deficit are factually significant at 5%, followed by gross fixed capital formation recording 1% level of significance. The adjusted RR^2 is 0.69 implying that the model fitted well within the data. Therefore, when real economic growth (RGDP) adjusts by 69%, this could be explained by the changes in all the explanatory variables. Likewise, there is 1% significance of the entire model signaled by F-statistic probability value of 0.0009, which do not exceed 0.01. The coefficient of foreign debt recorded a negative value of -0.723, which is factually significant at 5% level. According to the findings, if foreign debt surge by 100%, the real

economic growth will dwindle by 72.3% ballpark. Therefore, the contribution of foreign debt to economic growth does not bode well for encouraging further accumulation of debt. The economic logical viewpoint in this case would suggest a cut in government expenditure owing to skyrocketing level of foreign debt, the results found here concur with the findings of Putunoi and Mutuku (2013).

An adverse link of domestic debt with real economic growth has been corroborated and denoted by a negative coefficient of 0.288 which is statistically significant at the 5% level. Therefore, a 100% increase in domestic debt induces real economic growth to fall by roughly 28.8%. This is a true reflection of the 'debt overhang effect'. The results are consistent with the Debt Overhang theory which stipulates that when size of the debt stock grows so large, it can retard economic growth. In other words, a large debt overhang increases the uncertainty of the environment in which the country is operating in, it acts as an indirect tax on returns to investors. The findings in this research support Elbadawi et.al. (1997) findings, in which debt accumulation proved to have a negative effect in 99 developing countries covering sub–Saharan Africa (SSA), Asia, Latin America and the Middle East Countries hence, external debt accumulation deters economic growth. The coefficient of budget deficit was found to be statistically significant at the 5% level with a negative value of 0.592.

This means that a 100% increase in inflation results in an approximately 59.2% decrease in real economic growth. A conceivable clarification for the negative sign could be that the funds that could have been used for productive purposes may be diverted towards the repayment of the debt. This may result in swarming out of the private sector when the government draws away resources in the economy towards the servicing of the debt. The results support the crowding out hypothesis by Cohen (1993) and Kasidi and Said (2013), who also found the same results. Furthermore, an adverse linkage of Inflation rate coefficient to real economic growth was attested significant. It has a coefficient of 0.751 which means that a 100% increase in inflation rate will induce approximately 75.1% decrease in economic growth. The gross fixed capital formation coefficient exhibited not just a positive link to real economic growth since the linkage is also significant. A coefficient of 0.032 means that if gross fixed capital formation increases by 100%, it will, in turn induce a 3.2% increase in real economic growth. Since investment is a dominant component of GDP, an increase in investment will also increase real income. The more the inflow of capital formation in an economy, the more national income will also increase.

Short run error correction model.

From the ARLD bound of cointegration, the results revealed the presence of the long-run behavior among the variables, thus suggesting that there is cointegration. The ECM inthis case would capture the long-run economic connection among economic growth and its determinants. To explain the connection between economic growth and its determinants in different time periods, both the long-run model and the short-run error correction mechanism (ECM) were employed.

Table 6 Short-run dynamics of the ARDL error correction model.

Dependent variable: LOGGDP				
Log run coefficients				
Variables	**Coefficients**	**St. Error**	**t-Static**	**p-values**

FDE	-0.461**	0.156	-2.959	0.004
DDE	-0.549	0.103	-5.289	0.000
INF	-0.417	0.076	-5.486	0.000
CBD	-0.801	0.236	-0.771	0.444
GFCF	0.011*	0.058	0.200	0.842
C	-0.624	0.121	-6.76	0.000

Source: Author's own computation. Note: 1% level of significant*, 5% level of significance**, and 10% level of significance***
Adjusted R-squared = 0.385716 F-statistic = 4.118739 (0.034756) Durbin-Watson = 1.370943

In the short run, most variables maintained their expected signs. A Durbin-Watson (DW) statistic of 1.371 suggests that there is no decision on autocorrelation since it lies between 1.166 (dL) and 1.808 (dU). The adjusted RR 2 with a value of 0.386 is very low since some variables had to be differenced once to make them stationary, which resulted in the loss of some degrees of freedom. However, the model is still useful as depicted by the F-statistic probability of 0.035, which is less than the 5% critical value. The prospect of spurious regression is ruled out by the circumstance of Durbin-Watson statistic being greater than the coefficient of determination. There is solid proof of debt-overhang as shown by a statistically negative connection between foreign debt and real economic growth. A 100% expansion in foreign debt results in 47.1% reduction in real economic performance.
This means that external debt accumulation retards economic performance in the short-term, and in the long-term. Clements, Bhattacharya, and Nguyen (2003) found similar results. However, domestic debt is found to negatively affect the real growth rate of South Africa although the effect is noteworthy in the short run. In addition, budget shortfall and the price level are found to influence economic performance negatively, as far as short run period is concerned. The results of this are evident in the coefficients, which are negative and factually significant. The coefficient of the gross fixed capital formation recorded a positive value of 0.0117, and it is statistically insignificant at 1% level of significance. A 100% expansion in gross fixed capital formation will increase real economic growth by 1.17%. The relationship is supported by the multiplier effect of national income, which states that initial injection of investment will produce immense mount in national income, and ultimately revive growth rate. The ECM coefficient printed a negative value of -0.642, signifying statistical significance, and suggesting that speed of acclimation to equilibrium consequential to a shock is roughly 60%. These findings are consistent with Mhlaba and Phiri (2017) findings, which affirmed negative short-term impacts amid growth and public debt.

Residual Diagnostics.
To confirm the legitimacy of the model assessed, the examination further checks for the presence of sequentially correlated disturbances utilizing the Breusch-Godfrey LM test. The test assumes that the residuals are not serially correlated, herein referred to as the null hypothesis. The computed probability coefficient is 0.424, which is more than 5% critical value, indicating null hypothesis acceptance. Because the model has no serial correlation, this model is desirable. Furthermore, the calculated probability value for the F-statistic is more than 5%, indicating homoskedasticity rather than heteroskedasticity. This implies a constant variance in the residuals, which is a desirable or good indication. The White test also confirms that the model does not suffer from heteroskedasticity because the

probability value is higher than 5% critical value. Accordingly, table 5 results suggest that model residuals have the desired statistical property of homoscedastic variances.

Table 7 Residual Diagnostics tests

Null hypothesis	F-Statistic	P-value	Decision
Residuals are not autocorrelated	0.623	0.424	Do not reject
Residuals are homoscedastic	1.691	0.123	Do not reject
The model is correctly specified	0.843	0.423	Do not reject

Source: Author's computations

From the Ramsey reset test. The null hypothesis state that the model is correctly specified. This came because of the p-value which is greater than the 5% level of significance. Therefore, the model is correctly specified.

Conclusion

This study investigated the effect of public debt on growth of the South African economy, as far as a set objective is concerned. Different techniques of econometrics were applied in the analysis that is ARDL bound cointegration, ECM, Granger causality test, ARDL model and CUSUM. The study obtained annual data (1961-2020) from different sources including SARB and World Bank for explanatory variables, to achieve the objectives set here-in. The ARDL co-integration test found that the investigated variables had a long-term relationship. It turns out that the relationship between FDE, DDE, CBD and INF and GDP are negative in the short and long-run, while GFCF revealed that a relationship with GDP is positive. The ECM model confirmed that these variables have a short-run relationship in the series and that the system can adjust to the equilibrium at a speed of 60%. The study recommends that South Africa needs to improve its productive capacity and infrastructure to raise exports, which in turn, will increase investment resources and reduce reliance on debt, and the economy should grow without reliance on debt. The policy makers should consider a route of investing in capital as a technique to expand the production capacity of the South African economy.

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