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The relationship between government debt and economic growth in South Africa with specific reference to Eskom

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Abstract

The increasing level of government debt continues to be one of the most contestable topics since the great recession due to its effect on growth; however, a consensus is yet to be achieved on the topic. The current study investigated the economic effects of deteriorating South African government debt for the period 1994 to 2019 with the application of the autoregressive distributed lag model by Pesaran et al. (1999), which generates efficient results in the presence of cointegration, yielding unbiased long-run estimates. In contrast to similar empirical studies, the analysis of Eskom's output on growth was found to be crucial. The bounds test exhibited that the regressors were cointegrated in the long run. The results infer that in the short run, government debt has a positive but weak influence on the economic growth rate. Although negative in the long run, debt does not Granger-cause growth. The results also showed that Eskom's output was negatively associated with economic growth in the long run and that government debt Granger-caused Eskom's output level.

Keywords: South Africa; Eskom; public debt; economic growth; ARDL and bound test

1 Introduction

The current study investigated the economic effects of ballooning South African (SA) government debt together with the debt of the state-owned enterprises (SOEs) from 1994 to 2019. The study also paid attention to the economic effects of Eskom output, which endured inefficiencies, as widely reported in the local media. Government debt is described in two categories as *gross debt*: the total amount of government liabilities requiring future payment of the interest incurred on debt, and the principal amount to the creditor. Additionally, the net government debt is described as the disparity between gross debt and the total value of assets, and is further divisible into domestic and foreign debt according to the international monetary fund (IMF) (2016). The level of gross government debt is conventionally presented as a debt-to-GDP ratio (debt over GDP), reflecting indebtedness as a percentage of the gross domestic product (GDP), also a principal indicator of the sustainability of government finances. This study assumed that government incurs debt to finance and facilitate the national economic development requirements and only intervenes in market economy affairs when required to stabilise the economy. Figure 1 below illustrates that, since the first democratic elections in 1994, also after being re-introduced into the global markets, debt levels have grown steadily until 2010, after which both government's borrowing and SOE debt levels grew markedly. The interest payment followed suit. The figure further indicates that the global subprime mortgage defaults, which erupted in 2006 into a global financial crisis, had no noticeable government debt surge. The great recession (GR), which occurred in 2007, left most governments' balance sheets in dire straits, since they were compelled to rescue their financial markets by financing the banks and increasing government expenditures. Ultimately, debt hit unprecedented levels. Globally, 60% of countries experiencing spiralling public debt levels since the GR are enduring below pre-crisis economic growth rates (see Chen et al. 2019); therefore, these conditions are not exclusive to South Africa.

This study data obtained from resbank repository imparted that since 1994, the average South African economic growth rate was 2.6%, largely due to a strong 3.5% growth rate per annum for four consecutive years from 2004 to 2008; however, since then, the country experienced five recessions resulting in an average growth rate of 0.26% (see Table1 statistical summary in section 4) whilst government debt levels increased threefold (see Figure 1 below). The statistical summary table below also showed that in 2019, the average debt-to-GDP ratio was 42.31% which initially decreased from 47.8% in 1994 down to 26.5% by 2008, retrogressing to unprecedented levels of 62.2% by 2019 (see national treasury 2020). The national treasury report 2019 also, showed that the total value of government revenue continued to diminish, amplifying concerns of unsustainable debt. The unsustainability of government debt is further heightened by surging debt interest payments, which have risen more than three-fold to R182 billion

since 2010, as shown in Figure 1 below. As a result of years of a worsening balance sheet, increasing cost of borrowing, government will be forced to reduce its spending particularly since its credit rating was downgraded to junk status due to increased risk of default on debt repayment (see Moody's 2020). The national treasury 2020 report also showed that the South African government attained favourable borrowing terms, since 92% of the debt is held by domestic investors and the remaining debt 8% held by foreign investors.

Therefore, the worsening SA debt level engaged discipline experts in policymaking and academia to examine the effect of debt on the economy, especially with increasing government financial backing of the SOEs (see national treasury 2020). Eskom is one of the SOEs and is a monopoly producer and supplier of electricity in South Africa. The company also exports electricity to some of the Southern African Development Community (SADC) countries. Eskom is influential in economic activity in South Africa; however, inexplicable making yearly losses, and therefore resolving borrowing enormously from government to continue as a business, worsening public debt (see national treasury 2020). Figure 1 below; illustrate the magnitudes of the escalating government gross debt, the SOEs government funding and the gross debt interest payments. This study date obtained from the resbank repository revealed that the SOEs and interest payment currently contribute approximately 13% and 6.5%, respectively.

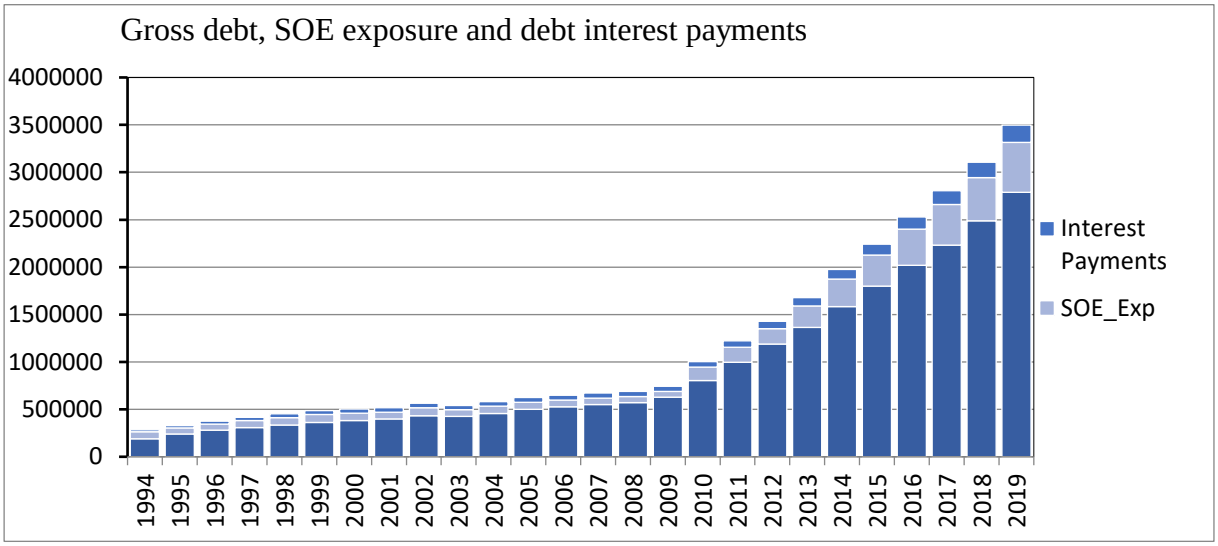

Figure 1: South African public debt, SOE borrowing and debt interest burden

Source: South African Reserve Bank (2020).

The figure above show that debt maybe becoming unsustainable because of the increasing gross debt together with debt interest payments; therefore, prompts debt overhang concerns, which describes increasing interest payments overshooting the GDP (see Krugman, 1988). As shown in Figure 1 above, interest payments are increasing at a fast pace therefore restricts policymakers' fiscal and monetary accommodation abilities. As illustrated in Figure 1, government should be seriously restructuring its debt, which also embodies decelerating spending on public infrastructure; education and healthcare (see Sibeko and Isaacs, 2019). Evidence shows that productive debt improves societal welfare; however, when deployed considerably, reckless debt produces deadweight loss, which is a cost to society (see Cecchetti, S. G., Mohanty, M. S., & Zampolli, F., 2011). The current study investigated the economic effect of public debt in both the short and long term. Additionally, the impact of Eskom's productivity on growth was considered. The study adds to current empirical evidence by finding a non-linear relationship between the level of public debt and growth and proving the crucial role Eskom's productivity plays in economic growth, as detailed in section 5.

This study starts with a literature review section reflecting relevant empirical evidence on the association between public debt and growth considered from a global perspective, then narrows down to South African evidence and concludes with the effect SOEs have on growth. The summary of the literature review produces mixed conclusions on the relationship between public debt and economic growth.

Following the literature review, is the description of the empirical methodology applied in the study, and the data used in estimating the economic effects of debt and SOEs. The results of the study are presented in section 5. The article concludes with a discussion of the findings and the limitations of the study.

2 Literature review

Since the great recession (GR) in 2007, considerable scrutiny and increasing empirical evidence have been presented on the effects of soaring government debt on economic growth. Empirical evidence has engendered debates on public debt effects and the associated inversion rates. These debates involve politicians, policymakers and academia, and are held in parliament conferences and in media forums. The debates revolve around the following three convictions.

- discipline researchers, such as Panizza and Presbitero (2013) holding that public debt is pro-growth overall following the Keynesian perspective, which underpins fiscal expansion policies on infrastructure and social security (Keynes, (1935);
- other researchers deduce that lower government debt levels stimulate growth. However, beyond a particular level, debt begins to impede growth in the long run because, under normal market conditions, increasing deficit spending will compete with private sector investments, resulting in crowding-out in the long run (see Elbadawi, I. A., Ndulu, B. J., & Ndung'u, N. (1997); Ndoricimpa, A. (2020); Reinhart, C. M., & Rogoff, K. S. (2010)). As a result, the association between debt and growth is non-linear and concave. This conviction is in line with the classical perspective, which advocates for balanced government budget and that it should borrow little (see Bernheim, 1989); and
- researchers, such as Zhang (1997) and Guex and Guex (2018), concluding that there is no association between debt level and future GDP. Their evidence supports the Ricardian equivalence (see Abel, 1991), which says that government debt financing efforts to stimulate the economy are ineffective because future aggregate demand will be unchanged since rational agents expect tax hikes. According to Barro (1989), researchers prefer to employ the Ricardian hypothesis only for comparison motives.

Contemporary belief or empirical evidence infers a non-linear relationship between government debt level and growth although most the evidence is generated from low- and middle-income countries (LMICs) since these nations have limited fiscal freedom (see Checherita & Rother, 2010). Consequently, their fiscal flexibility is boosted by foreign investments flowing from developed nations to stimulate their public infrastructure spending. Elmendorf and Mankiw (1998) found a positive correlation between increasing debt and growth in the short run, although the authors report that capital investment would be weakened in the long run, because interest rates will be higher. As a result, a country with large debt levels needs coordination between fiscal and monetary policymakers to keep interest rates low and to keep inflation under control because of the debt service costs. The increasing debt level will exacerbate macroeconomic instability following the financial market crisis (see Koh, Kose, Nagle, Obnsorge, and Sugawara (2020). Therefore, government could expand the tax base and rate to expand revenue receipts in support of debt servicing; yet, higher tax rates generate a deadweight loss to society (see Elmendorf & Mankiw, 1998).

Semjonova (2014) investigated the long-run correlation between government debt level and economic growth. This showed no correlation. However, she found that, in Western Europe, high government debt levels were associated with reduced growth rates at the time, while in South and East Asia; higher debt levels were associated with higher growth. Semjonova (2014) evidence adds to the substantial number of studies declaring a non-linear and concave relationship between increasing government debt and economic growth (see Checherita & Rother, 2010; Reinhart & Rogoff, 2010). These latter authors report that a debt–GDP ratio of greater than 90% in developed countries are associated with reduced growth rates.

According to Krugman (1988), escalating indebtedness increases the risk of debt-overhang, implying that creditors or investors will lend with some expectation that a government will default on the agreed debt repayment plan. Clements, Bhattacharya and Nguyen (2003) investigated the relationship between external debt and economic growth based on information gathered from 55 highly indebted poor income

countries (HIPCs) using data from 1970–1999. This data strengthen the debt-overhang anxiety, and Clements et al. (2003) conclude that increasing debt has a detrimental influence on the growth rate at a specific threshold level of 25% of the GDP net present value of external debt and approximately 50% of the GDP for the face value of debt.

Research by Reinhart and Rogoff (2010) found a link between inflated public debt, growth and the inflation rate using public debt data covering the period 1946–2009 from 44 countries comprising 20 advanced and 24 emerging economies. Reinhart and Rogoff (2010) infer the existence of a non-linear relationship between debt and growth attributed to acutely rising interest rates when the debt of a country extends beyond manageable levels needing fiscal adjustments in the form of tax hikes and spending cuts. Reinhart and Rogoff (2010) also reported a turning point of debt-to-GDP between 60% and 90% in developed countries, eliciting that beyond the threshold point, increasing government debt depletes growth. The authors also found a 60% debt–GDP level for emerging economies beyond which growth slumps significantly. Reinhart and Rogoff (2010) state that the turning point for emerging markets was lower relative advanced markets because the emerging markets were dependent on external borrowing. Herndon, Ash and Pollin (2014) corroborate the findings by Reinhart and Rogoff (2010) using Reinhart and Rogoff's (2010) original dataset concentrating on 20 developed economies. Herndon et al. (2013) unveiled coding errors, selective exclusion of data, and unorthodox weighting of summary statistics in the study by Reinhart and Rogoff (2010), as a result, Reinhart and Rogoff (2010) inference was imprecise. Reinhart and Rogoff (2013) acknowledged the errors reported in Herndon et al. (2013). The re-estimated results by Herndon et al. (2013) reasserted the non-linearity evidence between debt and economic growth; however, they declared a considerable higher turning point of 120% debt–GDP in developed economies.

Adding to the debate is the research by Elbadawi et al. (1997) on the impact of external debt on economic growth and investment using a quadratic model with the application of data from 99 developing countries from the following regions, sub-Saharan Africa (SSA), Latin America, Asia and the Middle East. Elbadawi et al. (1997) found a positive relationship between debt and GDP up to the ratio of 97% and that beyond this ratio, growth decreases – more so in the SSA region. Elbadawi et al.'s (1997) findings were underpinned by Ndoricimpa (2020), although Ndoricimpa (2020) describes a lower turning point of 62–66% compared to 97% reported by Elbadawi et al. (1997).

2.1 South African evidence

A study by Baaziz, Guesmi, Heller, and Lahiani (2015) on the effects of debt on growth in South Africa describes a turning point of 31.7% debt–GDP level, inferring that government debt has a positive effect on economic growth up to the level of 31.7% debt–GDP and debt level above this threshold negates growth.

2.2 State-owned enterprises

Holz (2011) researched the impact of state-owned enterprises (SOEs) on economic growth in China by applying Hirschman's unbalanced growth hypothesis (see Hirschman, 1958). Holz (2011) found that SOEs influence growth through linkage at national level and that this influence does not exist at regional level. An investigation by Odhiambo (2009) found a bi-directional causality between electricity consumption and economic growth in South Africa. However, no causality found by Dlamini, Balcilar, Gupta, and Inglesi-Lotz (2015) in their investigation of the causality between electricity consumption and economic growth in South Africa on data from 1972–2009 by applying a bootstrap rolling window estimation technique (see Dlamini et al., 2013); also see (Härdle, Horowitz and Kreiss (2003) and Politis (2003). Research by Khobai (2018) inferred causality flowing from economic growth to electricity consumption in the long run using panel data from the BRICS countries (i.e. Brazil, Russia, India, China and South Africa), thus, supporting the evidence by Odhiambo (2009). The study by Bildirici, Bakirtas and Kayikci (2012) found causality flowing from electricity consumption to economic growth in contrast to Khobai (2018), Dlamini et al. (2013) and Odhiambo (2009).

2.3 Summary

The debt level of a country distinctly affects its economic growth performance, attributable to unique economic conditions. The debt level of a country and its economic performance can be attributed to

many factors; therefore, the economic effects of government debt remain complex to decipher (see International Monetary Fund (2018). Most empirical evidence is generated on government debt ratio effects, which helps discern between the low and high debt levels (see International Monetary Fund (2012). However, this study's literature review showed that most such studies employed variant estimation techniques. Moreover, there is no consensus on the estimation technique and the optimum threshold (see International Monetary Fund (2012). This study's literature review evidence offers a balanced approach to South African policymakers since current debt levels may be unsustainable leading to macroeconomic instability.

3 Empirical model

The current study investigated the influence of increasing South African public indebtedness on economic performance, and concentrated on the impact Eskom's productivity has on growth. The study employed the internal growth model developed by Romer (1986). Romer's internal growth model regards economic growth in the long run as an increasing function of external economic forces, such as technological advancements supported by government's policies rather than internal factors advocated by neoclassical growth models (see Solow, 1956).

The Romer model is expressed as follows:

$$Y_t = f(AK_t) \qquad 1.1$$

where Y_t is the output variable, A stands for the economy-wide knowledge, and K is the total capital stock (see Romer (1986) and Jones (2019).

The current study held that, since the country is still developing, incremental government expenditures are directed at investing in productive inputs, such as the accumulation of productive machinery, enhancing labourer knowledge, skills, and improving labour productivity economy-wide (see Fleischhauer (2007). Economic growth accelerates as per fundamental and proximate causes of growth theory (see Davoodi and Zou 1998; Snowdon and Vane, 2005). The central government is also assumed to be influential in the types of projects financed in line with the findings (Davoodi and Zou (1998). These latter authors researched the effects of fiscal fragmentation in developed and developing nations and found that in developing countries, fiscal fragmentation was negatively associated with growth; however, in developed nations, fiscal fragmentation was growth neutral. Government debt impedes economic growth performance, measured as real GDP. This is also expressed as real GDP per capita derived by dividing real GDP by population size (see Mohr, Yu, and Mollentze (2016). Economists use the real GDP per capita index (see Mohr et al. (2016) to measure prosperity of the nation in guiding policymakers on how the economy is growing or contracting in per capita terms (see Mohr et al. (2016) and (Osberg & Sharpe, 2011).

The model used in the current study is expressed in equation 1.2 below, and what follows is a description of selected variables of the model:

- Y_t is the dependent variable being economic effects or growth rate;
- Y_{t-1} stands for the effect of lagged independent variable;
- $Gross\_debt_t$ stands for gross government debt;
- $lgwatts_t$ stands for Eskom production; and
- $linflation_t$ stands for inflation.

$$Y_t = f(Y_{t-1}, lgross\_debt_t, lgwatts_t, linflation_t) \qquad 1.2$$

Furthermore, Eskom continues to borrow significant amounts of money from government, which in turn worsens the government debt level; therefore, the expectation is that Eskom will utilise funds to boost the supply electricity and without power surges, also reducing load shedding. The funding of Eskom by government indirectly supports economic activity and growth; thus, spurs the country to catch up with the developed countries on per capita income terms (Gerschenkron, 1962) also see Mueller and Mueller (2016); Vu and Asongu (2020).

4 Empirical methodology

The current study applied an autoregressive distributed lag (ARDL) model by Pesaran and Shin (1999), which is an ordinary least square (OLS)-based estimation technique because of its advantages for both non-stationary time series data and a mixed order of integration (see Pesaran and Shin (1999). Odhiambo (2015) employed the ARDL model researching the causality between government expenditure and economic growth in South Africa. An ARDL model is also preferred for lagged internal and external variables in small finite datasets whilst producing unbiased long-run estimates (see Pesaran, Shin and Smith, (2001). The ARDL model is specified below in equation 1.3 in a log-linear form:

$$\mathrm{lrGDP_t} = \gamma_{0i} + \alpha_1 \mathrm{lrgdp_{t-1}} + \alpha_2 \mathrm{lgross\_debt_t} + \alpha_3 \mathrm{lgwatts_t} + \alpha_4 \mathrm{Inflation_t} + \varepsilon_{it} \quad 1.3$$

In the equation –

- the $\mathrm{lrGDP_t}$ variable is the dependent variable (growth);
- γ_0 stands for a constant term;
- $\alpha_1 \mathrm{lrgdp_{t-1}}$ represents a lagged dependent variable effect;
- $\alpha_2$lgross_debt represents gross debt;
- $\alpha_2$lgwatts represents Eskom's electricity output;
- $\alpha_4$inflation represents the rate of inflation; and
- ε_t is an error term.

Before estimating the ARDL model output, it is crucial to run the bounds test (see Pesaran et al., 2001) to examine the long-run relationship of the variables in the model. The bounds test is distinguished for its efficiency in small sample size, also allowing OLS estimation in the presence of cointegration (see Pesaran et al., 2001). The bounds test is right if external variables are I(0), I(1) or mutually integrated although not suitable for I(2) variables (Pesaran et al., (2001)). The current study used the error-correction model (ECM) (see Engle and Granger, 1987) and Kuo, 2016) which is recommended if two or more variables are bound together (see Pesaran et al., 2001) to estimate the long-run relationship of variables, as shown in equation 1.4:

$$\Delta lrgdp_t = \gamma_0 + \sum_{t=1}^{p} \gamma_1 \Delta rgdp_{t-1} + \sum_{t=1}^{q} \gamma_2 \Delta lgross\_debt_{t=1} + \sum_{t=1}^{q} \gamma_3 \Delta lgwatts_{t=1} + \sum_{t=1}^{q} \gamma_4 \Delta linflation_{t=1} + \lambda ECT_{t=1} + \varepsilon_t \quad 1.4$$

Equation 1.4 above shows exponents p and q, which represents the lag of a dependent variable and independent variables respectively. The λ sign represents the long-run coefficient and adjustment speed (see Rao, 2007).

The bounds test hypothesis testing was as follows:

The null hypothesis: there are no long-run relationships between variables implying no cointegration

$$H_0 : \beta_1 = \beta_2 = \beta_3 \quad 1.5$$

The alternative hypothesis: there are long-run relationships between variables implying cointegration

$$H_A : \beta_1 \neq \beta_2 \neq \beta_3 \quad 1.6$$

The bounds test outcome is displayed in Table 4 below, and its F-statistic value was contrasted against the lower bound and upper bound of the tabulated critical values (Pesaran et al., 2001). If the F-statistic value is greater than the upper bound, critical values indicate cointegration, and if smaller than the lower bound, critical values indicate no cointegration (see Pesaran et al., 2001).

5 Data description

The current study employed time-series data, which covered the period from 1994 to 2019. The variables of the current study model were as follows: real GDP ($\mathrm{lrgdp_t}$), the ratio of gross government debt to GDP ($\mathrm{lgross\_debt_t}$), Eskom's electricity production represented by $\mathrm{lgwatts_t}$, and the consumer price index measure shown as $\mathrm{linflation_t}$. The current study data were drawn from the following three reliable data repositories:

- the resbank.co.za supplied the following annually published variables:

$rgdp_t$, its percentage change, gross government debt. The codes for these variables were KBP6006Y, KBP6006Z and KBP4114F respectively (see resbank, 2020).

- Statistics South Africa (Stats SA) supplied Eskom output lgwatts, which is published monthly (see Stats SA, 2020). The lgwatts variable had to be converted into annual data using Eviews software frequency converter.
- the World Bank open data repository provided the annual inflation data (see World bank open data, 2020).

Eviews11 was the statistical software used for transforming data into logarithmic form for interpretation purposes, and Microsoft Excel was used for plotting all the graphs and the tables. The time-series data showed 26 observations per variable.

6 Empirical results

The study's statistical summary of the time series is presented below in Table 1, which shows 26 observations per variable in their natural forms. The statistics summary revealed that the real growth had averaged 2.65% since 1994, which was consistently below the desired growth rate of 5% or 6% per annum (see Stats SA, 2020) reflecting a considerable high standard deviation of 1.74% (see Stats SA, 2020). The average debt to GDP ratio was 42.31%, with a maximum of 62.2% and a high standard deviation of 9.2% (see resbank, 2020). Eskom's output averaged 16 970 gwatts reaching a maximum of 19 288 gwatts with a standard deviation of 1894.77 gwatts although a deeper analysis revealed a 10% decrease in the production of electricity since 2012 and showing no signs of recovery (see Stats SA, 2020).

Table 1: Statistical summary of the time series

Variable	Observations	mean	Standard Deviation	Maximum	Minimum
rgdpt (%)	26	2.65	1.74	5.6	-1.5
gross_debtt (%)	26	42.31	9.15	62.2	26.5
gwattst	26	16970.83	1894.77	19288.08	12903.25
inflation (%)	26	5.83	2.35	10.06	-0.69

The correlation of the time series is shown in Table 2 below. The variable correlation matrices revealing that the coefficients are appropriately signed. Debt and Eskom's output are negatively correlated with real growth, and Inflation is positively associated with real growth.

Table 2: The correlation of the time series

Variables	$rgdp_t$	$gross\_debt_t$ (%)	$gwatts_t$	$inflation_t$ (%)
$rgdp_t$	1.0			
$gross\_debt_t$	-0.70	1.0		
$gwatts_t$	-0.01	-0.43	1.0	
$inflation_t$	0.02	0.05	-0.45	1.0

Figure 2 below illustrate the relationship between the GDP per capita (%) and government debt. Plotted on the x-axis in Figure 2, is the debt to GDP ratio, with the real growth per capita on the y-axis. The GDP per capita index is a metric that breaks down the economic output of the country per individual and is computed by dividing the GDP by the population size (see Mohr et al., 2016). Economists use this index to gauge the productivity of a country also the index used for cross-country productivity comparison (see Bartelsman, Haltiwagner and Scarpetta, 2013). In Figure 2, the histogram graph shows the impact of increasing government indebtedness on the real GDP per capita from 1994 to 2019. It

shows that, as the government debt-to-GDP ratio increased, the GDP per capita increased and peaked at 31.4% debt-to-GDP and above 31.4%, the GDP per capita decreased. Additionally, incremental debt hindered growth until the 47.4% level, beyond which per capita growth turned negative with the exception being the years 1994 and 1995 when growth was positive. The study data also revealed that the country experienced six recessions since 1994 and one 0% growth year (2015), with all these events being associated with higher debt levels. South Africa is an unequal nation and, as illustrated in Figure 2, higher government debt levels exacerbated inequality and poverty. The resolve of the current study was to decipher the effects of spiralling government debt on growth rather than proving the growth turning point. The turning point in Figure 2 below is identical to the threshold of 31.37% estimated by Baaziz et al. (2015), in which they used real GDP data compared to real GDP per capita data used in this study. The IMF (2012, p109) affirms, "there is no single threshold for debt ratios that describes bad from the good debt ", therefore, the Figure 2 should be interpreted with caution.

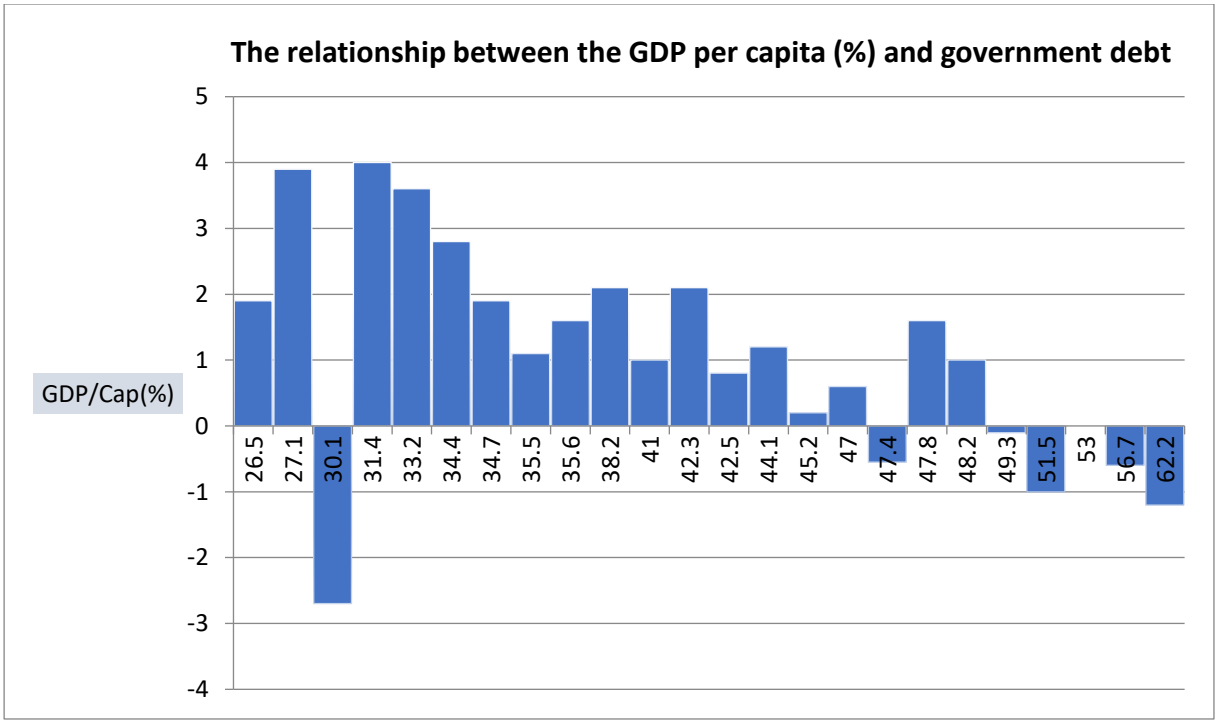

Figure 2: Relationship between the GDP per capita (%) and government debt
Source: South African Reserve Bank (2020).

The augmented Dickey–Fuller (ADF) test was conducted with an intercept and a trend, and was followed by the cointegration test in the form of a bounds test. The ADF test results show that that all variables are I(1). The $lrgdp_t$ and $linflation_t$ variables were significant at the 5% level and the lgross_debt and lgwatts variables were also statistically significant at the 1% level; therefore, the null hypothesis, which indicated the existence of a unit, was rejected.

Table 3: The ADF unit root tests outcome

Log levels				First difference				
		Intercept	Intercept & trend			Intercept	Intercept & trend	
Variable	AIC lag	stat	stat	Variable	AIC lag	stat	stat	I(d)
LRGDP	0	-1.23	-0.43	ΔLRDGP	1	-4.83***	-4.25**	I(1)

Lgross_Debt	1	-0.86	-0.08	ΔLgross_Debt	0	-2.39	-3.21	I(0)
				Δ^2Lgross_Debt	**0**	**-6.29*****	**-6.18*****	**I(1)**
Lgwatts	3	-1.28	-0.32	ΔLgwatts	2	-1.33	-5.08***	I(1)
Linflation	0	-4.13***	-3.12	ΔLinflation	5	-2.56	-3.87**	I(1)

*** Statistically significant at the 10% level**

**** Statistically significant at the 5% level**

***** Statistically significant at the 1% level**

7 Model estimates

The series was integrated into an order I(1), allowing running an ARDL estimation technique, as recommended by Nkoro (2016). After specifying the ARDL model (1,2,2,0) and obtaining the short-run estimates, the bounds test (Pesaran et al., 2001) was conducted for cointegration on all four vectors. The bounds test results, revealed that three regressions were cointegrated with the F-statistic above the upper bound of the 1% critical level whilst the debt variable was not cointegrated. As a result, both the short-run and long-run relationships were estimated using the ARDL technique and error correction model (ECM) (see Pesaran and Shin (1999), Engle and Granger, 1987) and Kuo, 2016).

Table 4: The bounds test outcome

Dependent variable	Model	F-statistic	1%	5%	10%	
			I(0) I(1)	I(0) I(1)	I(0) I(1)	Outcome
F(lrgdp, lgwatts, lgross_debt, linflation)	ARDL(2,2,2,0)	4.87	4.29 - 5.61	3.23 – 4.35	2.72 - 377	Y
F(lgross_debt: lrgdp, lgwatts, linflation)	ARDL(1,1,1,1)	0.9	4.29 – 5.61	3.23 – 4.35	2.72 – 3.77	N
F(Lgwatts: lgross_debt, lrgdp, linflation)	ARDL(2,1,0,0)	5.91	4.29 – 5.61	3.23 – 4.35	2.72 – 3.77	Y
F(linflation: lrgdp, lgross_debt, lgwatts)	ARDL(1,0,2,0)	3.46	4.29 – 5.61	3.23 – 4.35	2.72 – 3.77	Y

The ARDL long- and short-run relationships were estimated, and are presented in Table 5 below. Disclosed first are the long-run relationships in Table 5. The coefficients are interpreted under the all things being equal assumption (see Persky, 1990) which simplifies reality by considering the impact of one variable at a time whilst holding the impact of all other variables constant.

The l**gross_debt** variable was negatively associated with real growth, and its estimated coefficient was 5.28. There was long-run causality from debt to real growth, and the inference was that a 1% increase in the level of government debt decreased real growth by 5.29 percentage points holding everything else constant. This result was statistically significant at the 1% level in the long run. The results support the evidence of Baaziz et al. (2015) and Odhiambo (2015). Additionally, a Granger causality test was conducted and revealed that gross debt does not Granger-cause real growth.

Eskom's output (lgwatts) was negatively associated with growth in the long run, and the coefficient was at negative 4.01. Real GDP and Eskom had a powerful positive correlation of 0.97, which was statistically significant at the 1% level; therefore, being cognisant of the fact that Eskom output continued to decline since 2007, the inference was that a percentage decrease in Eskom's output hampered real growth by 4.01 percentage points. This result was not statistically significant. There was also no Granger causality between the two variables (i.e. $rgdp_t$ and $lgwatts_t$). One can confidently assume that when Eskom's output increases, this will have a positive effect on growth.

The l**inflation** variable was negatively associated with growth with a coefficient of 0.27. The inference was that in the long run, a percentage increase in inflation decreases real growth by 0.4 percentage point;

however, the result was not statistically significant. The result upholds empirical evidence by Hodge (2006) and Bittencourt et al. (2015) on inflation and growth relationships. The long-run model results are displayed in Table 5 below.

Table 5: The ARDL long-run model results

Model: ARDL (1220)				
Dependent variable: D(LRGDP)				
Variables	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
LGROSS_DEBT	-5.28267	1.621001	-3.258894	**0.0068*** **
LGWATTS	-4.059491	2.932251	-1.384428	0.1914
LINFLATION	-0.265474	0.363315	-0.7307	0.479
*** denotes 1% significance level				
** denotes 5% significance level				
* denotes 10% significance level				

The short-run dynamic findings are presented in Table 6 below, and reveal that inflation variable was negatively associated with growth in retains sign both the short run and long run. The lagged dependent variable results agreed with the priori expectations with reference to the sign and statistical significance. The priori is the assumption that the current growth rate is dependent on the past growth rates (see Keele and Kelly, 2006).

At log level, government debt was positively associated with growth by 0.39 percentage points, and the lagged debt variable predicts a negative influence on the growth rate by 5.12 percentage points, which is statistically significant at the 1% level. This implied that a percentage increase in government debt would hurt economic growth.

At log level, Eskom output had a positive coefficient of 15.17; thus, inferring that a percentage increase in Eskom's output would boost growth by a significant 15.17%. However, its lagged output predicted detrimental effects on growth by 11.58 percentage points, and both coefficients were statistically significant at the 5% and 1% significance levels respectively.

The inflation variable was also negatively associated with growth by 0.25, inferring that a percentage increase in inflation hampered real growth by 0.25 percentage points, although not statistically significant but this is in line with the literature evidence, which infers a negative relationship (see Andres & Hernando, 1997).

The equilibrium correction term coefficient was correctly signed at negative 0.97 and was statistically significant at the 1% significance level. This implied that the reversion to long-run equilibrium after a shock was at an adjustment speed of 97%.

Table 6: ARDL short-run model results

Model: ARDL (1220)				
Dependent variable: D(LRGDP)				
Variables	**Coefficient**	**Std. error**	**t-statistic**	**Prob.**
C	58.56043	11.88507	4.927225	0.0003

LRGDP(-1)	-0.968636	0.262741	-3.686654	0.0031
D(LGROSS_DEBT)	0.399161	2.125805	0.187769	0.8542
D(LGROSS_DEBT(-1))	-5.116984	1.482706	-3.451113	0.0048
D(LGWATTS)	15.17251	5.330469	2.846374	**0.0147****
D(LGWATTS(-1))	-11.57651	7.516642	-1.540117	0.1495
LINFLATION	-0.257148	0.337165	-0.762676	0.4604
CointEq(-1)*	-0.968636	0.196299	-4.9345	**0.0003*****

*** denotes 1% significance level

** denotes 5% significance level

* denotes 10% significance level

After estimating the short-run relationships, a Granger causality test of all the model variables was conducted. The test results are shown in Table 7 below, revealing no causality between debt and real growth for two lags; however, causality existed when lagged once, which was significant at the 1% level. Table 7 Granger causality result described a statistically significant unidirectional causality from government debt to Eskom output, which is statistically significant at the 5% significance level. There is also a causal relationship from real growth to inflation, which was statistically significant at the 5% level.

Table 7: The Granger causality tests

Pairwise Granger causality tests

Sample: 1994 to 2019

Lags: 2

Null hypothesis:	**Obs**	**F-statistic**	**Prob.**
LGROSS_DEBT does not Granger-cause LRGDP	21	2.06839	0.1589
LRGDP does not Granger-cause LGROSS_DEBT		0.40153	0.6759
LGWATTS does not Granger-cause LRGDP	21	0.32132	0.7298
LRGDP does not Granger-cause LGWATTS		1.3628	0.2841
LINFLATION does not Granger-cause LRGDP	18	0.27888	0.761
LRGDP does not Granger-cause LINFLATION		5.20947	**0.0218**
LGWATTS does not Granger-cause LGROSS_DEBT	24	1.17507	0.3303
LGROSS_DEBT does not Granger-cause LGWATTS		4.00885	**0.0353**
LINFLATION does not Granger-cause LGROSS_DEBT	21	1.80608	0.1962
LGROSS_DEBT does not Granger-cause LINFLATION		0.86788	0.4387
LINFLATION does not Granger-cause LGWATTS	21	0.03864	0.9622
LGWATTS does not Granger-cause LINFLATION		1.94683	0.1751

8 Conclusion

The current study contributes to the continuing complex debate on the worsening impact of government debt on growth in South Africa. It also focussed on the impact of SOEs (in this case, Eskom) on growth. As shown, the South African debt level, interest payment, even with SOEs debt guarantees, continues

to deteriorate since 2010. The summary of the statistics showed that the economy has experienced a suboptimal growth rate of 2.65% per annum since 1994 with higher-than-average rates before 2008. After that, a continued period of lower growth rates or negative rates followed, implying a negative relationship with increasing state indebtedness. Approximately 55.5% of South African citizens lived in poverty in 2015 (see Stats SA, 2015). Figure 2 above showed that higher government debt is associated with decreased income per capita; therefore, millions more are forced into poverty each year due to increased government indebtedness. Government spending beyond its means cripples social welfare; therefore, authorities must stick to the optimal spending level, enhancing social welfare and quality of life.

The current study employed the ARDL bounds testing model of cointegration, assessing the short-term and the long-term economic effects of government debt, Eskom production output and inflation. The bounds test outcome proved that the regressors were bound together in the long run.

The estimated model results showed that the lower level of government debt positively affects real growth in the short term; however, growth declines as the debt levels increase in the long term. Higher long-term debt impeded growth by 5.28 percentage points, which is significant at the 1% level. Figure 2 above strengthened this evidence as it illustrated that, beyond the 31.4% debt-to-GDP level, incremental government debt negates growth. The conclusion therefore is that government debt and growth exhibit a non-linear relationship endorsing evidence generated by Baaziz et al. (2015). The study did not find Granger causality between government debt and real growth after two lags; therefore, one cannot conclude the existence of a direct and strong relationship between government debt and growth. However, adjusting the lag to 1, government debt had a unidirectional causal effect on growth significant at the 5% level. The study also found a unidirectional causality from government debt to electricity production, which was statistically significant at the 5% level.

Eskom output positively influences economic growth in the short run; however, dwindling production levels together with load shedding hamper growth in the long run. In the short run, Eskom productivity influences growth by 15.17 percentage points at a decreasing rate of 11.58 percentage points, which is statistically significant at the 5% level. Moreover, in the long run, Eskom output hampered growth by 4.05 percentage points, although this was not statistically insignificant. The conclusion is that Eskom production plays a vital role in the South African economy and this study discovered a perfect positive correlation of 0.97 with the growth rate (Sarkodie & Adams, 2020). The short-term data conclude a strong causality from growth to Eskom output; therefore, one can conclude that a growing South African economy influences Eskom productivity, strengthening evidence generated by Khobai (2018) and Odhiambo (2009). The current study also found a direct and significant influence by government debt on Eskom's output, which is significant at the 1% level. The inference is that for government to stimulate the economy (indirectly), an optimal and consistent Eskom electricity supply would boost higher growth levels. Moreover, the SA government must commit to productive debt guarantees in financing Eskom rationally in the manner of reforming or modernising its productive capacity on a collective with its management and regulators.

Inflation hurts growth in the short run and the long run by 0.26% percentage points although not statistically significant. The study found that real growth Granger-causes inflation at a statistically significant level of 5%. Study data indicate that some of the higher growth rates coincided with higher inflation rates of greater than 5% at a lower than 48% debt-to-GDP ratio. Despite South African inflation being within range of the monetary policy-targeted rate (Coco & Viegi, 2016); the results imply that the monetary policy authorities have a challenging task achieving a lower but growth-positive inflation level.

The current study used three reliable data repositories and dropped other variables of interest due to multicollinearity (see Allen, 1997). The relationship between public debt and growth continues to be challenging and varies from country to country. As the literature review section showed that several of these studies used different models in estimating the relationship between debt and growth. Therefore, further research is recommended on the most appropriate modelling technique also research on factors impeding linkage, such as institutional quality, corruption, structure, and public debt composition.

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