Is public debt harmful towards economic growth? New evidence from South Africa

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IS PUBLIC DEBT HARMFUL TOWARDS ECONOMIC GROWTH? NEW EVIDENCE FROM SOUTH AFRICA

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ABSTRACT: The issue of whether public debt is useful or harmful towards economic growth is one of the most prevailing debates in the literature with no consensus existing on the subject matter. The study employs the ARDL model to examine the long-run and short-run effects of public debt on economic growth for South African data spanning a period between 2002:q2 to 2016:q4. Our sensitivity analysis consists of re-estimating our empirical regressions using two sub-samples dataset corresponding to the pre-crisis period (i.e. 2002:q1 to 2007:q2) and the post-crisis period (i.e. 2007:q3 to 2016:q4). All estimated regressions unanimously find negative long-run debt –growth relationship although the short-term effects are unclear with some evidence of a positive short-run relationship between the time series specifically in the post-crisis period. Overall, our empirical results have some useful ramifications towards policymakers.

Keywords: Public debt; Economic growth; ARDL cointegration; Financial crisis; South Africa.

JEL Classification Code: C32; C51; H60; O40.

1 INTRODUCTION

Following the sub-prime crisis of 2007, a prominent area of much contention within the macroeconomic paradigm concerns the effects of government debt on economic growth. The financial turmoil of 2007, which arose as an outcome of the crashing of the US housing market and the subsequent failure of the US banking system, eventually led to the global recession period of 2009. Since then governments worldwide have battled to recuperate from the aftermath of the crisis, with a number of policymakers worldwide developing contingency plans dependent primarily on fiscal intervention. The global crisis and malaise have brought about large government debt positions that are more harmful than crowding out and this is illustrated by the sovereign debt default situations reached by several European countries that have required massive bail-outs by international financial institutions (Mabugu, 2013). So even though at face value it would appear that the adverse effects of the credit crunch have been more severe for Western and other industrialized economies, the effects of the crisis on developing countries certainly cannot be taken for granted.

Historically, African economies have been characterized by fiscal government who have acquired high debt levels owed to external creditors such as the International Development Association (IDA), African Development Bank (ADB), International Monetary Fund (IMF) and other international financial institutions. This dependence on debt as demonstrated by African economies resonates mainly due to the failure of governments in these countries to finance much required expenditure programmes solely through the collection of tax revenues. Therefore, African government s have been compelled to borrow mainly through the channels of issuing of bonds, treasury bills and other debt securities which are considered to be very safe financial instruments towards international investors. Consequentially, such government borrowing is intended to stimulate the economy by investing funds from foreign investors into the domestic economy. However, the overall cost of debt towards African government has been long of concern to academics and policymakers alike and the question of whether public debt is helpful or harmful towards economic growth lies at the centre of this debate. In particular, whilst it is acknowledged that public borrowing is inevitable towards the

financing of fiscal activities in African economies, it is notable that severe debt management practices may outweigh any potential welfare benefits that could have been gained through such borrowing.

Thus in our study, we focus our empirical efforts on investigating the empirical relationship between government debt and economic growth for the South African economy using data spanning through the post-democratic period of 1994 to 2016. For the case of South Africa, as the largest and arguably the most developed economy in the Sub-Saharan African (SSA) region, the issue of the effects of debt on growth have been a lingering one. Since the democratic transition of 1994, fiscal authorities have been charged with the gruesome task of eradicating the social ills of the country. Since then government has successfully brought down the debt-to-GDP ratio down from 46 percent of GDP in 1994 to 22 percentage of GDP in 2007 and yet economic growth rates have also significantly improved from roughly 3 percent in 1994 to 5.6 percent in 2006. However, the global financial crisis has caused debt levels to almost double from 23 percent of GDP in 2008 to 45 percent of GDP in 2015 whereas economic growth rates have slightly deteriorated from 3 percent in 2008 to 1.3 percent in 2015. In 2013, fiscal authorities implemented two main expenditure programmes, the New Growth Path (NGP) and the New Development Plan (NDP), which are keen on simultaneously improving economic growth rates and reducing debt-to-GDP ratios as part and parcel of a wider range of intermediate goals aimed at eradicating unemployment and poverty over the next couple of decades.

In differing from a majority of empirical studies previously conducted for the South African economy (i.e. Amoateng and Amoako-Adu (1996); Fosu (1999); Iyoha (1999); Pattillo et al.; Hussain et al. (2015); Baaziz et al. (2015) and Akinkunmi (2017)), we use the ARDL model which presents certain advantages in comparison to other conventional cointegration models. For instance, the integration properties of the time series is less of a concern under the ARDL framework which allows for cointegration relations between a mixture of I(0) and I(1) variables. Moreover, the ARDL model performs exceptionally well with small sample sizes. This latter feature of the model is particularly important when performing our sensitivity

analysis in which the empirical data will be split into two smaller sub-samples corresponding to the pre and post financial crisis periods. Furthermore, our study differs from a majority of previous studies which employ panel techniques in their analysis. The results from these studies tend to generalize their empirical findings for a wide range of countries with different individual characteristics hence rendering country specific studies a safer alternative in investigating the debt-growth relationship for South Africa

Against this background, we arrange the rest of the paper as follows. The following section of the paper presents the theoretical and empirical review of the associated literature whereas section 3 of the paper outlines the empirical specifications and ARDL models used in our study. Section 4 presented the empirical data and results whilst the study is concluded in the section 6 of the paper in the mainly form of policy implications.

2 LITERATURE REVIEW

2.1 Theoretical review

Within the academic paradigm there three schools of thought which have denominated the exposition on the subject matter. The first hypothesis is the Keynesian hypothesis which argues for a positive effects of public debt on economic growth. According to this school of thought/these theorists, budget deficits exert a crowding in or expansionary effect on the economy. In particular, budget deficits are argued to increase aggregate demand, which in turn leads to higher private savings and investment (Van and Sudhipongpracha, 2015). However, such a positive debt-growth relationship can only occur if the finance obtained from public borrowing is accompanied by "productive government spending' such as public infrastructure expenditure.

The second school of thought comes courtesy of neo-classical economist who argue that public debt creates crowding out effects which only exist in the short-run since tax burdens are transferred to future generations. In particular, these theorists hypothesize on budget

deficits simultaneously causing an increase in private consumption as well as a decline in personal savings and investment which ultimately results in a decline in economic growth. The resulting negative debt-growth relationship is further attributed to two underlying theories namely, the debt overhanging theory of Krugman (1988) and the liquidity constraint hypothesis. On one hand, the debt overhanging theory states that high debt acts as a tax on future output and reduces incentives for savings and investment whilst, on the other hand, the liquidity constraint hypothesis states that the requirement to service debt reduces funds available for investment purposes, hence a binding liquidity constraint on debt would restrain investment (Fosu, 1999).

The last school of thought is the Ricardian-equivalence theory as popularized by Barro (1989) which hypothesizes on debt bearing no significant effects on economic growth. Advocates of this view argue that repayment of acquired government debt will take place through future taxation and thus individuals, who are rational beings, will increase their savings through acquiring government issued securities. In particular, this occurs since individuals will sacrifice and reduce current consumption in order to pay for future tax burdens. This results in aggregate demand to be the same as if government had chosen to increase tax now and not later, and ultimately this leaves steady state interest rates and private consumption unaffected (Mosikari and Eita, 2017).

2.2 Empirical review

To say the least, the literature is abundant with empirical works which have examined the relationship between public debt and economic growth. Much of the available literature has focused on Latin American countries (see Sen et al. (2007) for 5 Latin American countries; Bittencourt (2015) for 9 South America countries), OECD and other industrialized economies (see Panizza and Presbitero (2014) for 17 OECD countries; Kempa and Khan (2015) for G7 countries; Gomez-Puig and Sosvilla-Rivero (2015) for EMU-11 countries) as well as Asian countries (see Chowdhury (1994) for 7 Asian-Pacific countries; Duad and Podivinsjy (2014) for Malaysia; Bal and Rath (2014) for India; Van and Sudhipongpracha (2015) for Vietnam;

and Akram (2016) for 4 Asian countries) with no concrete consensus being drawn from the literature. Nevertheless, for the sake of brevity and relevance, we shall restrict our review to studies which have included South African data within the empirical analysis. We find that these studies can be broadly segregated into two strands of literature, the first being panel studies which have included South African within a host of other countries in their empirical analysis and the second being country-specific studies on the South African economy.

The first cluster of studies include the works of Amoateng and Amoako-Adu (1996) for 35 African countries; Fosu (1999) for 35 Sub-Saharan African (SSA) countries; Iyoha (1999) for 50 African countries; Pattillo et al. for 93 developing countries; Hussain et al. (2015) for 48 Sub-Saharan African (SSA) countries and Akinkunmi (2017) for 22 Sub-Saharan African (SSA) countries. In summarizing the findings of this literature, we observe that the studies of Iyoha (1999), Hussain et al. (2015) and Akinkunmi (2017) advocate for a negative relationship between government debt and economic growth hence implying that policymakers should note be concerned with accumulation of high levels of debt as such external sources of finance are important for growth. On the other hand, the work of Fosu (1999) find an insignificant relationship between debt and growth hence urging policymakers to implement debt management policies and programmes as a means of securing long-term economic growth.

Under the second classification of empirical studies, being the country specific studies, we note that the works of Baaziz et al. (2015) is the only study that falls under this category, that is, to the best of our knowledge. In adopting a rather unique approach, the authors employ a smooth transition regression (STR) framework to model the nonlinear correlations between debt and growth. In particular, the finding of the study point to debt levels of 31.37 percent which are harmful to economic growth. Policymakers are thus advised to lower debt ratios to 31.37 percentage of economic growth. Other studies which advocate for a similar nonlinear relationship include the works of Reinhart and Rogoff (2010) for 44 countries; Eberhardt and Presbitero (2015) for 118 countries. However, in wholly taking the above reviewed literature into consideration, we conclude that the currently available literature has not produced a unified

consensus on the effects of public debt on economic growth for South Africa hence warranting further deliberation on the subject matter.

3 METHODLOGY

In investigating the debt-growth relationship the simplest estimation regression found in the literature involves estimating a bi-variate empirical regression between the time series (Amoateng and Amoako-Adu (1996); Panizza and Presbitero (2014); Kempa and Khan (2015); and Gomez-Puig and Sosvilla-Rivero (2015)). Typically such regressions assume the following function form:

$$GDP_t = \alpha + \beta_1 DEBT_t + e_t \quad (1)$$

Where GDP is a measure of economic growth, DEBT is a measure of government debt and e_t is a well-behaved error term. As previously discussed, the coefficient on the debt variable can be either positive (i.e. Keynesian hypothesis), negative (i.e. Neo-classical hypothesis) or insignificant (i.e. Ricardian-equivalence hypothesis). However, bi-variate regressions like that represented by equation 1 are prone to being criticized on the basis of the omitted variable bias. Therefore, multivariate regression specifications have become a more popular alternative approach in terms of econometrically estimating the debt-growth relationship. These multivariate regression commonly assume the following regression specification:

$$GDP_t = \alpha + \beta_1 DEBT_t + \beta_2 X_t + e_t \quad (2)$$

Where the vector X_t represents a matrix of growth determinants which are typically chosen on the basis of traditional growth theory. One of the most popular growth determinants found in the literature is investment, which according to conventional dynamic growth theory is the engine of economic growth and is thus considered to be positively correlated with growth. Henceforth we employ investment as our first control variable. Another popular control variable found in the literature which we use is the inflation rate which in the South African

context provides a direct measure of monetary policy outcomes on economic growth due to the Reserve Bank's adopted inflation targeting mandate of 3 to 6 percent. From theoretical perspective the effects of inflation on growth has been predominately assumed to be negative although some early theorists argued on a positive relationship (Tobin, 1965) or an insignificant relationship (Sidrauski, 1967). Our final control variable is terms of trade which provides the most convenient measure of degree of openness. Following the global liberalization of markets as experienced in the 1990's, the role which trade activity plays on economic development has intensified. According to traditional growth theory, higher degree of trade openness should result in improved economic growth. Nevertheless, during periods of crisis, more open economies may be more vulnerable towards absorbing the adverse effects of the crisis hence openness may adversely affect growth during these periods. Having identified plausible control variables for our vector X_t, we can specify our final multivariate estimation regression as:

$$GDP_t = \alpha + \beta_1 DEBT_t + \beta_2 INV_t + \beta_3 INF_t + \beta_4 TOT_t + e_t \quad (3)$$

Where INV is investment, INF is inflation and TOT is terms of trade. As mentioned earlier on, we employ the ARDL model of Pesaran et al. (2001) as our choice of econometric modelling and firstly re-specify the bi-variate as represented in equations 1 as the following ARDL and error correction model (ECM) specifications:

$$\Delta GDP_t = \sum_{i=1}^{n} \phi_1 \Delta GDP_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta DEBT_{t-i} + \beta_1 GDP_{t-i} + \beta_2 DEBT_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta GDP_t = \sum_{i=1}^{n} \phi_1 \Delta GDP_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta DEBT_{t-i} + \gamma_1 ECT_{t-i} + u_t \quad (5)$$

Whereas the multivariate regression (3) is re-specified as the following ARDL and error correction model (ECM) specification:

$$\Delta GDP_t = \sum_{i=1}^{n} \phi_1 \Delta GDP_{t-i} +$$
$$\sum_{i=1}^{n} \phi_2 \Delta DEBT_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta INV_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta INF_{t-i} + \beta_1 GDP_{t-i} + \beta_2 DEBT_{t-i} +$$
$$\beta_2 INV_{t-i} + \beta_2 INF_{t-i} + \varepsilon_t \quad (6)$$

$$\Delta GDP_t = \sum_{i=1}^{n} \phi_1 \Delta GDP_{t-i} +$$
$$\sum_{i=1}^{n} \phi_2 \Delta DEBT_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta INV_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta INF_{t-i} + \gamma_1 ECT_{t-1} + u_t \quad (7)$$

Where β_i's are the long-run regression coefficients, ϕ_i's are the short-run coefficients and ECT's are the error correction terms which measure the speed of adjustment back to steady-state equilibrium in the face of external shocks to the economy. The error correction terms are assumed to lie within an interval (0, -1) although there are some exceptional cases where the coefficient can be allowed to be lie between -1 and -2. Incidentally, significant negative error correction terms indicates long-run causality from the regressor to the regressand variable. However, prior to estimating our ARDL models it is imperative that one tests for cointegration effects. To this end, the study uses the bounds test for cointegration effects which tests the joint null hypothesis as:

$H_0: \beta_1 = \beta_2 = \ldots = \beta_i = 0 \quad (8)$

And this is tested against the alternative hypothesis of significant ARDL cointegration effects i.e.

$H_0: \beta_1 \neq \beta_2 \neq \ldots \neq \beta_i = 0 \quad (9)$

The test is tested with an F-statistics which is compared to the upper and lower bound critical values tabulated in Pesaran et al. (2001). The decisions rule states that cointegration are assumed if the obtained F-statistics exceeds the upper bound of the critical statistics, no cointegration if the F-statistics lies below the lower bound of the critical value and is indecisive if the F-statistics lies in between the lower and upper critical bound.

4 DATA AND EMPRICAL RESULTS

4.1 Data description and unit root tests

The data used in our study has been collected from the Federal Reserve Economic Data (FRED) and South African Reserve Bank (SARB) online databases over a quarterly period of 2002:q2 to 2017:q4. The dataset consists of gross domestic product (GDP), nominal government debt (debt_n), gross government debt (debt_g), total CPI inflation (INF), gross domestic fixed investment (INV) and terms of trade (TOT). Note that our study employs two measures of debt, those being, gross debt and net debt as a percentage of GDP. The summary statistics for the employed time series are reported in Table 1 whilst the correlation matrices between gross debt, GDP and other growth determinants are reported in Table 2 whilst those between net debt, GDP and other growth determinants are reported in Table 3.

The summary statistics reveal that both gross and net debt have averaged 37.20 and 32.74 percent of GDP, respectively, having reached maximums of 51.60 and 45.70 percent of GDP in 2016 whilst recording record lows of 26.00 and 21.70 percent of GDP, respectively, in 2008. We note from the relatively high standard deviations, the government debt has been quite volatile over the sample period. Economic growth, as measure by GDP has averaged 2.75, reaching a maximum of 7.4 percent in 2005 whilst reaching a low of -6.1 percent in 2009. We observe that the reported GDP averages are much lower than the 6 percent target commonly stipulated or prescribed in policy programmes. Encouragingly enough inflation has averaged 5.77, a statistic which falls right within the upper bound of the SARB's 3 to 6 percent target. Lastly, domestic investment has averaged 17 percent as a share of GDP, a statistic which highlights the problem of low investment levels currently experienced in the country whilst the low growth average of 0.21 for terms of trade is of policy concern.

Table: 1: Summary statistics of the time series

	Debt_g	Debt_n	GDP	INF	INV	TOT
Mean	37.20	32.74	2.76	5.77	19.26	0.67
Median	35. 10	32.60	2. 70	5. 90	19.40	0.40
Maximum	51.60	45.70	7. 40	14.10	25.30	7.50
Minimum	26.00	21.60	-6.10	-1.60	15.00	-4.80
Std Dev	7.56	7.06	2. 63	3.22	2.16	2.88
Skewness	0.38	0.25	-0.66	0.52	0.08	0.28
Kurtosis	2.09	2.11	3.76	3.81	3.29	2.70
Jarque Bera	3.60	2.52	5.85	4.39	0.27	1.02
Probability	0.16	0.28	0.05	0.11	0.87	0.59

As can mutually observed from the correlation matrices reported in Tables 2 and 3, all correlation coefficients produce negative estimates with the exception of the correlation between inflation and domestic investment whose correlation coefficient is positive. A majority of these correlations are plausible that is, from a theoretical perspective, we do notice that the negative correlation found between trade and growth contradicts conventional theory which hypothesizes on openness being beneficial for growth. Nevertheless, this seemingly 'strange' negative correlation between trade and growth has been previously documented for South Africa in the works of Phiri (2017). Moreover, the correlation coefficients between the various variables produces moderate estimates hence ruling out any preliminary evidence of multicollinearity.

Table 2: Summary statistics of the time series

	Debt_g	GDP	INF	INV	TOT
Debt_g	1				
GDP	-0. 27	1			
Inf	-0. 13	-0. 15	1		
Inv	-0. 12	-0. 45	0. 26	1	
TOT	-0. 09	-0. 03	-0. 15	-0. 05	1

Table 3: Summary statistics of the time series

	Debt_n	GDP	INF	INV	TOT
Debt_n	1				
GDP	-0. 22	1			
Inf	-0. 16	-0. 15	1		
Inv	-0. 26	-0. 45	0. 26	1	
TOT	-0. 07	-0. 15	-0. 15	-0. 061	1

To check the stationarity of the underlying variables the study uses the ADF, PP and DF-GLS unit root tests which are performed with i) an intercept and ii) a trend, and the results of this empirical exercise being reported in Table 4. AS can be seen, the unit root test results produce mixed empirical evidences. For example, in their level, gross debt, net debt and terms of trade all fail to reject the unit root null hypothesis for all unit root tests regardless whether performed with an intercept or with a trend. On the other hand, inflation fails to reject the unit root hypothesis when all unit root tests are performed with an intercept and only for the PP test when performed with a trend. For GDP, on the DF-GLS test performed with either an intercept or with a trend manages to reject the unit root null hypothesis in it's levels whilst the other test statistics fail to reject the unit root null hypothesis. Last, for investment in it's levels, only the DF-GLs tests performed with an intercept manages to reject the unit root null hypothesis. Nevertheless, in their first differences, all the time series manage to reject the unit root hypothesis for a majority of the observed time series. There are, ofcourse, some exceptions which exist in which the variables in the first difference do not reject the unit root null hypothesis, like for the investment variable when the test are performed with a trend and also concerning the gross debt as well as the net debt variables when the ADF and PP test are performed with an intercept as well as when the ADF is performed with a trend. Collectively, were are able to conclude that none of the observed time series is convincingly integrated of an order higher than I(1), hence permitting us to proceed with our ARDL empirical modelling.

Table 4: Unit root tests results

	Intercept			Trend		
	ADF	PP	DF-GLS	ADF	PP	DF-GLS
GDP	-2. 09	-2. 13	-2. 19**	-2. 71	-2. 57	-2. 94*
ΔGDP	-4. 52***	-5. 99***	-4. 55***	-4. 46**	-7. 82***	-4. 77***
Debt_g	-0. 87	-0. 48	-1. 02	-0. 99	-1. 04	-1. 88
ΔDebt_g	-2. 14	-1. 95	-2. 22**	-1. 95	-3. 49*	-2. 46*
Debt_n	-1. 62	-0. 99	-1. 59	-1. 18	-1. 09	-2. 11
ΔDebt_n	-1. 66	-1. 62	-1. 72*	-1. 67	-3. 21*	-2. 32
INF	-0.39	-0.79	-1. 10	-3. 38*	-2. 32	-3. 79***
ΔINF	-3.64**	-2. 47	-3. 77***	-4. 40**	-5. 14***	-4. 99***
INV	-2. 07	-1. 49	-1. 93*	-2. 00	-1. 21	-2. 33
ΔINV	-4. 66***	-5. 64***	-4. 96***	-2. 60	-2. 44	-2. 82
TOT	-1. 20	-1. 24	-0. 81	-1. 44	-1. 44	-1. 69
ΔTOT	-3. 51**	-3. 50**	-3. 64***	-3. 55*	-3. 72**	-3. 83***
Critical levels						
1% level	-3. 67	-3. 64	-2. 63	-4. 30	-4. 26	-3. 77
5% level	-2. 96	-2. 95	-1. 95	-3. 57	-3. 55	-3. 19
10% level	-2. 62	-2. 61	-1. 61	-3. 22	-3. 20	-2. 89

4.2 ARDL modeling estimates

Having confirmed that our employed series are not integrated of an order equal to or greater than order I(2), we proceed to model our ARDL regressions. As a first step in this process, we conduct bounds test for cointegration on our four empirical specifications. The suitable lag length for each regression is based on the Schwarz information criterion (SIC). As can be deduced from the results reported in Table 6, all regression specifications significantly reject the null hypothesis of no ARDL cointegration relations amongst the variables. In particular, we find that each of the computed F-statistics exceeds the upper bound of the 1 percent critical level hence indicating cointegration effects at all significance levels. In light of these optimistic results, we can estimate the long-run and short-run ARDL relationships for each of our specified regressions.

Table 5: Bounds test for cointegration

Specification	Selected model	F Statistic	5%		1%	
			I(0)	I(1)	I(0)	I(1)
F(GDP| Debt_n)	ARDL (1, 0)	4. 34	3. 62	4. 16	4. 94	5. 58
F(GDP| Debt_n, INF, INV, TOT)	ARDL(1, 0, 3, 10)	5. 86	2. 56	3. 49	3. 29	9. 37
F(GDP| Debt_g)	ARDL (1, 0)	5. 77	3. 62	4. 16	4. 94	5. 58
F(GDP| Debt_g, INF, INV, TOT)	ARDL (1, 0, 3, 1, 0)	5. 65	2. 58	3. 49	3. 29	4. 37

Our empirical long-run and short-run ARDL estimates are presented in Table 6. As can be observed from the long-run estimates reported in Panel A of Table 6, the coefficient on public debt on all four regression is negative and significant at all critical levels. This piece of empirical evidence offers support in favour of the Neo-classical hypothesis for the South African economy and also joins a host of previous empirical studies which have found a similar negative debt-growth relationship for South African data (Amoateng and Amoako-Adu (1996); Fosu (1999); Iyoha (1999); Pattillo et al.; Hussain et al. (2015) and Akinkunmi (2017)). We also notice that the remainder of the long-run coefficients are similarly negatively related with economic growth at all significant levels. Whilst the finding of a negative inflation-growth relationship is theoretically expected and is previously documented in the study (Hodge 2002, 2006), the findings of a negative investment-growth and trade-growth relationship is contradictory to growth theory. However, we do not dismiss our empirical findings since former studies of Phiri (2017) found a similar negative investment-growth ad trade-growth relations for similar South African data.

In turning our attention to Panel B of Table 6 which reports the short-run coefficients as well as the error correction terms for all estimated models. We firstly note that debt remains negatively and significantly related with growth across all estimated regressions. However, for the remaining variables in the multivariate regressions (i.e. model 2 and 4), the results differ between the different measures of public debt. In particular, when net debt is used (i.e. model 2) inflation is still negative and significantly related with growth whilst investment and terms

of trade are positively related with growth. However, when gross debt is employed (i.e. model 4), both inflation and investment produce positive and statistically significant coefficients whilst terms of trade is negative and significant at all critical levels. We lastly, not that all error correction coefficients produce the correct negative and statistical significant estimates ranging between -0.48 and -0.74 implying that between 48 and 74 percent of deviations instigated by external shocks are corrected in each time period over the long-run.

Table 6: Long run and short run ARDL estimates

	F(GDP| Debt_n)		F(GDP| Debt_n, INF, INV, TOT)		F(GDP| Debt_g)		F(GDP| Debt_g, INF, INV, TOT)	
	coefficient	p-value	coefficient	p-value	coefficient	p-value	coefficient	p-value
Panel A: Long-run estimates								
Debtg	-	-	-	-	-0. 07	0. 00***	-0. 11	0.00***
Debtn	-0. 10	0.00***	-0. 13	0. 00***	-	-	-	-
Inf	-	-	-0. 37	0. 00***	-	-	-0. 38	0. 00***
Inv	-	-	-0. 51	0. 00***	-	-	-0. 45	0. 00***
TOT	-	-	-0. 01	0. 00***	-	-	-0. 01	0. 00***
Panel B: Short-run estimates								
Δ (Debtg)	-	-	-	-	-	-	0.01	0. 00***
Δ (Debtn)	-0. 10	0. 00***	-0. 12	0. 00***	-0. 10	0. 00***	-0. 20	0. 00***
Δ (Inf)	-	-	-0. 21	0. 00***	-	-	1.12	0.00***
Δ (Inv)	-	-	1.10	0.00***	-	-	0.10	0. 00***
Δ (TOT)	-	-	0.01	0. 00***	-	-	-0. 71	0. 02**
ECT (-1)	-0. 48	0. 00***	-0. 74	0. 00**	-0. 48	0.00***	-0.64	0.00***

Notes: "*". "**", and "***" denote the 10 percent, 5 percent and 1 percent significance levels, respectively.

4.3 Sensitivity analysis

To ensure the reliability of our empirical results we take caution and additionally investigate whether the global financials crisis has altered the cointegration relationship between government debt and economic growth. We find such an empirical exercise as being useful since previous studies have not directly considered whether a major structural event such

as the global financial crisis may have altered the debt-growth relationship. Therefore, we split our empirical data into two sub-sample periods, with one corresponding to the pre-crisis period (i.e. 2002:q2 – 2007:q2) and the second corresponding to the post-crisis period (i.e. 2007:q3 – 2016:q4). As can be observed in Table 7, the ARDL bounds test for cointegration as performed on all four regressions in both sub-periods reject the null hypothesis of no cointegration effects at all critical levels hence advocating for cointegration effects before and subsequent to the financial crisis.

Table 7: Bounds test for pre and post crisis periods

Specification	Selected model	F Statistic	5%		1%	
			I(0)	I(1)	I(0)	I(1)
Panel A: Pre-crisis						
F(GDP| Debt_n, INF, INV, TOT)	ARDL(1, 0, 4, 1, 0)	5. 90	2. 56	3. 49	3. 29	4. 37
F(GDP| Debt_n)	ARDL (1, 0)	5. 77	3. 62	4. 16	4. 94	5. 58
F(GDP| Debt_g, INF, INV, TOT)	ARDL (1, 0, 3, 1, 0)	6. 06	2. 58	3. 49	3. 29	4. 37
F(GDP| Debt_g)	ARDL (1, 0)	5. 89	3. 62	4. 16	4. 94	5. 58
Panel B: Post-crisis						
F(GDP| Debt_n, INF, INV, TOT)	ARDL(1, 0, 0, 1, 0)	7. 90	2. 56	3. 49	3. 29	4. 37
F(GDP| Debt_n)	ARDL (1, 0)	6. 14	3. 62	4. 16	4. 94	5. 58
F(GDP| Debt_g, INF, INV, TOT)	ARDL (1, 0, 3, 1, 0)	5. 65	2. 58	3. 49	3. 29	4. 37
F(GDP| Debt_g)	ARDL (1, 0)	5. 54	3. 62	4. 16	4. 94	5. 58

The long-run and short-run ARDL estimates for the four regression in the pre and post crisis are reported in Tables 8 and 9, respectively. In similarity to the results obtained for the full sample, the reported results in Panel A indicate that in both sub-samples public debt exerts a negative effect on economic growth. Moreover, whilst inflation exerts a significantly negative effect in both sub-periods, we note that the sign on the coefficient on the investment variable switches from being negative and significant in the pre-crisis to being positive and significant in the post-crisis. Nevertheless, the important implications drawn from our sensitivity analysis

is that debt adversely influences economic growth in both-sub-periods, a finding which bears important policy implications.

Table 8: Long run and short run ARDL estimates (pre-crisis)

	F(GDP| Debt_n, INF, INV, TOT)		F(GDP| Debt_n)		F(GDP| Debt_g, INF, INV, TOT)		F(GDP| Debt_g)	
	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value
Panel A: Long-run estimates								
Debtg	0	-	0	-	-0. 12	(0.00)***	-0. 32	(0. 00)***
Debtn	-0. 13	(0. 00)***	-0. 18	(0.00)***	0	-	0	-
Inf	-0. 37	(0. 00)***	0	-	-0. 19	(0. 00)***	0	-
Inv	-0. 51	(0. 02)**	0	-	-0. 59	(0. 02)**	0	-
TOT	-0. 00	(0. 00)***	0	-	-0. 06	(0. 05)*	0	-
C	0	-	10. 08	-	0	-	16. 70	-
Panel B: Short-run estimates								
Δ (Debtg)	0	-	0	-	0.10	(0. 00)***	0. 34	(0. 00)***
Δ (Debtn)	-0. 10	(0. 00)***	0. 19	(0. 00)***	0	-	0	-
Δ (Inf)	-0. 26	(0. 00)***	0	-	-0.12	(0. 00)***	0	-
Δ (Inv)	1.15	-	0	-	0.10	(0. 00)***	0	-
Δ (TOT)	-0.01	(0. 00)***	0	-	-0. 02	(0. 02)**	0	-
ECT (-1)	-0. 68	(0. 02)**	-0. 84	(0. 02)**	-0. 77	(0. 02)**	-0. 93	(0. 02)***

Notes: "*". "**", and "***" denote the 10 percent, 5 percent and 1 percent significance levels, respectively.

Table 9: Long run and short run ARDL estimates (post-crisis)

	F(GDP| Debt_n, INF, INV, TOT)		F(GDP| Debt_n)		F(GDP| Debt_g, INF, INV, TOT)		F(GDP| Debt_g)	
	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value	Coefficient	P Value
Panel A: Long-run estimates								
Debtg	0	-	0	-	-0. 11	(0.00)***	-0. 05	-
Debtn	-0. 15	(0. 00)***	-0. 03	(0.00)***	0	-	0	(0. 00)***
Inf	-0. 23	(0. 00)***	0	-	-0. 38	(0. 00)***	0	-
Inv	-1. 08	(0. 02)**	0	-	-0. 45	(0. 00)***	0	-
TOT	-0. 15	(0. 00)***	0	-	-0. 00	(0. 00)***	0	-
C	30. 38	-	2. 63	-	17. 94	-	1. 96	-
Panel B: Short-run estimates								
Δ (Debtg)	0	-	0	-	0.01	(0. 00)***	1. 38	-
Δ (Debtn)	-0. 44	(0. 00)***	0. 08	(0. 00)***	-0. 20	(0. 00)***	0	(0. 00)***
Δ (Inf)	-0. 31	(0. 00)***	0	-	1.12	-	0	-
Δ (Inv)	0.96	-	0	-	0.01	(0. 00)***	0	-
Δ (TOT)	-0.11	(0. 00)***	0	-	-0. 71	(0. 02)**	0	-
ECT (-1)	-0. 99	(0. 00)**	-0. 60	(0. 00)***	0	-	-0. 46	(0. 00)***

Notes: "*". "**", and "***" denote the 10 percent, 5 percent and 1 percent significance levels, respectively.

4.4 Stability analysis and residual diagnostics

The last stage of our empirical analysis involves performing diagnostic tests on the estimated regressions corresponding to the full sample, the pre-crisis and post-crisis periods. Panels A, B and C of Table 10 respectively reports the diagnostic tests (i.e. test for normality, serial correlation, heteroscedasticity and functional form) for the full sample, the pre-crisis and post-crisis periods. We note that all 12 estimated regressions from the entire study mutually reject the null hypothesis of non-normality, autocorrelation, heteroscedasticity and inappropriate functional form. We thus conclude that the empirical regressions comply with the classical regression assumption and can be interpreted with economic meaning.

Table 10: Residual diagnostics on estimated regressions

	F(GDP| Debt_n, INF, INV, TOT)	F(GDP| Debt_n)	F(GDP| Debt_g, INF, INV, TOT)	F(GDP| Debt_g)
Panel A: Full-sample				
J-B	1.49 (0.47)	0.81 (0.67)	1. 07 (0.58)	1.51 (0.47)
B-G	0.55 (0.58)	0.11 (0.89)	0.94 (0.40)	9.46 (0.01)
ARCH	0.00 (0.96)	0.87 (0.36)	0.03 (0.86)	0.77 (0.40)
White	0.76 (0.51)	0.51 (0.76)	2.74 (0.00)	0.51 (0.76)
Reset	4.42 (0.04)	1.84 (0.09)	1.02 (0.31)	0.99 (0.34)
Panel B: Pre-crisis				
J-B	0.60 (0.74)	4.11 (0.13)	0.75 (0.68)	4.11 (0.13)
B-G	0.11 (0.90)	0.68 (0.51)	0.18 (0.84)	0.68 (0.51)
ARCH	0.08 (0.78)	1.33 (0.25)	0.10 (0.76)	1.33 (0.25)
White	4.41 (0.12)	2.89 (0.02)	0.47 (0.89)	2.89 (0.02)
Reset	2.12 (0.04)	0.36 (0.72)	2.22 (0.03)	0.35 (0.72)
Panel C: Post-crisis				
J-B	3.95 (0.14)	3.78 (0.15)	0.75 (0.68)	0.24 (0.89)
B-G	1.27 (0.29)	0.27 (0.77)	0.18 (0.84)	0.06 (0.94)
ARCH	0.55 (0.46)	0.81 (0.38)	0.10 (0.76)	0.79 (0.38)
White	0.53 (0.92)	2.72 (0.04)	0.47 (0.89)	3.81 (0.00)
Reset	2.11(0. 04)	0.99(0. 33)	2.22(0. 03)	1.48(0. 15)

Note: p-values reported in parentheses ()

5 CONLCUSION

Following the global financial crisis of 2007 and the resulting global recession period of 2009, much debate has circulated around the issue of whether public debt would serve as a panacea towards improved economic growth. In this study, we investigate the case of the South African economy using post-democratic quarterly data spanning between 2002:q2 and 2016:q4. Our primary mode of empirical investigation is the ARDL cointegration approach of Pesaran et al. (2001) which allows for modeling cointegration relations amongst a mixture of I(0) and I(1) time series. Our empirical results reveal that whilst gross public debt may be beneficial towards short-run economic growth, the long-term effects remain negative. Our results are strengthened by our sensitivity analysis which involved splitting he empirical data into two sub-samples corresponding to the pre-financial crisis (2000:q1 to 2007:q2) and the post-financial crisis periods (2007:q3 to 2016:q4). These latter results reinforce our initial findings of an adverse relationship between public debt and economic growth. Overall, our obtained empirical results have important implications towards policymakers.

The first policy implication derived from our study is that policymakers should be extremely cautious in acquiring high levels of debt and that the adopting/implementation of debt management programmes should form a vital part of policy design. Another policy implication that can be derived from our study is that the global financial crisis did not alter the relationship between public debt and economic growth. Taking into consideration that our empirical analysis covers a post-democratic period, our results specifically imply that since 1994, debt management should have formed a crucial component of policy design in efforts to improve economic growth and the advent of the crisis has not changed this fact. Our study therefore re-insures that policymakers should continue to place emphasis on lowering public dent to levels as a formal part of policy programmes aimed at improving economic growth rates. Future studies could possibly identify different channels through which public debt levels could be lowered, particularly focusing on the post-crisis era.

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