Estimating the optimal growth-maximising public debt threshold for Zimbabwe

N. Mupunga & P. le Roux

A B S T R A C T

This paper attempts to estimate an optimal growth-maximising public debt threshold for Zimbabwe. The public debt threshold is estimated by assessing the relationship between public debt and economic growth. The analysis is undertaken to determine the tipping point beyond which increases in public debt adversely affect economic growth. The paper contributes to the debate on the link between public debt and growth by testing the presence of a Laffer-curve type relationship, where the contribution of public debt to growth is theorised to be positive at lower levels and negative at higher levels of public debt. The analysis confirms the existence of an inverted U-shaped relationship between public debt and economic growth in Zimbabwe. The optimal growth-maximising public debt threshold was estimated at a public debt-to-GDP ratio of between 45 and 50 per cent. The policy implication of the analysis is the need to ensure that public debt management policies are in line with the growth-maximising public debt threshold. This will ensure sustained economic growth and employment rates, which are key tenets for sustainable economic development.

Key words: public debt threshold, growth maximising, Laffer curve

Introduction

There is general consensus that increases in public debt enhance economic growth up to a certain level, beyond which further increases in public debt become a drag on economic growth (Reinhart & Rogoff 2010). At low levels, debt can enhance economic growth by providing much-needed capital. Further increases in debt beyond a certain point, however, lead to lower and possibly negative growth rates.

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This translates into a relationship that can be better approximated by an inverted U-shaped curve, which is also known as the debt Laffer curve. The point at which public debt negatively affects growth provides information on the growth-maximising public debt threshold. Based on this empirical premise, this paper attempts to determine the optimal or tipping point beyond which public debt in Zimbabwe has a negative impact on growth.

The paper complements existing empirical evidence on the relationship between growth and public debt in low-income countries using Zimbabwe as a case study. The paper specifically attempts to test the empirical premise that there is a non-linear relationship between public debt and growth. Zimbabwe makes an interesting case for analysing the relationship between public debt and growth given the existence of a debt overhang, which has been unanimously cited as a major drawback to the country's economic growth prospects (IMF 2012b: 2). A public debt overhang refers to a scenario where higher and unsustainable levels of borrowing by government expose a country to efficiency losses (Megersa 2014: 3). A pronounced debt overhang and the associated cost of servicing it will create difficulties for a country to properly invest its income and foster economic growth. The isolation of Zimbabwe from the international credit community left the country with limited borrowing options, compared to other countries in the low-income category. This scenario presented the country with new and complex challenges to access funding at low cost subject to a prudent degree of risk.

The public debt overhang has mainly affected Zimbabwe's economic growth prospects through its inability to access additional financing to stimulate economic activity. The country's financing requirement also remained extensive, reflecting the need to draw up an ambitious plan to finance capital expenditure and development (Government of Zimbabwe 2013: 25). The inability of Zimbabwe to borrow from concessional sources has seen the government seeking loans from non-concessional sources, including borrowing on the domestic market at higher interest rates. The increasing reliance on domestic debt and non-concessional sources further exacerbated the country's debt overhang. Of particular concern is that such domestic borrowing has been used to finance current expenditures, with very few resources allocated to capital projects (IMF 2012b: 2).

The debt overhang has to some extent undermined the country's credit rating and its ability to attract foreign direct investment, as well as to mobilise direct budget and balance of payments support. Consequently, the country has been denied access to lines of credit critically needed for economic recovery. The debt burden has also been contributing to an increase in the cost of borrowing for both government and the private sector. This development has rendered the economy uncompetitive, with

adverse consequences for the export base, which provides the much-needed liquidity to service the external public debt. The adverse impact posed by the debt overhang highlights the importance of optimal public debt management policies to avoid the costly mistakes of accumulating high public debt levels.

Despite the existence of the large number of publications on public debt overhang, there is still considerable debate on growth-maximising public debt levels. Reinhart and Rogoff (2010) found that a public debt-to-GDP ratio higher than 90 per cent is associated with considerably lower average real GDP growth rates. This finding was challenged by Herndon, Ash & Pollin (2013), who argued that the threshold effect estimated by Reinhart and Rogoff (2010) vanishes after correcting for a coding error and using a different weighting of the data. Kumar and Woo (2010) also claimed to have found some evidence of a non-linear relationship between debt and growth. The higher levels of initial debt have been found to have a proportionately larger negative effect on subsequent growth (Kumar & Woo 2010). Cecchetti, Mohanty & Zampolli (2011) found that beyond 96 per cent of GDP, public debt becomes a drag on growth. Checherita-Westphal and Rother (2010) noted an inverted U-shaped relationship between debt and growth, with a turning point between 90 and 100 per cent. Baum, Checherita-Westphal & Philipp (2013) found that public debt has some non-linear effects on growth, leading to lower growth when it exceeds 95 per cent in the Euro area. Caner, Grennes & Koehler-Geib (2010) found a threshold effect at 77 per cent of GDP using a large sample of countries, with the threshold being lower for emerging markets.

The public debt thresholds for low-income countries are calibrated by the IMF mainly to determine borrowing limits from the IMF and other concessional funds (IMF 2013). The IMF also sets limits on non-concessional external borrowings by low-income countries (LICs) under the IMF-supported programmes. In the IMF's view, these limits are meant to prevent the build-up of unsustainable debt, while allowing for adequate external financing. However, the existence of different growth-maximising public debt thresholds suggests the need for country-specific debt thresholds. The main objective of this paper is, therefore, to estimate the optimal growth-maximising public debt threshold for Zimbabwe. The focus is on optimal public debt instead of the relationship between growth and public debt, which has traditionally been the focus of most empirical research studies. The paper is structured as follows: a brief overview of the relationship between public debt and growth; a review of the empirical literature on the growth-maximising public debt threshold; a discussion of the methodology of the study; presentation of results; and conclusion and policy recommendations.

Brief overview of public debt and economic growth in Zimbabwe

Historically, from 1980 until 2012, Zimbabwe's public debt-to-GDP ratio averaged 55.4 per cent, reaching an all-time high of 105.9 per cent in December of 2008. The slowdown in the public debt-to-GDP ratio from 2008 onwards reflects improvement in capacity to repay as opposed to actual public debt service. The country has not been fully servicing its debt for over a decade, which has culminated in the accumulation of external payment arrears estimated at 60 per cent of GDP in 2012 (IMF 2012b). Generally, public debt as a percentage of GDP is used by investors to measure a country's ability to make future payments on its debt. Figure 1 shows the relationship between economic growth and public debt in Zimbabwe over the period 1980 to 2012.
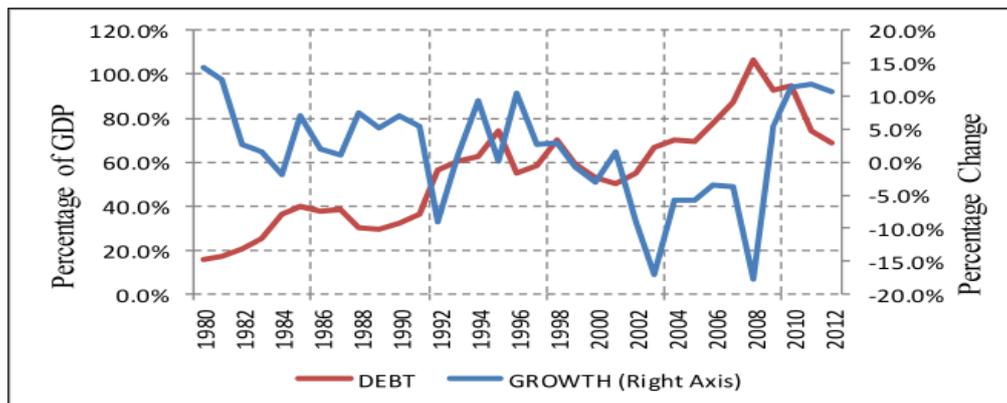
Figure 1: Public debt and economic growth in Zimbabwe

Source: World Development Indicators Database (2013)

Figure 1 shows that economic growth rates have been declining at a time when the public debt-to-GDP ratio was increasing. This suggests a negative relationship between public debt and growth. There is, however, a potential endogeneity problem where the growth in public debt may be attributed to a response by policy-makers to stimulate growth amid declining economic activity. The accumulation of debt to unsustainable levels resulted in the country's failing to access additional new loans for infrastructural development. As a result, the savings and employment rates in the country were severely constrained. This resulted in lower than expected growth rates of the economy. The debt overhang has also led to a huge credit risk premium for both the public and the private sector, resulting in increased cost of funds, with adverse effects on the country's competitiveness.

Moreover, the progressive decline in economic activity over the period 1999 to 2008, due in part to the economic crisis experienced by Zimbabwe from 2000 to 2008, led to a steady rise in the debt-to-GDP ratio. Accordingly, from a backward-looking perspective, the analysis suggests that public debt increased during times of economic recession and slowed down during the post-crisis period. It is apparent that public debt increased sharply between 2000 and 2008 when the economy was in an economic crisis characterised by spiraling hyperinflation. Public debt, however, maintained a downward trend following the adoption of a multi-currency regime in 2009, which was instrumental in fostering economic growth.

Literature review

The literature on the relationship between public debt and growth suggests an inverted U-shaped relationship between these variables. This implies the existence of an optimal growth-maximising public debt-to-GDP ratio. Checcherita-Westphal and Rother (2010) as well as Reinhart and Rogoff (2010) found empirical evidence in support of an inverted U-shaped relationship between public debt and growth. This strand of literature suggests that when the public debt-to-GDP ratio is below a certain threshold, the crowding-in effect dominates the crowding-out effect, and increases in public debt promote economic growth. However, beyond this threshold, public debt will have a negative effect on growth, as the crowding-out effect outweighs the crowding-in effect. The crowding-in effect occurs when increased public sector spending replaces, or drives down, private sector spending, while the crowding-out effect refers to a situation where government borrowing to finance the deficit reduces the quantum of loanable funds available to the private sector, thereby effectively crowding them out. Figure 2 shows the theoretical relationship between economic growth and the public debt-to-GDP ratio.

Figure 2 shows the theoretical tipping (d*) point beyond which public debt has a negative effect on growth. At point d*, further increases in public debt would slow down economic growth. Point d* can, therefore, be considered as the optimal growth-maximising public debt threshold.

The growth-maximising public debt threshold is also in the spirit of the debt Laffer curve introduced in the context of the debt overhang hypothesis (Sachs 1989). The Laffer curve posits that higher debt levels tend to be associated with lower probabilities of debt repayments. The public debt overhang literature asserts that large public debt stocks are expected to lower economic growth rates through the
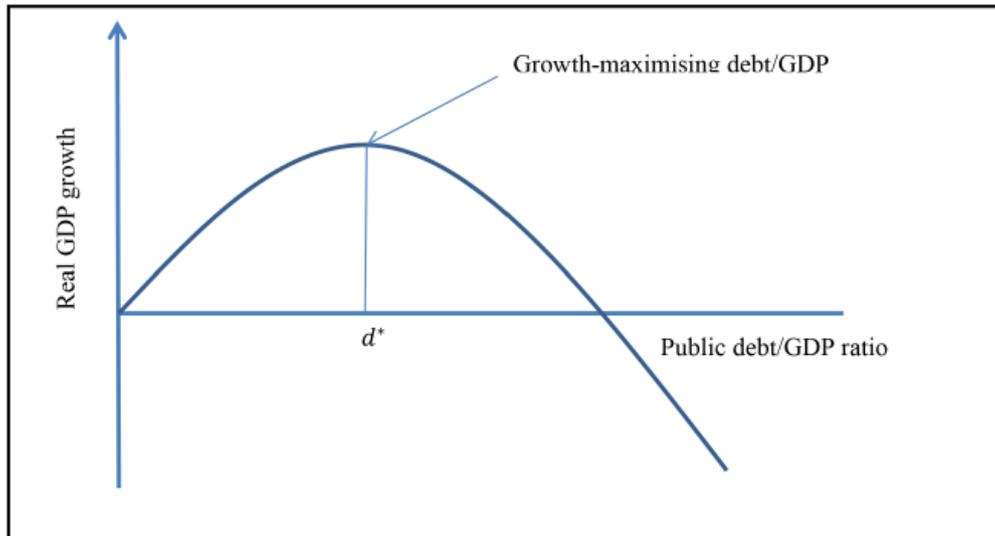
Figure 2: The optimal (tipping) point between public debt and growth

Source: Adapted from Pattillo, Poirson & Ricci (2002)

reduced investment channel. The assertion is that when public debt becomes so large, investment will become insufficiently low, thereby undermining economic growth. Consequently, the debt burden will result in shortages of liquidity, thereby negatively affecting capital formation and economic growth. Krugman (1988) formulated the actual derivation of the Laffer curve and the underlying logic behind it. The reason for the divergence is that the more a country accumulates debt, the harder it becomes to finance it because of the increased servicing obligations, which effectively act as a tax on investment, policy reforms or other activities that require up-front costs in exchange for future benefits (Pattillo, Poirson & Ricci 2002: 3).

Contrary to the growth-maximising public debt literature, Panizza and Presbitero (2013) found that the theoretical models on the relationship between debt and growth yield ambiguous results. Similarly, Greiner (2012) concludes that there is no well-specified model that can generate an inverted U-shaped relationship between debt and growth. Moreover, some researchers have found a strictly negative correlation between public debt and economic growth (Ferreira 2009; Kumar & Woo 2010). This shows that the literature on the link between public debt and growth is not conclusive. Kourtellos, Stengos and Tan (2012) found that the problem with the relationship between debt and growth is that it ignores the problem of endogeneity between these two variables. This implies that the question of whether high levels

of public debt can affect economic growth remains an empirical issue and country specific. This confirms the importance of the present study.

The empirical literature on the relationship between public debt and growth in developing countries has mainly emphasised the impact of external debt and debt restructuring on growth (Checherita-Westphal & Rother 2010). These studies found evidence supporting the existence of a non-linear relationship between external debt and economic growth. Pattillo et al. (2002) used a large panel dataset of 93 developing countries over the period 1969–1998 and found that the impact of external debt on economic growth is negative for net present value of debt levels above 35–40 per cent of GDP. Clements, Bhattacharya and Nguyen (2003) investigated the same relationship for a panel of 55 low-income countries over the period 1970–1999 and found that the optimal point in the net present value of external debt is at around 20–25 per cent of GDP. Schclarek (2004) also investigated the relationship between public debt and GDP growth for a sample of 24 industrial over the period 1970–2002 and found no robust evidence of a statistically significant relationship.

The more common approaches applied to determine the optimal growth-maximising public debt thresholds include the use of spline functions, histograms and threshold estimations. Reinhart and Rogoff (2010) applied a descriptive analysis using data from 44 countries and found a negative relationship between growth and public debt over the period 1790–2009. Their analysis showed that economic growth in advanced countries was around 4 per cent higher for countries with a public debt-to-GDP ratio of less than 30 per cent than for those with a debt-to-GDP ratio above 90 per cent. Reinhart and Rogoff (2010) concluded that countries with a public debt that exceeds 90 per cent of GDP would end up seeing their growth rates falling drastically. The same study found a lower threshold of 60 per cent for external debt of emerging market economies. The analysis by Reinhart and Rogoff was criticised by Herndon et al. (2013), who found that Reinhart and Rogoff had made a coding error. The analysis by Herndon et al. (2013) did not, however, significantly change the results of Reinhart and Rogoff.

Caner et al. (2010) used annual data from 77 countries for the period 1980–2008 to assess the optimal growth-maximising public debt. The analysis found a growth-maximising public debt level of 77 per cent for developed countries and 64 per cent for developing economies. Checherita-Westphal and Rother (2010) applied a panel regression analysis of public debt using data from 12 European countries from 1970 to 2008. Their results revealed a concave non-linear inverted U-shaped relationship between public debt ratios and economic growth rates. Checherita-Westphal and Rother (2010) estimated the optimal growth-maximising public debt to be around 90 per cent, similar to the findings of Reinhart and Rogoff (2010). Greiner (2012), however, shows that the results of Checherita-Westphal and Rother (2012) are driven

by their assumption that the deficit is equal to public investment at each point in time.

Kumar and Woo (2010) found some evidence of non-linearity, with higher levels of debt having a proportionately larger negative effect on subsequent growth. Kumar and Woo (2010) used data for advanced economies from 1970 to 2007 and found that a 10 percentage point increase in the debt-to-GDP ratio is associated with a slowdown in economic growth of 0.15 percentage points. The authors tested for non-linearities between debt and growth by introducing interaction terms between debt and dummy variables for three ranges of debt, namely, 30, 60 and 90. Cecchetti et al. (2011) provided further evidence using data for 18 OECD countries from 1980 to 2010. They found that long-term growth is severely affected when the debt ratio exceeds a public debt ratio of 85 per cent. Egert (2013) applied different time periods of the Reinhart and Rogoff (2010) database from 1790–2009 and found a small negative correlation between debt and growth. Moreover the estimated endogenous debt-to-GDP thresholds were found to be generally much lower than 90 per cent.

A study by Presbitero (2010) for low-income countries over the period 1990–2007 that also included Zimbabwe shows that public debt has a negative impact on growth up to a threshold of 90 per cent of GDP. The IMF (2010) used data for 38 developed and developing economies for the period 1970–2007 and found that the elasticity of growth with respect to debt is -0.02. Their results suggest that the growth-inhibiting effects of a given percentage increase in the public debt-to-GDP ratio can be overwhelmed by a given percentage increase in other growth-promoting variables achieved through public spending. Cordella, Ricci and Ruiz-Arranz (2010) found evidence of debt overhang at net present value of the debt-to-GDP ratios of above 20–25 per cent in countries with sound policies and institutions. However, their analysis shows that the debt overhang becomes irrelevant at debt ratios above 70–80 per cent. They also found evidence of weaker and lower thresholds in countries with bad policies and institutions. The conclusion from their analysis was that investment in countries with high indebtedness does not depend on debt levels.

The various ranges of optimal growth-maximising public debt thresholds show that the literature on optimal public debt remains far from robust. The IMF (2010) noted that the claim that high public debt causes lower growth is not grounded in robust empirical evidence. As noted by the IMF (2010: 7), there is a possibility that the growth-inhibiting effects of increases in public debt can be outweighed by a corresponding growth-promoting variable achieved through public spending. The existence of inconsistent empirical evidence on debt and growth shows that the literature on growth-maximising public debt is still incomplete; this emphasises the importance of further empirical analysis of growth-maximising public debt thresholds.

Methodology

The methodology applied in this paper draws from an econometric analysis of the relationship between public debt and economic growth. The analysis involves estimating a model that relates the economic growth rate to the public debt and other variables. However, since the study seeks to determine whether a non-linear relationship exists between public debt and economic growth, a bivariate quadratic growth equation is estimated and plotted consistent with the approach taken by Checcherita-Westphal & Rother (2012). The model is specified in equation (1):

$$growth_t = \alpha + \beta debt_t + \gamma debt_t^2 + \text{other control variables} + \varepsilon_t \qquad (1)$$

where $growth_t$ is the economic growth rate and $debt_t$ is public debt as a percentage of GDP. Other control variables such as domestic savings, government consumption, openness and gross fixed capital formation are included to improve the model diagnostics. The explanatory variables are expressed as percentages of GDP. The control variables used in this paper are standard variables found to be statistically significant drivers of economic growth in previous empirical literature (Checcherita-Westphal & Rother 2010; Panizza & Presbitero 2013; Wright & Grenade 2014). It should, however, be noted that the purpose is not to assess the drivers of economic growth but to use the link between public debt and growth to determine the optimal growth-maximising public debt threshold.

A crisis dummy variable is also included to account for the crisis experienced by Zimbabwe in the period 2000–2008. The crisis dummy was assigned the value of 1 for the period after 2000 up to 2008 and 0 for the earlier periods and from 2009 onwards. Trade openness, defined as the ratio of total exports of goods and services plus imports of goods and services to GDP, is also included among the control variables. Openness increases a country's vulnerabilities to external shocks, which lowers revenue and growth. The openness variable has a positive impact on economic growth (Berg & Krueger 2003: 37), More open economies are able to generate the trade surpluses needed to service external debt and are less likely to experience difficulties with external public debt (Daniel, Callen, Terrones, Debrun & Allard 2003: 113).

Estimation method

The model is estimated using an instrumental variable approach to avoid the potential reverse causality from economic growth to the public debt ratio. The link between debt and growth could be driven by the fact that low economic growth can

lead to high levels of public debt (Krugman 2010). The lagged terms of regressors are utilised as instruments, and a one year lag is applied for simplicity. The analysis is extended to selected low-income countries for robustness checks. This entails estimating equation (1) using panel regression analysis for data for selected low-income countries in sub-Saharan Africa.

Testing for the presence of an optimal/tipping point

The calibrated optimal growth-maximising public debt threshold is further tested using a threshold approach consistent with the approach of Hansen (1996, 2000). The threshold model is specified as shown in equations (2) and (3):

$$growth_t \;=\; \beta_i X_t + D_t + \varepsilon_t \qquad D_t \leq \gamma \tag{2}$$

$$growth_t \;=\; \beta_i X_t + D_t + \varepsilon_t \qquad D_t > \gamma \tag{3}$$

where D_t is the threshold variable that takes the value of 1 if the public debt-to-GDP ratio exceeds the calibrated growth-maximising public debt threshold (d*) and zero if not, γ becomes the threshold and is the vector of other control variables. The other variables remained the same as in the specified growth model in equation (1).

Data sources

The data are based on the IMF World Economic Outlook (April 2014) and the World Bank's World Development Indicators (2013) databases. The IMF database includes gross government debt-to-GDP and economic growth ratios, including almost all IMF member countries. Table 1 shows the descriptive statistics for the data used in the study.

The descriptive statistics in Table 1 show that Zimbabwe attained a minimum growth rate of -17.7 per cent and a maximum of 16.2 per cent during the period under review. Similarly, the country's public debt-to-GDP ratio averaged 55.4 per cent, while economic growth averaged 2 per cent. The variables of interest, notably the economic growth rate and the public debt-to-GDP ratio, show minimum variation, with the exception of domestic savings and credit to private sector, which show wider variations.

Table 1: Descriptive statistics for Zimbabwe (1980–2012)

	Mean	Median	Maximum	Minimum	Std. dev.	Observations
Economic growth	2.12	1.33	16.24	-17.71	0.07	33.00
Public debt	55.41	56.13	106.42	16.22	0.23	33.00
Government consumption	17.70	17.92	27.49	2.05	5.62	33.00
Domestic investment	14.72	15.57	24.58	2.00	6.59	33.00
Foreign direct investment	0.93	0.35	6.94	-0.45	1.56	33.00
Domestic savings	8.52	13.78	22.08	-21.46	12.61	33.00
Credit to private sector	29.57	28.41	103.63	7.48	16.84	33.00

Source: Researcher's own computations based on World Development Indicators database (World Bank 2013)

Stationarity tests

The time series properties of the data were also explored to inform the estimation of the determinants of growth. The results indicate that all variables are stationary after first differencing at the conventional significance level of 5%. The tests were done using the Augmented Dickey Fuller (ADF) tests; the results are shown in Table 2.

Table 2: Results of unit root tests

	Augmented Dickey-Fuller test	
	Level	First Difference
Public debt/GDP ratio	-1.73798 (0.4033)	-5.31534*** (0.0001)
Domestic savings	2.54812 (0.1141)	7.23569*** (0.000)
Government consumption	2.25971 (0.1905)	5.61673*** (0.0001)
Gross fixed capital formation	0.10184 (0.8646)	4.58812*** (0.0006)
Credit to Private Sector	3.88747* (0.0957)	5.35944*** (0.0001)
Economic growth	2.92756* (0.0836)	6.48047*** (0.0001)

Note: *** indicates significance at 1%, ** significance at 5% and * significance at 10%. Figures in parenthesis are p-values.

Empirical results and discussion

This section presents the empirical results of the estimated growth-maximising public debt threshold. First, a regression equation assessing the drivers of economic growth is estimated in line with the model specification (1). The results of the determinants of economic growth in Zimbabwe are illustrated in Table 3.

Table 3: Long run determinants of growth in Zimbabwe (1980–2012)

Variable	Model (1980–2012)
Constant	6.583*** (0.000)
Public debt/GDP	-0.378** (0.038)
Public debt/GDP squared	-0.084** (0.049)
Openness	-0.021** (0.0374)
Government consumption	-0.009** (0.029)
Credit to private sector	0.006* (0.081)
Domestic savings	0.004*** (0.026)
Crisis dummy	-0.028** 0.042
Gross fixed capital formation	0.011 (0.109)
Autoregressive lag AR(1)	0.962*** (0.000)
Diagnostics	
R-squared	0.946
DW-statistic	1.957
J-statistic	22.000
Prob (J-statistic)	0.009

Note: The figures in parenthesis are probability values, * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

The results from the econometric analysis of the determinants of economic growth show that domestic savings and credit to the private sector have a positive and

statistically significant impact on economic growth, while government consumption, the crisis dummy and openness have significantly negative impacts on growth. The negative coefficient on government consumption suggests that government was pursuing a counter-cyclical fiscal policy by increasing consumption in response to lower growth and reducing it in response to higher growth. The coefficient for the debt-to-GDP ratio shows that for every percentage point increase in the debt-to-GDP ratio, the growth rate of per capita income falls by 0.37 per cent. Moreover, the estimated coefficient of the quadratic form in the estimated growth equation was found to be negative and significant, implying that the results can be plotted on a public debt/growth scatter plot to determine the optimal public debt. These results are consistent with the literature on cross-country growth analysis that found a positive effect of credit to private sector on growth (Levine, Loayza & Beck 2000). The results are also consistent with Barro (1999), who found that growth is inversely related to government consumption. The results show a negative relationship between economic growth and public debt, consistent with the research findings of Megersa (2014).

Although it is common practice to regress economic growth on an array of potential determinants, as shown by the results in Table 3, the usefulness of this approach has increasingly been questioned by a number of empirical studies (Sala-i-Martin 1997; Levine & Renelt 1992). Bosworth and Collins (2003) suggest the need to focus only on a core set of variables of interest and evaluate the importance of other variables conditional on inclusion of the core set (Kumar & Woo 2010: 6). As such, the analysis of the growth-maximising public debt threshold in this paper focused mainly on the link between debt and economic growth.

Optimal growth-maximising public debt threshold

Since the study focuses mainly on the relationship between public debt and economic growth, a bivariate model was estimated to examine the optimal growth-maximising public debt threshold. The plot assists in determining the existence of a Laffer-curve type relationship, where public debt contributes to economic growth up to a certain point (optimal threshold). After this point has been reached, further increases in public debt would start to have a negative effect on growth. The plot from the econometric results of the estimated quadratic bivariate equation (4) is shown in Figure 3.

$$\text{GDP} = 0.07323*\text{DEBT} - 0.08213*\text{DEBT}^2 \tag{4}$$
(0.351) (0.0241) R squared 0.30 DW 1.92
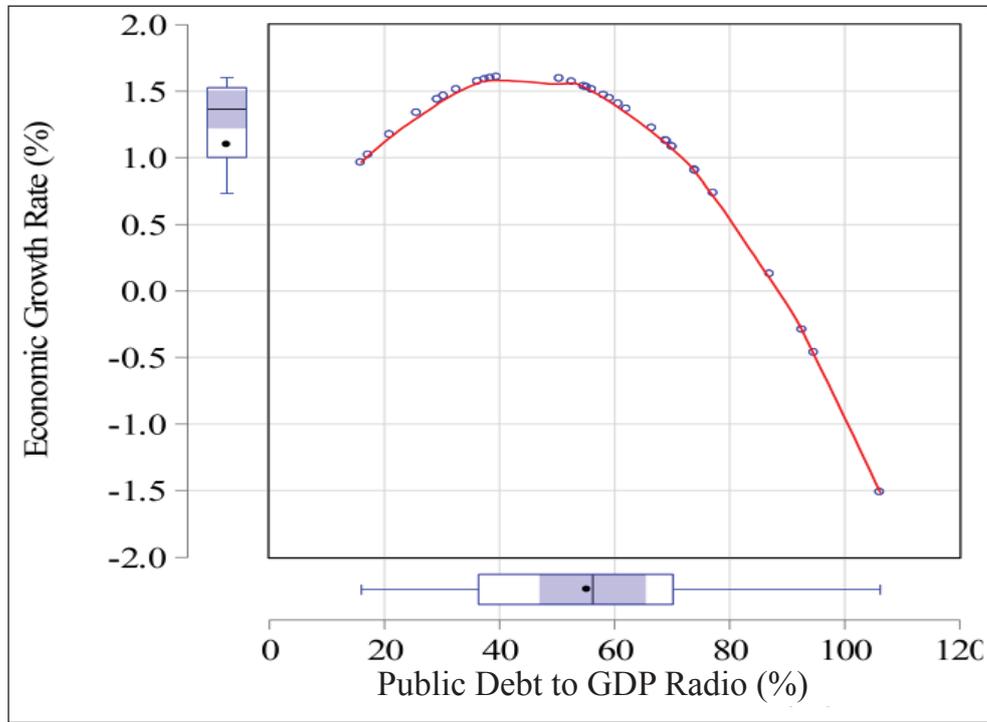
Figure 3: Optimal growth-maximising public debt threshold for Zimbabwe

The chart in Figure 3 depicts a concave or inverted U-shaped relationship between economic growth rates and the public debt-to-GDP ratio. The results suggest that Zimbabwe achieved higher growth rates when the public debt-to-GDP ratio was around 45–50 per cent. Assuming that the past provides a reasonable guide to the future, the 45–50 per cent range could be considered an optimal growth-maximising public debt threshold for Zimbabwe. The results also confirm the debt overhang hypothesis found with respect to the link between external debt and growth in low-income countries (Cordella et al. 2010).

This estimated public debt ratio is higher than the 38 per cent public debt-to-GDP ratio calibrated by the IMF and World Bank (2012: 25) for low-income countries rated weak in terms of country performance and institutional assessment (CPIA). However, as highlighted by Buffie, Berg, Pattillo, Portillo & Zanna (2012: 6), the IMF benchmarks are not based on country-specific fundamentals and are too conservative. There is also a danger that the public debt limits proposed by the IMF stifle potential growth for the economy.

Robustness checks

In addition to assessing the optimal growth-maximising public debt threshold using a quadratic form, other functional forms are assessed to test the sensitivity of public debt thresholds. The analysis was mainly undertaken for robustness checks. The coefficients for the other functional forms were derived from using similar regression specifications. The analysis involves assessing the optimal growth-maximising public debt threshold using powers greater than one (1), as was done in Checherita-Westphal and Rother (2010). The results are shown in Figure 4. All the graphs depict the relationship between public debt-to-GDP ratio and economic growth rates.

The results from applying different functional forms do not significantly change the results obtained using a quadratic form. The results show that the relationship between public debt and economic growth remains concave. Consequently, using different functional forms, public debt-to-GDP ratio turning points are estimated at a range between 45 and 50 per cent. The results also show that lower powers yield slightly lower debt turning points than higher powers. The results are shown in Table 4.

Table 4: Optimal growth-maximising public debt levels

Power	Coefficient debt/GDP	Coefficient debt/GDP power term	Optimal/Tipping point
1.2	0.404** (0.068)	-0.420** (0.058)	45.01
1.4	0.197** (0.053)	-0.212** (0.071)	45.08
1.6	0.128* (0.0741)	-0.141** (0.049)	46.05
1.8	0.094* (0.078)	-0.105** (0.046)	47.06
2.0	0.073 (0.351)	-0.082** (0.024)	48.07
2.2	0.059* (0.089)	-0.067** (0.043)	48.08
2.4	0.050* (0.096)	-0.056** (0.0431)	49.05
2.6	0.043 (0.105)	-0.048** (0.043)	49.11
2.8	0.038 (0.110)	-0.041** (0.043)	50.02
3	0.034 (0.119)	-0.036** (0.045)	50.05

Note: * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

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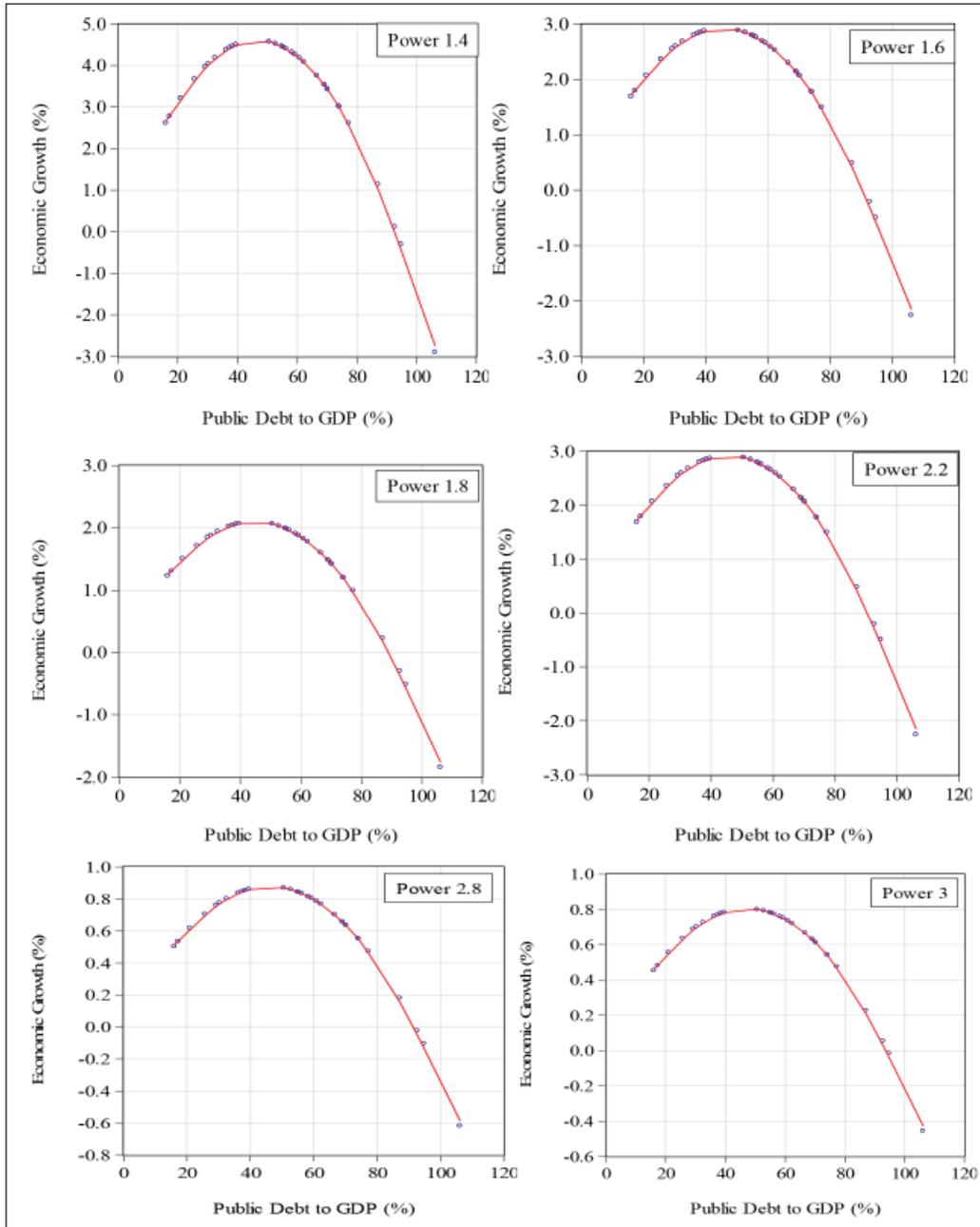
Figure 4: Growth-maximising public debt level for Zimbabwe using alternative functional forms

The results from the quadratic form yield an optimal public debt turning point of about 48 per cent of GDP. The results also show that the coefficient of the public debt remains significant for higher power but yields almost the same tipping point as immediate functional forms. The estimated negative relationship between economic growth and public debt confirms the adverse impact of higher levels of public debt on economic growth. As such, the results rule out the policy option of excessive reliance on borrowing to support economic activity. The results underscore the need to ensure an optimal size of public debt by implementing ambitious strategies for debt resolution that are consistent with enhancing economic growth prospects.

Threshold effect check

As an additional robustness check, the dummy variables for the calibrated ranges of optimal threshold of public debt were applied to check for the existence of the non-linear effects. The analysis involves estimating two models, one with a dummy variable for public debt below the calibrated threshold and another model with a dummy for public debt levels above the same threshold. The threshold effect results are shown in Table 5.

The results from the threshold effect in Table 5 show that public debt levels below 50 per cent have a significant and positive impact on growth. Before this point is reached, additional debt positively impacts on economic growth due to the stimulus effects of fiscal policy. However, once a debt threshold is reached, this positive effect disappears or becomes insignificant. This is confirmed by the negative coefficient of the dummy variable (Dummy 2) for debt ratios above 50 per cent. The results thus suggest the existence of an optimal public debt threshold in Zimbabwe, where debt can have a stimulus effect on growth up to a value of between 45 and 50 per cent of GDP and then becomes a drag on economic growth when public debt ratios exceed the estimated 50 per cent public debt-to-GDP threshold.

Evidence from selected low-income countries

Additional robustness checks were also undertaken using data for selected low-income countries (LICs) to infer the growth-maximising public debt threshold. The analysis contributes to the empirical literature on growth-maximising public debt thresholds in LICs. Figure 5 shows the relationship between public debt and economic growth in selected LICs in sub-Saharan Africa over the period 1980–2012.

Table 5: Validating the presence of the optimal growth-maximising public debt threshold for Zimbabwe

Variable	Model 1	Model 2
Constant	2.994***	2.003**
	0.000	0.004
Public debt	-0.441***	-0.220***
	0.003	0.078
Government consumption	-0.023**	0.003*
	0.030	0.095
Domestic credit	0.014	0.014
	0.498	0.562
Domestic savings	0.005***	0.006***
	0.002	0.005
Gross fixed capital formation	0.011*	0.011*
	0.102	0.164
Dummy 1	0.096***	–
	0.030	
Dummy 2		-0.018
		0.640
Autoregressive (1)	0.526***	0.638***
	0.000	0.000
R-squared	0.965	0.957
J-statistic	21.381	21.282
Prob (J-statistic)	0.000	0.000

Note: * indicates significance at 10%, ** significance at 5% and *** significance at 1%.

There are few observations in the upper right hand corner of Figure 5, implying that higher public debt ratios are associated on average with lower economic growth rates. The fitted regression equation shows a coefficient of public debt-to-GDP ratio of -0.022. This result suggests that a 10 percentage point increase in the public debt-to-GDP ratio is on average associated with a subsequent slowdown in economic activity of about 0.22 percentage points. The analysis, however, ignores the potential endogeneity and the influence of other growth-enhancing macroeconomic variables. It is possible that the adverse impact of debt on growth can be outweighed by the impact of other growth-enhancing macroeconomic variables. In such circumstances, one may observe an increase in economic activity at a time when public debt has reached unsustainable levels.
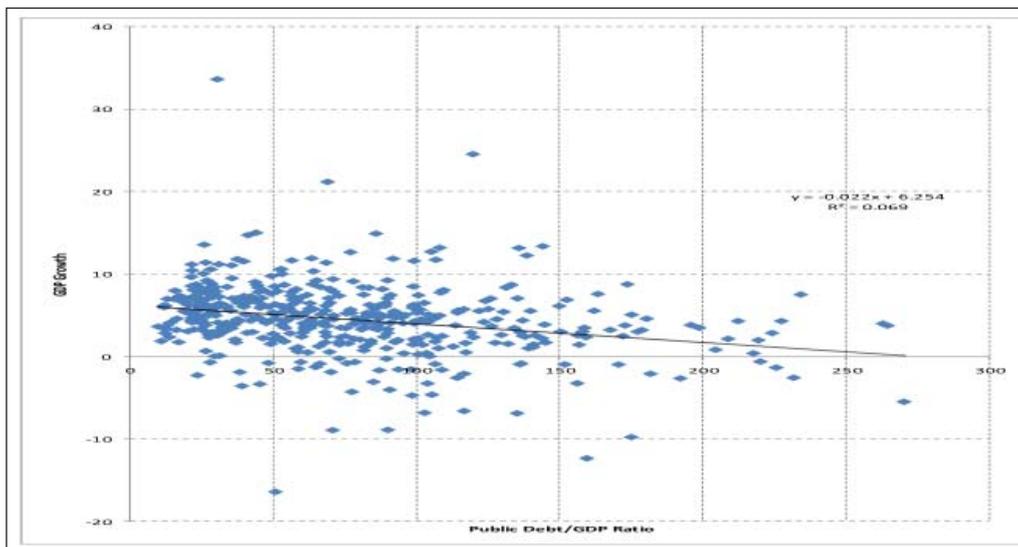
Figure 5: Optimal growth-maximising public debt for selected low-income countries (1980–2012)

Source: Researcher's own calculations based on IMF World Economic Outlook (April 2014) database

Optimal growth-maximising for low-income countries

The optimal growth-maximising public debt threshold for selected low-income countries was computed using the panel regression of a quadratic bivariate equation. The results from a fixed effect Swam Arora panel regression analysis using the quadratic form are shown in Table 6.

Table 6: Regression results of a bivariate debt growth model for low-income countries

Variable	Variable coefficient
Debt	0.0998* (0.0167)
Debt squared	-0.0005*** (0.0000)
Diagnostics	
R-squared	0.3421
DW-statistic	1.824

Note: * indicates significance at 10%, ** significance at 5% and *** significance at 1%

The results from the panel regression analysis in Table 6 show a negative and significant quadratic coefficient of public debt, implying that it is concave. The

negative association between debt and economic growth has been established in previous empirical literature (Cecchetti et al. 2011; Checherita-Westphal & Rother 2010; Reinhart & Rogoff 2010). Panizza and Presbitero (2012) confirmed the existence of a negative association between public debt and growth in low-income countries. The plotted results on the optimal growth-maximising public debt using the quadratic form are shown in Figure 6.
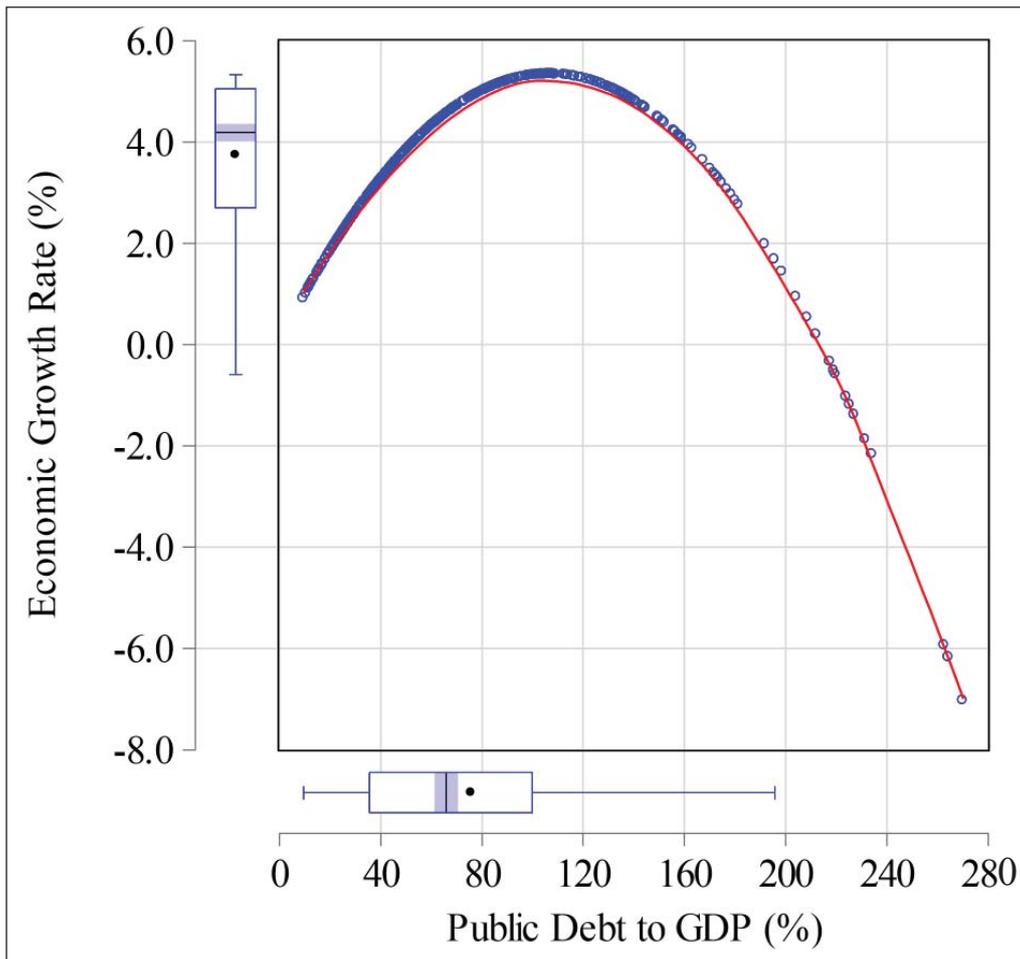
Figure 6: Optimal growth-maximising public debt threshold for selected low-income countries

The results in Figure 6 using the basic quadratic form and fixed effects Swam Arora panel regression analysis for low-income countries also suggest an inverse U-shaped

relationship between public debt and economic growth. As before, the graph plots the annual change in economic growth against the public debt-to-GDP ratio. The robust observation from the growth-maximising public debt for low-income countries indicates a threshold of between 80 and 120 per cent of GDP, beyond which public debt will be harmful to growth. This finding mirrors that of Reinhart and Rogoff (2010), who found that economic growth is adversely affected when public debt exceeds 90 per cent of GDP. The difference in the results is mainly due to differences in the methodological approach and the composition of the sample investigated. Accordingly, the results from this analysis complement the research findings of Checherita-Westphal and Rother (2012), Reinhart and Rogoff (2010), Caner et al. (2010) and Kumar and Woo (2010) on growth-maximising public debt thresholds.

The results support the hypothesis that debt makes some positive contribution to economic growth in low-income countries (LICs), albeit only up to a point. Beyond this point, further increases in public debt may start to be a drag on economic growth. The results confirm the empirical analysis by Presbitero (2010), which shows that public debt has a negative impact on output growth up to a threshold of 90 per cent of GDP. Presbitero (2010) estimated the threshold effect using a panel data analysis of LICs for the period 1990–2007. The low debt-carrying capacity for Zimbabwe compared to other LICs may be attributed to a prolonged period of economic crisis experienced by the country between 2000 and 2009.

External debt growth turning point

As an additional robustness check, external debt, which constitutes the bulk of public debt in most low-income countries (LICs), is also tested to infer the growth-maximising public debt threshold. The assessment of external debt provides a good approximation of overall indebtedness in LICs, since external debt has over the years constituted the bulk of public debt in LICs. As noted by Panizza (2008: 12) and Presbitero (2010: 7), external public debt has been declining, while domestic debt was on the increase from 1990 onwards. Table 7 summarises the results of the optimal public debt ratios in four groupings. These groups are the average growth rates realised when public debt ratios were within these categories: <30%; 30–60%; 60–90%; and >90%. This categorisation is consistent with that used by Reinhart and Rogoff (2010).

Table 7: Determining growth-maximising external public debt ratios for low-income countries

Country	Period	Below 30%	30–60%	60–90%	90% and above
Benin	1980–2012	3.94	5.34	2.82	
Burkina Faso	1980–2012	3.97	5.95	60.14	1.32
Burundi	1980–2012	4.00	4.49	4.24	-0.16
Cameroon	1980–2012	3.37	2.72	-0.37	3.67
Central Africa Republic	1980–2012	4.16	1.55	3.52	1.02
Chad	1980–2012	5.45	5.79	7.01	
Ethiopia	1980–2012	10.62	1.40	4.31	3.70
Gambia	1980–2012	0.00	3.37	5.26	3.19
Ghana	1980–2012	8.05	1.54	4.74	4.14
Guinea	1980–2012	3.94	0.00	2.70	3.73
Guinea Bissau	1980–2012	4.78	-6.71	0.00	2.31
Kenya	1980–2012	4.67	3.17	4.16	1.47
Lesotho	1980–2012	2.77	4.28	2.61	
Malawi	1980–2012	3.96	1.89	3.85	2.08
Mali	1980–2012	5.14	-3.05	3.34	3.15
Mozambique	1980–2012	0.00	5.26	3.35	6.79
Niger	1980–2012	5.24	1.84	1.89	1.35
Rep of Congo	1980–2012	5.32	0.00	10.22	3.39
Rwanda	1980–2012	4.64	1.07	11.72	-50.25
Senegal	1980–2012	3.38	3.29	3.06	1.63
Sierra Leone	1980–2012	9.53	4.47	-0.59	1.09
Tanzania	1980–2012	7.09	6.70	6.09	3.10
Zambia	1980–2012	6.69	6.04	5.34	1.61
Zimbabwe	1980–2012	7.79	3.89	-0.16	-5.11
Average		**4.94**	**2.68**	**6.22**	**-0.28**
Median		**4.66**	**3.23**	**3.68**	**1.62**

Source: Researcher's own computations based on World Economic Outlook (April 2014) database

The results in Table 7 show that growth was highest at external public debt-to-GDP ratios below 30 per cent. The analysis also shows negative growth rates on average for external public debt ratios in excess of 90 per cent. The results shows that increases in external public debt affect economic growth at relatively low levels of debt between 60 and 90 per cent in countries such as Zimbabwe, Cameroon and Sierra

Leone. This result is consistent with a generalisation of Krugman's (1988) model of debt (Malone 2011). The external debt overhang affects economic growth through private investment, which is affected when both domestic and foreign investors are deterred from supplying further capital due to perceived high country risk. This has been the case in Zimbabwe, where the suspension of loan disbursements by traditional creditors adversely affected the country's growth prospects. Patillo, Poirson and Ricci (2004) noted that total private investment may also be affected through a reduction in total factor productivity and increased uncertainty about future policy decisions.

Conclusion and policy recommendations

This paper has analysed the optimal growth-maximising public debt threshold for Zimbabwe by assessing the relationship between public debt and growth. The analysis was undertaken to determine the tipping point beyond which public debt adversely affects economic growth. The paper contributes to the debate on the link between public debt and growth in determining the optimal public debt thresholds in low-income countries (LICs). The paper tested the presence of a Laffer curve-type relationship, where the contribution of public debt to growth is theorised to be positive at lower levels and negative at higher levels. A quadratic econometric model was applied to fit a non-linear relationship between public debt and growth. For robustness checks, different functional forms for polynomials ranging from 1.2 to 3 were also applied in line with the approach by Checherita-Westphal and Rother (2010) to assess the sensitivity of the results to different functional forms.

The results confirm the existence of a concave or inverted U-shaped relationship between debt and growth found in the empirical literature. The optimal public debt level has been estimated to be around 45–50 per cent for Zimbabwe and 80–120 per cent for selected LICs. The sensitivity analysis conducted using different functional forms did not significantly change the estimated optimal growth-maximising public debt threshold for Zimbabwe. As such, it can comfortably be concluded that the optimal public debt threshold is within the simulated range of between 45 and 50 per cent of GDP.

The results obtained in this paper are consistent with the debt overhang hypothesis found in the analysis of the relationship between external debt and economic growth (Cordella et al. 2010). The results are consistent with empirical evidence on the relationship between public debt and growth in LICs. The findings in this paper complement the theoretical expositions by Reinhart and Rogoff (2010), Caner et al. (2010) and Kumar and Woo (2010). The calibrated low debt-carrying capacity for

Zimbabwe, compared to other LICs reflects the underlying economic challenges experienced by the country over a decade from 2000 to 2012. The sustained decline in the economic activity during the crisis period reduced the debt-carrying capacity of the country. The results, therefore, suggest that achieving sustained growth would enhance the country's debt-carrying capacity. Since the data cover a timeline spanning more than 30 years and the variables in the model are significant, it can be concluded that Zimbabwe must ensure that the size of its public debt is in line with the growth-maximising public debt ratios. This will ensure sustained economic growth and employment rates, which are key tenets for sustainable economic development.

Notwithstanding the question on the direction of causality, the findings provide useful insights into the growth-maximising public debt threshold. The study is relevant for policy-makers in providing quantitative estimates of the growth impact of high indebtedness. As such, the findings can assist in informing the policy agenda to address the imperatives of debt resolution, fiscal consolidation and growth acceleration. The rational conclusion from the results presented in this paper is that Zimbabwe should aim to achieve a public debt-to-GDP ratio that does not impede growth by adopting debt-management policies that move its public debt trajectory towards the 50 per cent threshold. It is also prudent for government to target public debt levels below the calibrated optimal threshold to cater for recessionary periods in the business cycle or to provide a safety margin against potential macroeconomic shocks. Overall, the results in this paper suggest that public debt helps to boost aggregate demand and increases societal welfare within a certain limit. After that, further increases in public debt could result in considerable economic costs, such as reduced private investments and rising sovereign credit risk. This implies that the benefit of accumulating debt will be greater than the cost when the debt level is low, but the cost will exceed the benefit if the public debt reaches a certain level.

Although the analysis in this paper has been limited to the optimal point beyond which debt adversely affects economic growth, the analysis can be extended further by utilising other approaches to identifying the optimal threshold of public debt. As suggested by Bannister and Barrot (2011: 6), other approaches that could be used include examining the efficacy of fiscal policy at alternative public debt levels. Furthermore, Reinhart, Rogoff and Savastano (2003) and Reinhart and Rogoff (2009) advocated the debt intolerance approach where the institutional investor rating is regressed on the debt ratio, default history and inflation. These approaches could form part of future research and analysis on the optimal public debt thresholds in LICs, and in Zimbabwe in particular.

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