

# Debt Sustainability and Financial Crises in South Africa

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## ABSTRACT

In this study, we use a long historical data series to assess debt sustainability in South Africa allowing for possible nonlinearities in the form of threshold behavior by fiscal authorities conditional on the recent history of indebtedness and the occurrence of financial crises. First, the results reveal that fiscal consolidation is maintained when a debt-to-GDP ratio of around 56 percent is reached with evidence of a statistically insignificant fiscal consolidation below this threshold level. Second, the results reveal that fiscal adjustment takes into account past levels of debt to allow for smoother corrective action. Third, fiscal consolidation occurs at a higher debt-to-GDP ratio during financial crises.

**KEY WORDS:** financial crisis, sovereign debt, thresholds

The recent sovereign debt crisis has drawn attention to the excessive and unsustainable government debt levels in many countries. South Africa has historically recorded high debt levels with the general government gross debt as a percentage of gross domestic product (GDP) reaching levels above 140 percent in 1900 and just below 120 percent during World War II, according to the Carmen Reinhart and Kenneth Rogoff database. The International Monetary Fund (IMF) *World Economic Outlook* database of April 2013 shows that South Africa has achieved sound fiscal outcomes in the past decade in which government net borrowing as a percentage of GDP averaged 2 percent, while government gross debt averaged about 34.5 percent. The IMF projects the government gross indebtedness to reach 44.8 percent in 2016. In addition, the world's biggest credit ratings agencies, Standard and Poor's, Moody's, and Fitch, have recently downgraded South Africa's sovereign debt rating citing the weak government's institutional strength and weak economic performance, among others, as potential threats to fiscal consolidation.

Cecchetti et al. (2011) note that government debt as a percentage of GDP has historically been high in many countries. However, Cottarelli et al. (2010) argue that determining the optimal level of indebtedness for the economy is not an easy task given that debt-related vulnerabilities are not homogeneous across countries. Thus the debt sustainability assessment program of the World Bank and the International Monetary Fund classifies countries into different categories using indicative thresholds for debt burden based on these countries' policy performance, while Bolton and Jeanne (2011) and Gros (2011) cite weak fiscal and monetary policies and institutions as important indicators of sustainability of sovereign debt. The essential ingredient of debt sustainability is solvency or the ability of a country to service

its debt in the long run. Bohn (2007, 2008) argues that sustainability of the intertemporal government budget requires government policies to be consistent with the present value of the budget constraint such that the present value of government expenditures equals the present value of its revenues. Thus the intertemporal budget constraint of the government is forward looking such that in a sustainable equilibrium, debt equals the sum of the discounted value of all future primary surpluses as opposed to the backward-looking fiscal reaction functions in some empirical studies.

According to Sarno (2001), linear models are likely to be too restrictive to adequately capture the asymmetries that may exist in the debt-to-GDP ratio, and hence he suggests the use of nonlinear debt sustainability methods. As a result, the nonlinear approaches to estimating government debt sustainability have gained popularity in empirical literature in recent years. This literature includes Arghyrou and Luintel (2007), Baum et al. (2013), Chang and Chiang (2012), Chortareas et al. (2008), Fincke and Greiner (2011), Legrenzi and Milas (2010, 2012, 2013), and Yilanci and Ozcan (2008), who use methods that include nonlinear error correction and threshold models. A large and growing body of empirical literature on thresholds beyond which government debt consolidation should occur includes Reinhart and Rogoff (2010a, 2012) and Reinhart et al. (2012), who suggest that real GDP growth begins to fall at government debt-to-GDP ratios above a threshold of 90 percent and when external debt reaches 60 percent of GDP in advanced and emerging economies. However, Herndon et al. (2014) find a calculation error in Reinhart and Rogoff's results, reigniting a controversy and necessitating minor revisions to the original results and a reply by Reinhart and Rogoff (2013). Despite the controversy, Reinhart and Rogoff's (2010a) results are largely consistent with the findings in Baum et al. (2013) Cecchetti et al. (2010), Checherita and Rother (2010), Cordella et al. (2005), and Egert (2012).

Another strand of the literature seeks to find the magnitude of fiscal adjustment beyond which debt-to-GDP ratio is deemed to maintain debt sustainability. This literature includes Legrenzi and Milas (2012), who provide evidence that corrective action to debt-to-GDP ratio per annum of around 8 percent is undertaken once debt threshold levels of around 80 percent and above are reached in GIIPS (Greece, Ireland, Italy, Portugal, Spain) countries. Cottarelli et al. (2010) find that advanced and emerging market countries adjust their structural primary balance by more than 7 percentage points of GDP. Cafiso (2012) finds the required fiscal adjustment of around 4.72 percent of debt-to-GDP ratio for a group of fifteen European countries, around 7–8 percent for Spain and the United Kingdom, and around 16 and 26 percent in Greece and Ireland, respectively. Empirical studies provide evidence of a historically sustainable fiscal policy in South Africa. These studies include Burger et al. (2012), who use nonlinear adjustment of a fiscal reaction function; Jibao et al. (2012), who use a smooth transition error correction framework; and Lusinyan and Thornton (2009), who use unit root and cointegration tests.

This article contributes to the literature on debt sustainability in South Africa by, first, employing models with fixed and time-varying thresholds and a long historical data series on the debt-to-GDP ratio in assessing debt sustainability in South Africa. The second contribution involves using models that allow the level of debt to vary relative to its recent history and the occurrence of financial crises. The nonlinear reaction by the fiscal authorities in South Africa to past indebtedness will elucidate how they reacted to indebtedness and also how they are likely to react to indebtedness in the future. The study will also provide evidence of how the fiscal authorities react to indebtedness during periods of financial crisis. With the exception of Legrenzi and Milas (2012, 2013) for the GIIPS countries, existing

empirical literature has not addressed these issues; hence, this article marks a significant point of departure from the existing literature on debt sustainability in South Africa.

### Empirical Debt Sustainability Models

The nonlinear adjustment of debt-to-GDP ratio when debt grows too high relative to a threshold, which is not necessarily fixed, is assessed by specifying the following nonlinear logistic smooth transition autoregressive (LSTAR) models proposed by Terasvirta (1994) and surveyed by Terasvirta (1998) and Van Dijk et al. (2002). Linear unit root tests suggest that the debt-to-GDP ratio is nonstationary. These results are not reported. However, the details are available from the authors upon request. Given the nonstationarity of debt-to-GDP ratio, the following model, denoted Model 1, is specified in line with the standard univariate adjustment mechanism as proposed by Bohn (1998, 2007):

$$\Delta d_t = \beta_0 + \beta_1 d_{t-1} \theta_{t-1}(d_{t-1}; \gamma, \tau) + \beta_2 d_{t-1} (1 - \theta_{t-1}(d_{t-1}; \gamma, \tau)) + \beta_L(L) \Delta d_{t-1} + \varepsilon_t, \quad (1)$$

where  $d_t$  is the debt-to-GDP ratio;  $\beta_L(L) = \beta_{L1} + \beta_{L2}L + \dots + \beta_{Ln}L^{n-1}$  is a measure of persistence in debt-to-GDP ratio where  $\beta_{L1} \equiv \beta_{L1}(1)$ ; the function  $\theta_{t-1}(d_{t-1}; \gamma, \tau)$  is the weight on debt-to-GDP ratio in period  $(t-1)$ ;  $\tau$  is the threshold value as defined in Equation (2) such that debt adjustment is allowed to differ between the different debt regimes;  $\beta_1$  measures the behavior of policy makers in period  $t$  when debt-to-GDP ratio in the previous period  $d_{t-1}$  is expected to be below the threshold  $\tau$ , while  $\beta_2$  measures the behavior of policy makers when  $d_{t-1}$  is greater than the threshold  $\tau$ . A priori, both  $\beta_1$  and  $\beta_2$  are expected to be negative when mean reversion in debt levels is expected. In the event that  $\beta_1 = \beta_2$ , the model simplifies to a linear specification, while there is a tendency for greater reaction to higher debt values when  $|\beta_1| < |\beta_2|$ .

The weight  $\theta_{t-1}(d_{t-1}; \gamma, \tau)$  is modeled using the following logistic function discussed in Van Dijk et al. (2002):

$$\theta_{t-1}(d_{t-1}; \gamma, \tau) = \Pr\{d_{t-1} < \tau\} = 1 - \frac{1}{1 + e^{-\gamma(d_{t-1} - \tau)/\sigma_{(d_{t-1})}}}, \quad (2)$$

where  $\gamma > 0$  is the smoothness parameter that determines the smoothness of the transition between regimes;  $\gamma$  is made dimension free by dividing it by the standard deviation of  $d_{t-1}$  following Granger and Terasvirta (1995) and Terasvirta (1994). The transition between regimes is endogenously determined given that both  $\gamma$  and the threshold  $\tau$  are estimated jointly with the remaining parameters.

The models specified above assume that changes in the policy makers' reaction to debt levels are driven by some fixed debt threshold level. However, this need not be the case. In his account of inflation expectation, King (1996) suggests that after experiencing high inflation for a long period of time, there may be good reasons for the private sector inflation expectations to follow a simple rule, which is a linear function of the inflation target and the lagged inflation rate. Similarly, instead of aggressively bringing debt to a particular threshold level, the fiscal authority may adopt smoother corrective action toward a time-varying

threshold in order not to trigger severe contraction in the economy. For instance, the current IMF managing director (Lagarde 2012) has called for caution on austerity if growth weakens. To allow for a smoother, rather than abrupt, corrective action, a variant of Model 1, which is denoted Model 2, is considered. This model is specified as follows:

$$\Delta d_t = \beta_0 + \beta_1 d_{t-1} \theta_{t-1}(d_{t-1}; \gamma, \tau_t) + \beta_2 d_{t-1} (1 - \theta_{t-1}(d_{t-1}; \gamma, \tau_t)) + \beta_L(L) \Delta d_{t-1} + \varepsilon_t, \quad (3)$$

where the time-varying threshold is of the form

$$\tau_t = \mu_1 \tau + (1 - \mu_1) \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\}, \quad (4)$$

This threshold is a linear function of a fixed threshold level of debt-to-GDP ratio and the lagged debt-to-GDP ratio with corresponding weights of  $\mu_1 \in [0, 1]$  and  $(1 - \mu_1)$ , respectively. The time-varying threshold implies that the policy maker uses a combination of a fixed reference level for debt-to-GDP ratio and a moving average of past debt-to-GDP ratio in evaluating changes in its response to debt;  $n$  measures the number of years a particular government holds office and runs the economic programs;  $n = 5$  is used given that it is consistent with general practice in South Africa. The values of  $n$  up to eight years were experimented with but yielded unsatisfactory results. The corresponding logistic function is as follows:

$$\theta_{t-1}(d_{t-1}; \gamma, \tau_t) = \Pr \left\{ d_{t-1} < \mu_1 \tau + (1 - \mu_1) \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\} \right\} = 1 - \frac{1}{1 + e^{-\gamma(d_{t-1} - \tau_t) / \sigma_{(d_{t-1})}}}, \quad (5)$$

Fiscal retrenchment can also occur during world financial crises. This is because there may be reasons in favor of raising the debt threshold in the fear of a greater recession following financial crises. The risk of a further downgrade by credit rating agencies could also lead to a lower debt ceiling due to possible debt refinancing constraints. To capture this phenomenon, the time-varying threshold of the following form is posited for Model 3:

$$\tau_t = \tau_0 + \tau_1 \text{financial\_crisis}_t, \quad (6)$$

where  $\tau_0$  is a fixed threshold similar to that in Model 1. When  $\tau_1 > 0$ , debt is allowed to bridge its threshold level before corrective action is taken while a  $\tau_1 < 0$  allows for a lower debt ceiling before debt consolidation is implemented. The corresponding logistic function is specified as follows:

$$\theta_{t-1}(d_{t-1}; \gamma, \tau_t) = \Pr \{ d_{t-1} < \tau_0 + \tau_1 \text{financial\_crisis}_t \} = 1 - \frac{1}{1 + e^{-\gamma(d_{t-1} - \tau_t) / \sigma_{(d_{t-1})}}}. \quad (7)$$

As a fourth possible model, we allow the threshold to be a function of both a moving average of past public debt-to-GDP ratio as per Model 2 and an interaction term between this variable and world financial crisis as per Model 3. In this case, the time-varying threshold is of the form.

$$\tau_t = \mu_1 \tau + \mu_2 \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\} + (1 - \mu_1 - \mu_2) \left( \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\} * \text{financial\_crisis}_t \right). \quad (8)$$

This threshold is a linear function of some fixed threshold level of debt-to-GDP ratio, the lagged debt-to-GDP ratio, and the interaction term with corresponding weight of

$\mu_1, \mu_2 \in [0, 1]$ , and  $(1 - \mu_1 - \mu_2)$ , respectively. This alternative scenario implies that debt threshold is increased further in line with past debt-to-GDP ratio when the world economy is in times of financial crisis (assuming that  $(1 - \mu_1 - \mu_2)$  is positive). The corresponding logistic function is as follows:

$$\theta_{t-1}(d_{t-1}; \gamma, \tau_t) = \Pr \left\{ \begin{array}{l} d_{t-1} < \mu_1 \tau + \mu_2 \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\} \\ + (1 - \mu_1 - \mu_2) \left( \left\{ \frac{1}{n} \sum_{j=1}^n d_{t-j-1} \right\} * \text{financial\_crisis}_t \right) \end{array} \right\} = 1 - \frac{1}{1 + e^{-\gamma(d_{t-1} - \tau_t) / \sigma(d_{t-1})}} \quad (9)$$

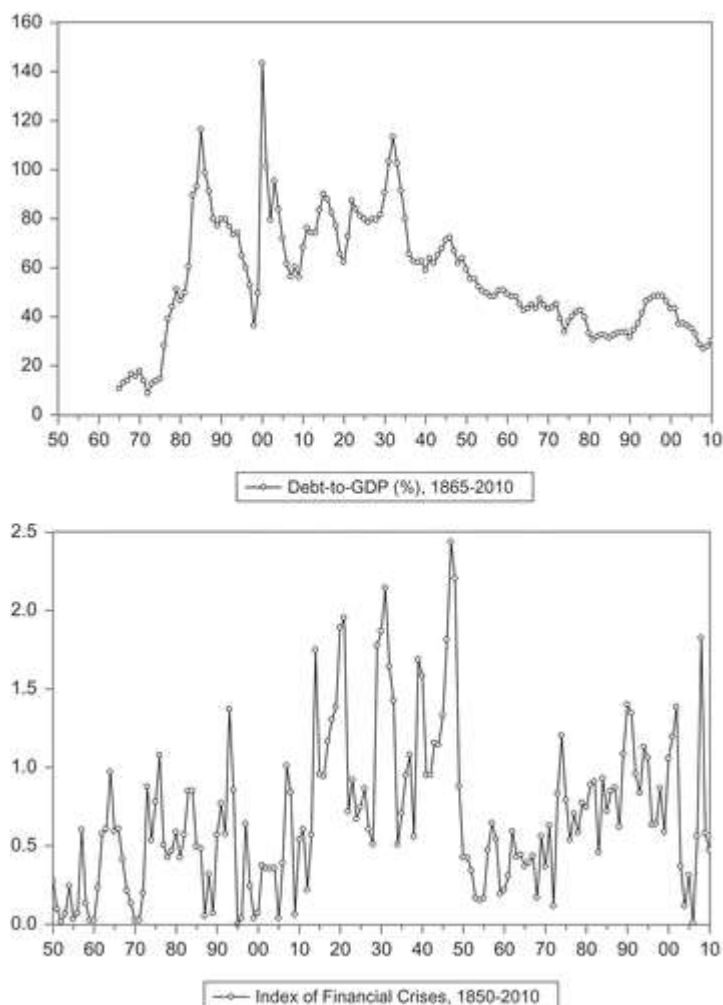
This model is denoted Model 4.

## Data Description

Annual data spanning the period 1865–2010 are used. These data come from the Carmen Reinhart and Kenneth Rogoff website at [www.reinhartandrogoff.com/data/](http://www.reinhartandrogoff.com/data/). Similar long historical data series covering the postwar period are used by Tronzano (2013) to study fiscal sustainability in India. Debt-to-GDP ratio for South Africa is total gross central government debt. The composite world financial crises index approximates the occurrence of financial crises by pooling the world's twenty largest economies together with South Africa, weighted by their relative purchasing power parity-based GDP share of total world GDP. The world financial crises index takes into account the incidences of instability in banking, currency, stock markets, debt, and inflation. A detailed explanation on the construction of the variables is available in Reinhart and Rogoff (2009, 2011). In our estimation, we also experiment with a financial crisis variable representing only the crises in South Africa; these results were not satisfactory and hence are not reported. The evolution of the main variables is shown in Figure 1, and Table 1 summarizes the minimum and maximum values of the main series, together with their mean, median, standard deviation, skewness, and kurtosis.

**Table 1. Descriptive statistics of the main variables**

	Debt-to-GDP ratio 1865–2010	Financial crises index 1865–2010
Mean	56.36528	0.732483
Median	50.70000	0.607004
Maximum	143.40000	2.436317
Minimum	8.60000	0.000000
Standard deviation	24.05258	0.504235
Skewness	0.503098	0.999489
Kurtosis	3.282968	3.837505
Jarque-Bera	6.555017	28.575420
Probability	0.037722	0.000001



**Figure 1. Evolution of the main variables.**

According to Figure 1, South Africa's total gross central government debt as a percentage of GDP reached levels above 140 percent in 1900 and just below 120 percent during World War II. The high debt levels declined markedly post-World War II, reaching a low of 30.6 percent in 1981 and 46.3 percent during the democratic transition in 1994. Debt started rising again in 1990 and reached a peak of 48.5 percent in 1997. However, it was successfully reduced to 26.7 percent in 2008 resulting in government gross debt average of about 34.5 percent between 2000 and 2010. According to Caprio and Klingebiel (2003) and Reinhart and Rogoff (2010b), South Africa experienced banking crises in 1977 and again during the recession in 1989, while the national government's external default episodes occurred in 1985–87, 1989, and 1993. In the post-World War II era, the world financial crises index points to incidences of financial distress during the banking crisis in 1974, the East European banking crisis of 1990, and the 1997 Asian incidences of financial distress were also experienced during the Argentine banking collapse and the accounting scandals of 2002 as well as during the recent financial crisis of 2008.

## **Empirical Results**

### **Unit Root, Structural Breaks, and Linearity Tests**

To determine the existence of different fiscal regimes and structural breaks, we perform both the Perron (1997) and Zivot and Andrews (1992) linear unit root tests that allow for one

endogenous structural break in the public debt-to-GDP ratio series. We note that the public debt-to-GDP ratio series follows a nonstationary process. The Perron and the Zivot and Andrews unit root tests do not reject the null, with test statistics of around  $-4.79$  and critical values at the 5 percent significance level of around  $-5.23$ , and these methodologies suggest one structural break in the period around 1875. However, given that the sample under study starts in 1865, this provides less evidence of structural break in the public debt-to-GDP ratio series. To confirm our results, we perform the Bai and Perron (2003) methodology for testing for multiple structural breaks in a regression model. To this end, we employ this test on the linear version of Model 1. The test finds no evidence of structural breaks in the regression with sequential  $F$ -statistic of 1.21 and critical value of 15.37.

Table 2 contains  $P$ -values of the standard linearity Lagrange multiplier (LM) tests:  $LM_1$ ,  $LM_3$ ,  $LM_3^e$ , and  $LM_4$  tests (see, e.g., Van Dijk et al. 2002) with  $d_{t-k}$ , where  $k = 1, 2, 3, 4$ , as transition variable. The null hypothesis in these tests is that  $\Delta d_t$  follows a stationary linear process, and the tests are based on a linear version of Model 1 as the null hypothesis. The computation of the test is carried out using the F version, which is an asymptotic Wald test. The  $P$ -values of the  $LM_1$  and  $LM_3^e$  tests indicate that linearity can be rejected strongly only if  $d_{t-1}$  is used as a transition variable. Based upon the  $P$ -values for the  $LM_3$  and  $LM_4$  tests,  $d_{t-3}$  and  $d_{t-4}$  may also be considered as transition variables. However, the lowest recorded  $P$ -value,  $d_{t-1}$ , is the preferred transition variable in both tests. The additional tests that discriminate between the LSTAR (logistic smooth transition autoregressive) models and the ESTAR (exponential smooth transition autoregressive) nonlinear models are not performed in this article. The LSTAR specification allows for different response to positive and negative deviations of  $d_{t-k}$  from some threshold value. This is convenient for modeling the fiscal rule in the presence of asymmetric behavior to low and high debt. This is not the case for the ESTAR specification, where positive and negative deviations from the threshold have the same effect.

**Table 2. LM-type test for nonlinearity**

Transition variable	$LM_1$	$LM_3$	$LM_3^e$	$LM_4$
$d_{t-1}$	0.000	0.000	0.000	0.000
$d_{t-2}$	0.230	0.170	0.451	0.259
$d_{t-3}$	0.277	0.002	0.334	0.000
$d_{t-4}$	0.641	0.017	0.616	0.049

Notes: p-values of F variants of the LM-type tests used in the specification procedure of Van Dijk et al. (2002). The  $LM_1$ ,  $LM_3$ , and  $LM_4$  tests are applied in a linear version of Equation (1). Source: Authors' calculation based on data from Reinhart and Rogoff (2009).

### Nonlinear Models Estimation

The empirical results are reported in Table 3 based on the sample period ranging from 1865 to 2010. The results for Model 1 show a statistically significant threshold of debt-to-GDP ratio of around 57 percent. Corrective action to increasing debt-to-GDP ratio below these thresholds is statistically insignificant at the 5 percent level of significance, while the threshold above which corrective action by the fiscal authorities takes place is statistically

significant. The fiscal authorities implement corrective action when debt-to-GDP ratio is above which corrective action is taken by the fiscal authorities is statistically insignificant.

**Table 3. Models estimates, 1865–2010**

	Model 1	Model 2	Model 3	Model 4
$\beta_0$	6.611 (3.92)	6.652 (2.56)	4.850 (3.88)	7.549 (2.69)
$\beta_1$	-0.118 (0.10)	0.168 (0.40)	-0.066 (0.09)	-2.120 (3.85)
$\beta_2$	-0.114 (0.05)	-0.120 (0.04)	-0.097 (0.04)	-0.128 (0.04)
$\beta_1$	0.023 (0.08)	0.036 (0.09)	0.019 (0.08)	0.029 (0.09)
$\tau$	56.66 (20.34)	57.68 (25.23)	57.01 (22.36)	57.52 (24.20)
$\gamma$	10.95 (-)*	10.01 (-)*	10.55 (-)*	10.05 (-)*
$\mu_1$		0.40 (-)*		0.55 (-)*
$\mu_2$				0.35 (-)*
$\tau_1$			5.52 (2.26)	
AIC	7.621	7.643	7.620	7.645
Regression standard error	10.783	10.90	10.77	10.91
$\bar{R}^2$	0.04	0.045	0.041	0.043
$F_{ar}$	1.22 [0.27]	59.10 [0.00]	1.64 [0.20]	0.67 [0.41]
$F_{arch}$	2.80 [0.10]	2.47 [0.12]	2.95 [0.09]	2.56 [0.11]
Parameter stability ( $p$ -value)	0.10	0.11	0.09	0.11

Notes: Model 1 is the model with a fixed threshold, and Models 2, 3, and 4 are models with time-varying thresholds that are described in the text. Van Dijk et al. (2002) argue that the likelihood function is very insensitive to  $\tau$ , suggesting that precise estimation of this parameter is unlikely. For this reason, we run a grid search in the range [0.1, 250] and fix the parameter to the one that delivers the best fit of the estimated models. AIC is the Akaike information criterion.  $F_{ar}$  is the Lagrange multiplier F-test for second-order residual serial correlation;  $F_{arch}$  is the first-order autoregressive conditional heteroskedasticity F-test (values are indicated in brackets). We set  $l = 1$  and  $n = 5$  above. In Models 2 and 4, estimates of  $\mu_1$  and  $\mu_2$  are based on a grid search in the [0.1, 0.99] range. Parameter stability is an F-test of parameter stability (see Lin and Terasvirta 1994). Numbers in parentheses are standard errors. \*Imposed value. Source: Authors' calculation based on data from Reinhart and Rogoff (2009).

The estimates of Model 2 provide empirical results for the model with time-varying threshold. The results show that South Africa maintained the debt-to-GDP threshold of around 58 percent with a 60 percent weight ( $\mu_1 = 0.4$ ) on past debt-to-GDP ratios. The speed of adjustment toward the threshold is somewhat higher than in the fixed debt threshold model, suggesting that the fiscal authorities decrease the debt-to-GDP ratio by 12 percent per annum once the debt-to-GDP is beyond the threshold. This higher mean reversion of debt to a moving average of past debt-to-GDP ratio suggests that the fiscal authorities have a tendency to allow higher debt in relatively higher debt episodes, most probably in order not to aggravate an already bad economic situation, yet fiscal retrenchment is faster once the debt threshold is reached. Some sensitivity analyses where we tried with values lower than 0.4 on the fixed threshold debt-to-GDP ratio changed some results. When the transition variable becomes smoother, and  $(1 - \mu_1)$  (a moving average of past debt-to-GDP ratio) lower, the nonlinearity gradually disappears.

The empirical results of Model 3 show the estimates of debt adjustment in the face of financial crises. These results indicate that the debt ceiling was raised during financial crises



(i.e.,  $\tau_1 = 5.52$ ). The empirical estimates of the models over the entire sample yield threshold estimates of around 57 percent, above which the fiscal authorities implement corrective measures with respect to debt. Model 4 provides evidence that the moving average of past debt-to-GDP threshold is higher during times of financial crisis. The model results are similar to those of Model 2 in that corrective action is taken once debt goes beyond the threshold level. The adjustment in debt is met at a faster rate of around 13 percent per annum once the debt-to-GDP threshold is exceeded. In comparison to Model 2, the fiscal authorities place a 35 percent weight on past debt-to-GDP ratios with a 10 percent weight on past debt during times of financial distress, exhibiting a higher tolerable level of debt in particularly adverse economic times. There is very little to discern among the estimated models based on the adjusted  $R^2$  and the regression standard error. Model 3 (the model with time-varying threshold and financial crisis variable) has the best fit as it records the lowest Akaike information criterion (AIC) and standard error. The diagnostic tests, reported in Table 3, show no serious misspecification except for a serial correlation issue in Model 2 (the model with time-varying moving average threshold debt-to-GDP ratio), while all models are robust to the Lin and Terasvirta (1994) parameter stability test.

Fiscal retrenchment at debt-to-GDP ratio of 56 percent is in contrast to the evidence in many countries. This is particularly the case in developed countries that have maintained debt-to-GDP ratios well above 100 percent. The IMF regards a debt-to-GDP ratio of 60 percent as a prudential limit in developed countries, while 40 percent is the debt-to-GDP ratio that should not be breached on a long-term basis in developing and emerging economies. The estimated debt-to-GDP ratio threshold of 56 percent for the sample period 1865–2010 is somewhat over the 30–50 percent threshold that the IMF recommends for developing countries depending on strength of policies and institutions in these countries. However, caution is advised given that government debt-to-GDP ratio in South Africa has not exceeded the 50 percent mark since 1960.

Although no study explicitly estimates the thresholds above which fiscal consolidation begins to take effect in South Africa, the findings in this study are consistent with the view that South Africa has achieved relatively sound fiscal outcomes in the recent past. Among others, Burger et al. (2012) conclude that the South African government has run a sustainable fiscal policy by reducing the primary deficit or increasing the surplus in response to rising debt since 1946, while Jibao et al. (2012) provide evidence that the South African government responds faster to budget deficits than to surpluses. The changes in overall debt are not exclusively under the control of the country's fiscal authorities. There are other factors such as interest rates that determine debt interest payments to be settled in international markets and exogenous cyclical factors that may be national and international, as well as other factors that affect the fiscal consolidation of a country, that cannot always be explicitly linked to specific policies. Therefore, the changes in the debt dynamics might not always be due to the actions of policy makers.

## **Conclusion**

In this study, we assess fiscal sustainability in South Africa allowing for possible nonlinearities in the form of threshold behavior by the policy makers. A long historical data series on the debt-to-GDP ratio for South Africa spanning the period 1865–2010 is used. Models with fixed and time-varying thresholds that allow the level of debt to vary relative to its recent history and the occurrence of financial crises are estimated. The empirical results

reveal a statistically significant threshold of debt-to-GDP ratio of around 56 percent during the sample period. The results further provide evidence that previous levels of debt play a role in debt adjustment decision and that the debt ceiling is raised during financial crises. There is evidence of a greater emphasis on fiscal sustainability where an increase in debt-to-GDP ratio above threshold results in stronger fiscal consolidation while fiscal adjustment below this threshold level is statistically insignificant.

Overall, the results indicate fiscal prudence in South Africa and are consistent with the view that South Africa has achieved relatively sound fiscal outcomes in the recent past despite the socioeconomic pressures that came with the political transition. However, factors such as the weak government's institutional strength, the weak economic performance, the labor tensions, high unemployment, and increasing external imbalances are threats to fiscal sustainability according to the world's biggest credit ratings agencies: Standard and Poor's, Moody's, and Fitch. It would be interesting to use structural variables such as the primary surplus/deficit and the interest rate. We intend to address this in future research.

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