Fiscal rules and regime-dependent fiscal reaction functions
The South African case

Philippe Burger, Marina Marinkov

Fiscal rules and regime-dependent fiscal reaction functions: The South African case

by

Philippe Burger *and* Marina Marinkov*

This article argues the case for a policy of "anchored flexibility" in the form of a flexible fiscal rule that allows for the pursuit of economic stability but always anchors that pursuit in fiscal sustainability. The rule is explicitly structured to be simple and is designed in analogy to the inflation-targeting framework. The article heeds the warning that consistently forecasting the output gap with any degree of precision is quite difficult, if not impossible, and thus proposes a target band for the deficit, instead of point targets for the overall deficit and the structural budget balance. To ensure fiscal sustainability over and above the contribution of the deficit rule, the article also proposes a band for the debt/GDP ratio. This debt rule acts as a negative feedback rule that stipulates the adjustments required in the deficit, should the actual debt/GDP ratio move outside the stipulated band. Since the government needs to change revenue and expenditure in order to change the deficit, the article then explores empirically whether and with how much revenue and expenditure in South Africa changed to maintain fiscal sustainability. More specifically the article explores various models of the fiscal reaction function to illuminate government behaviour in South Africa. These models consider how the deficit, expenditure and different types of revenue reacted to the debt/GDP ratio and the output gap to ensure fiscal sustainability. Lastly, the article considers measures that could enhance the automatic stabilisers, while simultaneously allowing for the maintenance of fiscal sustainability in the medium term.

JEL classification: H60, E62, C32

Keywords: fiscal rules, fiscal reaction function, time-series models, South Africa

* Philippe Burger is Professor and Chair of the Department of Economics at the University of the Free State, South Africa. Marina Marinkov is Senior Researcher at the Macroeconomics and Public Finance Unit of the Financial and Fiscal Commission (FFC), South Africa. An earlier version of this article was presented at the ERSA Workshop on Public Economics (Economic Research Southern Africa, *http://econrsa.org*) held at the Stellenbosch Institute for Advanced Study on 2-3 May 2011. The authors wish to thank George Kopits, Estian Calitz and Krige Siebrits as well as other participants in the ERSA workshop for valuable comments. The usual disclaimers apply.

The financial and economic crisis that started in 2008 as well as the response of governments to the crisis resulted globally in fast-rising public debt/GDP ratios. Governments in countries such as Greece, Ireland and Portugal face the possibility of debt restructuring and bailouts by the EU and the IMF, while countries such as the United Kingdom and the United States also experienced the sharpest peace-time increase in their debt/GDP ratios since modern times. Financial markets too express uncertainty, and several calls have been made in the United Kingdom and the United States to identify an "exit strategy" from the large stimulus policies pursued by their governments. South Africa also experienced an increase in its public debt/GDP ratio, though the increase is not nearly as dramatic as in the countries cited above (see Figure 1). These increases in public debt/GDP ratios globally raise again the question whether flexible fiscal rules are not necessary. More specifically: Is what is needed not rules that allow for stimulus measures during recessions, but rules that also identify an exit strategy from these measures? Indeed, if these exit strategies are clearly defined in terms of a fiscal rule, the stimulus measures themselves might generate more market confidence and thus have a larger impact.

Figure 1. **The public debt/GDP ratio in South Africa**
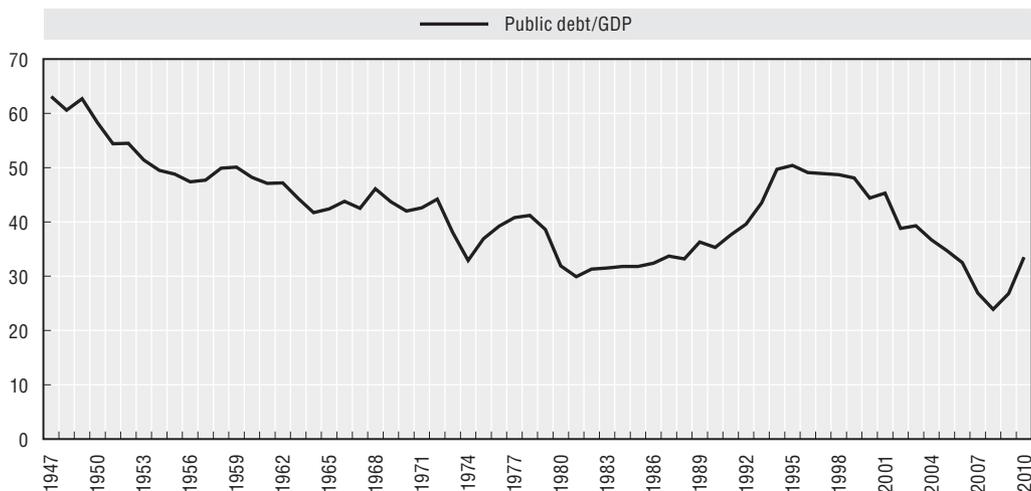
Source: South African Reserve Bank.

Therefore, this article argues the case for a policy of "anchored flexibility" in the form of a flexible fiscal rule that allows for the pursuit of economic stability but always anchors that pursuit in fiscal sustainability. The rule is explicitly structured to be simple and is designed in analogy to the inflation-targeting framework. In addition to containing a proposal for a fiscal rule that describes how the government should react in future, the article also explores how the government reacted in the past by presenting estimations of the fiscal reaction function. Various specifications of that function are presented. In

addition, the estimated fiscal reaction functions are also used to explore whether revenue or expenditure carried the largest burden of adjustment in the past. Showing that the largest adjustments fell on revenue, the article also proposes how expenditure measures can be augmented to allow for increased sensitivity to recessions, while also creating a mechanism for a fast adjustment and restitution of fiscal sustainability once the recession passes.

1. Whence fiscal rules?

The debate about fiscal rules is not a recent phenomenon, with the underlying concern regarding the size and burden of public debt being an age-old one, going back centuries. For instance, referring to 18th century United Kingdom, David Hume (1742) stated that "… either the nation must destroy public credit, or public credit will destroy the nation". The oldest fiscal rule is the simple balanced budget rule, succinctly stated for the first time in modern times in the "treasury view" of 1929 (Clarke, 1988). However, the Great Depression highlighted the untenable nature of this rule during severe recessionary times. Thus, following the Great Depression, rules gave way to discretionary fiscal policy in the 1940s, 1950s and 1960s. Keynesian economics and Abba Lerner's "functional finance view" emphasised that government should not focus on balancing the budget, but rather on balancing the economy; the budget will then take care of itself (Lerner, 1951). These views provided the theoretical underpinnings for discretionary fiscal policy.

Discretionary policy seemed to have carried the day in the first three decades following WWII. The exceptional economic growth rates and the rather low interest rates meant that governments could grow their economies out of the public debt burdens that they incurred during WWII. South Africa is no exception, with public debt doubling in amount during the first three decades, though halving as a ratio of GDP. However, this does not mean that fiscal rules disappeared altogether. Most governments still followed a basic public sector golden rule whereby loans were predominantly incurred to finance infrastructure and capital, while current expenditure was financed by tax revenues. Fiscal rules also did not disappear from economic literature. As early as 1948, Milton Friedman argued the case for a flexible fiscal rule that allows for the operation of what is today known as automatic stabilisers. To quote him: "The principle of balancing outlays and receipts at a hypothetical income level would be substituted for the principle of balancing actual outlays and receipts" (Friedman, 1948:249-250). Hence, Friedman's proposal essentially aims at balancing the budget over the business cycle.

As Friedman argued, his proposal was not an isolated set of ideas, since it drew on existing ideas circulating in academic and policy circles at the time. Though Friedman made his proposal in 1948, fiscal rules only became a serious topic of discussion again in the 1980s and 1990s, following the significant deficit and debt problems that many developed countries then faced. By this time, the debate on fiscal rules could also draw on a significant public choice literature emphasising issues such as time inconsistency in the behaviour of governments, the deficit bias of governments, and the political business cycle (*cf.* Alesina and Perotti, 1994; Corsetti and Roubini, 1996; Drazen, 2004; Kydland and Prescott, 1977).

Different authors also had different definitions of what constitutes fiscal rules, but all definitions implied a constraint of fiscal policy actions over time (*cf.* Buti and Giudice, 2002, 2004; Drazen, 2004; Kell, 2001; Kopits, 2004; Kopits and Symansky, 1998; Milesi-Ferretti,

2003; Siebrits and Calitz, 2004; and Tanner, 2004). In addition, most authors view fiscal rules as restrictions on budget deficits, the level of public debt or government expenditure (*cf.* Milesi-Ferretti, 2003:378-379; Tanner, 2004:719). Differences do exist as to whether rules should be permanent or could also include temporary restrictions (*e.g.* the 3% stipulation of GEAR, the "Growth, Employment and Redistribution" strategy of the ANC-led government in South Africa in 1996) and whether rules should be contained in policy statements or also encoded in law (*cf.* Kopits and Symansky 1998:2). According to Kopits and Symansky (1998:18-20) and Kell (2001:8-30), a good fiscal rule should be:

- well-defined;
- highly transparent;
- simple in the eyes of the public;
- flexible enough to accommodate cyclical fluctuations and exogenous shocks;
- consistent with other macroeconomic policies;
- adequate with respect to specific goals;
- enforceable in the given environment and supported by efficient policies.

To the above list one could also add that a good rule should ease the ability of government to pursue fiscal sustainability or, alternatively, constrain the ability of government to run an unsustainable fiscal policy. Kopits and Symansky (1998:19-20) nevertheless argue that a trade-off exists between these characteristics. Thus, probably no rule will possess all characteristics – *e.g.* simpler rules might be less flexible, but more credible.

An important characteristic of the modern fiscal rules is the concern to reconcile the need for fiscal sustainability with the desire to allow for government to support economic stability, mostly through automatic stabilisers. In doing so, modern fiscal rules follow directly from Friedman's 1948 proposal.

2. A flexible fiscal framework: the basics

Properly designed automatic stabilisers enhance the ability of government to implement a flexible fiscal rule. Such a rule is sensitive to the business cycle, but simultaneously also ensures fiscal sustainability. It is therefore less of a rule and more of a guiding framework; it constitutes "anchored flexibility".

A flexible fiscal rule that is embedded in properly designed permanent and temporary automatic stabilisers allows for both a timely response to a downturn and more certainty about the path back to fiscally sustainable levels of expenditure, revenue and debt once the economy stabilises. In 2010/11, concern in countries such as the United Kingdom and the United States regarding the "path back" found expression in debates about the so-called "exit strategy" governments should follow in the aftermath of the very large fiscal injections that economies received following the 2008/09 financial crisis. These concerns regarding exit strategies highlight the role that could be played by "anchored flexibility" built into fiscal rules to provide more certainty. Moreover, more certainty about the "path back" to fiscal sustainability might also increase confidence in the success of stimulus policy and thereby enhance fiscal multipliers and thus the impact of a stimulus policy.

Given that fiscal sustainability is largely about the trajectory of debt/GDP, a debt/GDP target level might be the right place to start when thinking about a fiscal rule or framework. The specific level at which to target the debt/GDP ratio might be arbitrary or based on a

structural analysis about the optimal level for the ratio. In principle, and following a golden rule that – in the long run – only investment should be financed by debt (thus allowing for short-run debt financing of current expenditure), the ratio should be set at the level of public capital that accords with society's optimal trade-off between public consumption today and public consumption in the future. In practice, though, the ratio will probably be set at an arbitrary level (such as 60% in the EU or 35% in South Africa – roughly the average for South Africa since 1994).

Suppose the debt/GDP target level is set at 35%. A deficit target can then be derived from the debt target. The deficit target is then defined to keep the debt/GDP ratio in the longer run at the 35% level. Thus, the deficit target will equal:

$$C^* = nD_{t-1}/Y_t \tag{1}$$

where C^* is the deficit, n is the long-run nominal economic growth rate, D is the debt of last year and Y is the expected GDP this year. One could also define n as the central inflation target (4.5% in the case of South Africa) and add the long-run expected real growth rate. The long-run nominal or real growth rate can be estimated or simply be a moving average.[1] Thus, if the central inflation target is 4.5% and the long-run growth rate is 3%, the nominal growth rate is expected to be roughly 7.5%. Therefore, with a 7.5% nominal growth rate in the long run and a debt/GDP target in the long-run level of 35%, the sustainable deficit is 2.4%. (Note that the real part of the deficit will be 1% [0.03 × (0.35/1.03)].) The government then also needs to decide at what long-run levels to set revenue and expenditure to yield this deficit level.

The sustainable level of the deficit is the structural budget balance (SBB), *i.e.* the level of the budget balance after the effect of the business cycle has been stripped out. Using the SBB (= C^*), as well as estimates for the elasticity of various revenues and expenditure and a forecast for the output gap, the government can forecast the actual levels of revenue, expenditure and the deficit using equations 1 to 4. The government may then decide to target the level of the actual deficit. Doing so also implies that the government implicitly is also targeting the structural budget balance. Furthermore, such a deficit target will, in principle, also allow the automatic stabilisers to operate and thereby build in some flexibility of the budget balance with respect to the business cycle.

$$T = \left(\frac{T^*}{Y}\right)\left(\frac{Y^*}{Y}\right)^{1-\varepsilon_R} \tag{2}$$

$$G = \left(\frac{G^*}{Y}\right)\left(\frac{Y^*}{Y}\right)^{1-\varepsilon_G} \tag{3}$$

$$SBB = C^* = T^* - G^* = nD_{t-1}/Y_t \tag{1.1}$$

$$C = T - G \tag{4}$$

where T and T^* are revenue and long-run revenue, G and G^* are expenditure and long-run expenditure, C is the deficit, Y and Y^* are output and long-run output, and ε_R and ε_G are the elasticities of revenue and expenditure with respect to the output gap.

However, targeting the level of the actual deficit as described above is notoriously fraught with problems. Favero and Marcellino (2005) show that even in economies as developed and relatively stable as the euro-area economies, the standard errors of deficit forecasts are relatively large (note that they wrote prior to the financial crisis and the subsequent sovereign debt crisis and the large and increased economic instability those

brought). To target the deficit level using equations 1 to 4 entails forecasting the output gap, which in turn requires not only forecasting actual output, but also potential output. Given that both actual output and potential output are stochastic in nature, forecasting them involves a degree of uncertainty.[2] Furthermore, even slight uncertainty with respect to the levels of actual and potential output translates into considerable uncertainty with respect to the output gap. Thus a relatively small unpredicted change in the level of actual or potential output can lead to a large unpredicted change of the output gap which, through equations 1 to 4, then translates into considerable unpredicted change in the deficit. Therefore, the government faces a high probability of missing the targeted deficit level. Measuring the government's success in complying with a fiscal rule that sets a target level for the deficit is nothing more than deception caused by spurious precision.

With or without a fiscal rule, governments always announce a specific point deficit target for the following year and therefore annually target the announced deficit. Fiscal rules constitute a permanent target with which the annual target needs to comply every year. Because governments frequently miss their annual targets as set out in their annual budgets, setting an annual target to comply with the permanent (fiscal rule) target means that governments are bound to violate such fiscal rules, thereby losing credibility. This problem raises the question of how governments can use a fiscal rule that is not wholly arbitrary, while also dealing with the uncertainty involved in setting the budget deficit.

One solution is for a government to set up a permanent (fiscal rule) target that targets the standard deviation of the deficit instead of the level of the budget deficit. Therefore, using historic data on the output gap, one can calculate the standard deviation of the output gap. Placing the values of two standard deviations for the output gap into equations 2 and 3, and then using equation 4, one can calculate the two-standard deviation band around the structural budget balance, with upper and lower values within which the announced deficit budgeted for the following year must fall. The government will then only need to ensure that the deficit budgeted for the following year falls within the band. This approach in essence allows the automatic stabilisers to act. The benefit of this approach is that when the actual deficit deviates from the budgeted deficit, the probability is high that the actual deficit still falls within the target band. Thus, when the actual deficit deviates from the budgeted deficit but deviations still fall within the target band, the government will not lose credibility.

Under normal circumstances, a rule such as the deficit rule set out above might be sufficient to ensure fiscal sustainability. Indeed, since two-standard deviations of the output gap are used to set the bandwidth within which the deficit movements will be limited, that bandwidth is designed to cover 95% of all output gap movements, *ceteris paribus*. However, the *ceteris paribus* clause may be contravened in the event of the unexpected. Furthermore, wrong forecasts for GDP or a lax attitude regarding the deficit that leads to a hardening of the upper bound of the deficit band could lead to a build-up of debt. In addition, the government needs to keep in mind the possibility of Japanese-style recessionary conditions when a prolonged recession causes the debt/GDP ratio to keep on increasing. Under these conditions, the deficit rule will not ensure fiscal sustainability even if the deficit remains within its band.

To deal with such events that cause a significant build-up of debt, the government may also implement a debt feedback mechanism in addition to the deficit band. Thus, for any per cent deviation above the target of 35%, a correction could be subtracted from the deficit

of the next couple of years to reduce the debt/GDP ratio back to target (the opposite can be done if debt falls below target). For instance, a feedback rule might state that a third of the deviation of debt from the target of the previous year should be subtracted from the deficit.[3] The debt feedback rule can be further refined so that, in this case too, the government might consider using a range within which the debt/GDP ratio can be allowed to fluctuate. Thus, the feedback mechanism kicks in when the debt/GDP ratio falls outside (for instance) the 25-45% band, thus ensuring that feedback does not occur in the depth of a recession.[4] The width of the band can be set arbitrarily or with reference to the deficit band. Thus, if the deficit band is set using two standard deviations of the output gap in equations 2, 3 and 4, and if on average downswings last (for instance) for two or three years, the government may set the bandwidth for debt so as to allow two or three successive years of the deficit at the maximum of its upper bound. This action will prevent a hardening of the upper bound of the deficit band. More importantly, the debt feedback rule ensures fiscal sustainability in the longer run by overriding the effect of the deficit rule when debt tends to increase above levels acceptable to the government.

3. A flexible fiscal framework: the mechanics

So how will a combined deficit-and-debt rule work? Suppose that C^{**}_t/Y_t is the projected budget deficit before adjustments are made to remain within the target ranges for both the deficit and debt:

$$C^{**}_t/Y_t = [(1 + v)(G_{t-1}) - (1 + r)(T_{t-1})]/(1 + n)Y_{t-1} \qquad (5)$$

where v is the growth rate of government expenditure, r is the growth rate of revenue, n is the nominal economic growth rate, G is government expenditure, T is government revenue and Y is nominal GDP. A deficit rule can then be defined as:

$$C_t/Y_t = C^{**}_t/Y_t - \alpha_1[C^{**}_t/Y_t - (C^*/Y)^L] - \alpha_2[C^{**}_t/Y_t - (C^*/Y)^U] \qquad (6)$$

where C is the actual budget deficit. A debt feedback rule can be defined as:

$$C_t/Y_t = C^{**}_t/Y_t - \beta_1[(D_{t-1}/Y_{t-1}) - (D/Y)^L] - \beta_2[(D_{t-1}/Y_{t-1}) - (D/Y)^U] \qquad (7)$$

where $(C^*/Y)^L$ and $(C^*/Y)^U$ represent respectively the lower and upper bounds for the target range for C^*/Y, and $(D/Y)^L$ and $(D/Y)^U$ represent respectively the lower and upper bounds for the target range for D/Y. In addition:

$\alpha_1 = 1$ if $C^{**}_t/Y_t < (C^*/Y)^L$ and $\alpha_1 = 0$ if $C^{**}_t/Y_t \geq (C^*/Y)^L$

$\alpha_2 = 1$ if $C^{**}_t/Y_t > (C^*/Y)^U$ and $\alpha_2 = 0$ if $C^{**}_t/Y_t \leq (C^*/Y)^U$

$0 < \beta_1 \leq 1$ if $D_{t-1}/Y_{t-1} < (D/Y)^L$ and $\beta_1 = 0$ if $D_{t-1}/Y_{t-1} \geq (D/Y)^L$

$0 < \beta_2 \leq 1$ if $D_{t-1}/Y_{t-1} > (D/Y)^U$ and $\beta_2 = 0$ if $D_{t-1}/Y_{t-1} \leq (D/Y)^U$

In principle, it is possible for governments to apply either equation 6 or equation 7. The deficit rule as contained in equation 6 will allow the deficit to move counter-cyclically, but within limits set by the lower and upper bounds. However, a drawback of this rule is that if the economy remains in a recession for a protracted period (Japan being a prime example), it will not prevent the debt/GDP ratio from increasing. Nevertheless, the rule will prevent fiscal unsustainability in the strict sense of the word by preventing the debt/GDP ratio and deficit/GDP ratio from both increasing at an increasing rate. More specifically, the rate at which the debt/GDP ratio will increase will remain constant relative to GDP. To ensure that debt does not increase either unboundedly or at a constant rate to GDP,

governments could use the debt rule contained in equation 7. Equation 7 in itself is sufficient to ensure that the debt/GDP ratio does not increase without limit. It also allows for counter-cyclical policy, but it places no limit on how quickly the lower or upper bounds for the debt/GDP ratio are reached from within the acceptable debt/GDP target range. However, as discussed in the previous section, the government can also combine the two rules:

$$C_t/Y_t = C^{**}_t/Y_t - \alpha_1[C^{**}_t/Y_t - (C^*/Y)^L] - \alpha_2[C^{**}_t/Y_t - (C^*/Y)^U] - \beta_1[(D_{t-1}/Y_{t-1}) - (D/Y)^L]$$
$$- \beta_2[(D_{t-1}/Y_{t-1}) - (D/Y)^U] \tag{8}$$

The same conditions for α and β apply as in the case of equations 6 and 7, and are augmented with the following condition: when $\beta_1 = 0$ and $\beta_2 = 0$, then $\alpha_1 = 1$ and $\alpha_2 = 1$, and when $\beta_1 \neq 0$ or $\beta_2 \neq 0$, then $\alpha_1 = 0$ and $\alpha_2 = 0$. Thus, the government applies both rules, with the additional condition ensuring that the debt rule dominates the deficit rule once debt exceeds the acceptable range.

The deficit rule then allows the government to run counter-cyclical policy, but it paces the speed of the stimulus or contraction by setting a limit to the range within which the deficit/GDP ratio can move. However, once the government reaches either the lower or upper bound of the debt/GDP ratio, the debt rule kicks in and sets the pace for the deficit/GDP ratio that the government can run.

There are three main benefits of the framework described above:

- The framework is simple to explain, as it is analogous to inflation targeting.
- Fiscal discipline is ensured but, as long as the actual deficit remains within the band, deviations of actual deficits from announced budget targets do not constitute failure to keep to the fiscal rule.
- The proposed rule is flexible, yet sets limits. It allows a government to react to recessionary conditions while also *ex ante* setting out the exit strategy the government can use. Market confidence is thus increased, which may also help to improve the impact of fiscal stimulus measures.

4. The fiscal reaction function: assessing the government's past behaviour

Achieving deficit and debt targets is done indirectly, through adjusting either revenue or expenditure levels or both. The IMF reports (IMF, 2011:88, 91) that, when attempting fiscal adjustment, G7 countries usually set out to cut expenditure rather than increase taxes.[5] However, expenditure cuts usually turn out to be much less than expected, while the revenue collected exceeds expectation. Applying a fiscal rule also entails adjusting either revenue or expenditure or both. In addition, understanding the revenue and expenditure behaviour of a government in the past might therefore act as a guide to what that government is likely to adjust in order to keep to its rule should no explicit changes to its behaviour occur. An understanding of past behaviour can also guide a government in making changes to its behaviour that will increase the scope for adjustment.

This section explores the past behaviour of the South African government to establish the behaviour of the deficit, revenue and expenditure with respect to debt. It shows that, as in the G7 countries, adjustments usually rely on revenue adjustments, though expenditure also adjusts. To investigate the past behaviour of the government, this section presents estimates of the fiscal reaction function, following the specification by Bohn (1998), Claeys

(2008), Favero and Marcellino (2005), and Favero and Monacelli (2005). Section 5 then discusses measures to increase the responsiveness of expenditure and revenue.

4.1. *Deriving the reaction function*

In essence, the reaction function considers the reaction of the primary balance/GDP, revenue/GDP or expenditure/GDP ratios to a change in the public debt/GDP ratio. Starting with the budget constraint of government (equation 9), one can derive Bohn's fiscal reaction function (Bohn, 1998).

$$D_t = D_{t-1} + i_t D_{t-1} - B_t \tag{9}$$

where D is public debt, i is the nominal interest rate on government bonds, and B is the primary balance (+ surplus; – deficit). From equation 9 one can get:

$$\Delta(D/Y)_t = [(r_t - g_t)/(1 + g_t)](D/Y)_{t-1} - (B/Y)_t \tag{10}$$

where r is the real interest rate, g is the real economic growth rate, and Y is nominal GDP. We define $\alpha_t^{Required} = (r_t - g_t)/(1 + g_t)$ and set $\Delta(D/Y)_t = 0$ to get the primary balance required to ensure a stable debt/GDP ratio:

$$(B/Y)_t^{Required} = \alpha_t^{Required}(D/Y)_{t-1} = [(r_t - g_t)/(1 + g_t)](D/Y)_{t-1} \tag{11}$$

To establish whether the government acted to keep its debt/GDP ratio stable over time, one can estimate what value $\alpha_t^{Required}$ took in reality. Thus, one can estimate:

$$(B/Y)_t^{Actual} = \alpha(D/Y)_{t-1} + \varepsilon_t \tag{12}$$

Equation 12 can be expanded to include a lag of the primary balance that will allow for inertia in government behaviour (De Mello, 2005:10). A constant (α_1) can also be added to allow for an (explicit or implicit) debt/GDP target not equal to zero. If necessary, the output gap can also be included as a control variable. The fiscal reaction function then becomes:

$$(B/Y)_t^{Actual} = \alpha_1 + \alpha_2(B/Y)_{t-1}^{Actual} + \alpha_3(D/Y)_{t-1} + \varepsilon_t \tag{13}$$

To expect government behaviour and thus the reaction function to remain constant over long periods of time might be construed as possibly (though not necessarily) unrealistic. More specifically, different political administrations may view their debt positions differently. To deal with the possible effect of different administrations, this article presents estimates of equation 13 that control for the different political administrations of South Africa since 1948 by including dummies that interact with the debt/GDP ratio.

A further refinement of equation 13 was made by Claeys (2008:24-30) and by Favero and Marcellino (2005:763) who follow Bohn's (1998) specification, but they prefer to separate the components of the primary balance. Therefore, using equation 13, they substitute expenditure and revenue, in turn, for the primary balance.

As long as $\alpha_3/(1 - \alpha_2)$ in equation 13 is equal to or larger than $\alpha^{Required}$ in equation 11, fiscal policy will be sustainable. However, this condition is limited to cases where $r > g$. Bispham (1987:67-70) showed that when $r < g$, fiscal policy technically speaking cannot become unsustainable if unsustainability is defined as a public debt/GDP ratio that moves to infinity in finite time. If $r \neq g$, equation 14 – which is a multi-period budget constraint – describes the dynamics of the debt/GDP ratio over time (with p being the initial debt/GDP ratio at time $t = 0$):[6]

$$D_t/Y_t = (B/Y)\left(\frac{1+g}{r-g}\right)\left(\frac{1+r}{1+g}\right)^t - (B/Y)\left(\frac{1+g}{r-g}\right) + p\left(\frac{1+r}{1+g}\right)^t \tag{14}$$

When $r > g$ and $t \to \infty$, equation 14 shows that the debt/GDP ratio will explode unless the first term on the right-hand side of equation 14, through an adjustment of the primary balance, is set equal in size but opposite in sign to the third term on the right-hand side. However, note that when $r < g$ and $t \to \infty$, equation 14 reduces to equation 15. Equation 15 indicates that when $r < g$ the debt/GDP ratio will converge to a stable ratio and thus not explode.[7] Therefore, even though it might still decide to react to its debt position when $r < g$, the government need not – within limits, of course – react to developments in the debt/GDP ratio.[8]

$$D_t/Y_t \to -(B/Y)\left(\frac{1+g}{r-g}\right) = (B/Y)\left(\frac{1+g}{g-r}\right) \tag{15}$$

To deal with the possibility that the government may or may not react to the debt/GDP ratio depending on the sign of the $(r_t - g_t)/(1 + g_t)$ gap, equation 13 can be estimated with a Markov-switching model. A number of studies have used Markov-switching models in which the probabilities of different fiscal policy regimes can vary endogenously (*cf.* Afonso *et al.*, 2009; Caceres *et al.*, 2010; Claeys, 2005; Favero and Monacelli, 2005). Generally, these studies impose two regimes *a priori* – *i.e.* a fiscal active and a fiscal passive regime as in Leeper (1991) – and then compare these models to a single-regime model as well as to higher-regime models.[9] However, two regimes can also be imposed when expecting one regime to apply when $r > g$ (a case where $\alpha_3 > 0$) and when $r < g$ (a case where $\alpha_3 \leq 0$). Neither of these two regimes is fiscally irresponsible; they merely represent two behaviours that, each in its specific setting, represent a sustainable fiscal policy. However, note that when imposing two regimes, the regimes observed might not be so closely linked to the sign of the $(r_t - g_t)/(1 + g_t)$ gap. Thus, one might simply find a stable debt regime where the government reacts to debt irrespective of whether r exceeds or falls short of g, and an unstable debt regime which technically is only possible when $r > g$. The latter might also be characterised as a fiscal active regime, while the former is the fiscal passive regime.

A further way in which to allow for changing behaviour over time is to follow Favero and Monacelli (2005) and Favero and Marcellino (2005). These authors take a slightly different approach from Bohn (1998) and Claeys (2008), by specifying a reaction function that allows for the government's response to debt to vary over time depending on the position of the real interest rate relative to the real economic growth rate. Equation 13 is then adjusted so that, using equation 11:

$$(B/Y)_t^{Actual} = \alpha_1 + \alpha_2(B/Y)_{t-1}^{Actual} + \gamma_1\alpha^{Required}(D/Y)_{t-1} + \upsilon_t = \alpha_1 + \alpha_2(B/Y)_{t-1}^{Actual}$$
$$+ \gamma_1(B/Y)_t^{Required} + \upsilon_t \tag{16}$$

where α_3 in equation 13 equals $\gamma_1\alpha^{Required}$ in equation 16.

Thus, as shown in equation 16, the fixed reaction to the debt/GDP ratio estimated with equation 13 becomes a time-varying reaction in equation 16 that depends on the movements in $\alpha^{Required}$ and thus $(r - g)/(1 + g)$. When fiscal policy is responsive to its debt position, $\gamma_1 = 1$ in equation 16. However, note that even though equation 16 allows for government behaviour as captured by $\gamma_1\alpha^{Required}$ to adjust over time depending exclusively on changes in $\alpha^{Required}$ and thus $(r - g)/(1 + g)$, one might also, in addition, allow for the time-varying behaviour of γ_1. The size of γ_1 might then also depend on the position of r relative to g. As with the discussion above, when $r < g$ the government might decide not to react to its debt, in which case $\gamma_1 = 0$, or it might act counter-cyclically, which means that $\gamma_1 < 0$. (It will be counter-cyclical provided that the cyclical increase [decrease] in the growth rate outpaces the cyclical increase [decrease] in the interest rate, meaning that $(r - g)$ moves

counter-cyclically.) To allow for all these different types of time-varying behaviour, this article presents results estimated with a single-regime model, a two-regime Markov-switching model, and a generalised method of moments (GMM) model estimated with interactive dummies. Just as with equation 13, equation 16 can also be estimated with the components of the deficit, thus separating revenue and expenditure. The following subsections present the estimation results for equations 13 and 16.

4.2. The reaction of the primary balance/GDP ratio to the debt/GDP ratio

This section presents results for fiscal reaction functions estimated with the primary balance, total expenditure and total revenue, as well as revenue collected from income taxes and goods and sales taxes. Because they contain the longest and most detailed time series, the data for the primary balance, as well as government revenue and expenditure, originate from the national government finance statistics obtained from the online download facility of the South African Reserve Bank (*www.resbank.co.za*). Monthly and annual data for the level series of the types of revenue are only available since 1990, with quarterly four-term percentage changes available since 1968 (except for sales taxes that were first levied in 1970). Quarterly and annual data for total expenditure and revenue are available from 1960, and quarterly data for interest payments are available since 1971. The public debt/GDP ratio refers to gross public debt for national government, and is available on an annual basis since 1947 and a quarterly basis since 1960. Primary balance data using government data are only available since 1971. However, the analysis uses a second primary balance series calculated with national accounts data only available on an annual basis and dating back to 1947. Since the underlying data-generating process for government data is the annual budget (*i.e.* the government reacts to the previous year's debt/GDP ratio), the above data were used to generate annual series using all available data. An exception is made with the Markov-switching models. The choice of using quarterly as opposed to annual data in the Markov-switching models was governed by concerns about the ability of the model to detect regime-switching behaviour. Studies like Cheung and Erandsson (2005) have found that, in addition to selecting a reasonable sample size, an increase in sample frequency offers a better chance of detecting Markov-switching dynamics. Hence, the Markov-switching models were estimated using quarterly data and government reacting to the fourth lag. The output gap was generated using a Hodrick-Prescott filter.[10] The regressions presented below use all available data (unless otherwise indicated), which means that sample periods are not always the same.

The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) stationarity tests (with stationarity as the null hypothesis) yield mixed results, in most cases indicating that at a 5% level the series are non-stationary, but at a 1% level they are stationary. Bohn (1998) notes that the debt/GDP ratio and the primary balance/GDP ratio usually display very high levels of persistence, so high indeed that it becomes extremely difficult to establish unambiguously whether or not the series are stationary. However, in several papers Bohn argues why the series should be accepted as stationary on economic grounds (Bohn, 1998). His reasoning is based on the fact that, in the United States, the real interest rate paid by the government has for most of the 20th century been below the economic growth rate, a point Bohn (2010) recently repeated.[11] Bohn (2007) also argues that one should not be overly concerned with the stationarity of the debt, expenditure or revenue series (whether or not expressed as ratio to GDP) because, if differencing these series any number of times renders them stationary, then a government satisfies its intertemporal budget constraint. Instead Bohn

argues for the use of "error-correction-type policy reaction functions", such as the one defined above, in which he does not explicitly control or account for the stationarity properties of the data. Favero and Marcellino concur with Bohn when they argue in their article that:

> As there are strong economic reasons to assume that all the seven variables [which include government receipts, expenditure, debt and the fiscal balance, all expressed as ratio to GDP] are stationary, we will proceed under this assumption even though the outcome of augmented Dickey-Fuller unit root tests is mixed, likely due to the low power of these tests in samples as short as ours (42 observations). (Favero and Marcellino, 2005:759; the text in square brackets above was not in the original, but refers to the variables that Favero and Marcellino included.)

Following Bohn (2007), this section presents estimates of various forms of the fiscal reaction function as specified in equation 13. Note that all the reaction functions were estimated using GMM to deal with problems of endogeneity (lags of the explanatory variables are used as instruments and all estimations are just identified).

Table 1 presents an estimate of equation 13 with the primary balance as a left-hand side variable and the output gap as a control variable. The model runs from 1971 to 2010 and was estimated using the primary balance data calculated with government data. As Burger *et al.* (2011) indicated, using a state space model for the period 1947-2009, the government's reaction changed in the 1970s and 1980s. To address the issue of possible breaks in government behaviour over time, the analysis uses a set of dummies that will interact with the debt/GDP ratio and distinguishes between the terms of the various administrations in power. In addition, the analysis uses the primary balance calculated with national accounts data and which covers a sample running from 1949 to 2010. Thus, it covers all the terms of both the National Party and African National Congress administrations. The dummy takes a value of one starting in the year after an administration took power, since that would be the first budget fully under control of that administration. The administrations were: Malan (1948-54), Strijdom (1954-58), Verwoerd (1958-66), Vorster (1966-78), Botha (1978-89), De Klerk (1989-94), Mandela (1994-99), Mbeki (1999-2008), Motlanthe (2008-09) and Zuma (2009-present). Since the Motlanthe administration was a caretaker administration for and until Zuma took power in 2009, their terms are put together.

Table 1. **The fiscal reaction function**
Sample 1971-2010; *p* values in brackets

	B/Y
(B/Y)(−1)	0.947 (0.000)
(D/Y)(−1)	0.090 (0.015)
(Y gap)(−1)	−0.553 (0.025)
C	−0.033 (0.024)
Adjusted R^2	0.29

Table 2 shows the results for the terms of the various administrations. The analysis was run for the full sample for which debt and deficit data are available, namely 1949-2010 (and thus includes all National Party and African National Congress administrations). Adding in turn the parameters of the various administrations' dummies that interact with

the debt/GDP ratio to the parameter of the debt/GDP ratio clearly indicates how the government's reaction changed over time. As mentioned above, prior to 1990, $(r - g)/(1 + g)$ in equation 13 was clearly negative, allowing the government to run a primary deficit without putting upward pressure on the debt/GDP ratio. The sum of the parameter of the dummy that interacts with the debt/GDP ratio and the parameter of the debt/GDP ratio is negative up to the late 1970s. Under the Botha administration, the sum is slightly positive (–0.054 + 0.057 = 0.003). However, during the De Klerk administration the sum is again negative (–0.054 + 0.035 = –0.019), in an era when $(r - g)/(1 + g)$ was turning positive for the first time (though it remained close to zero and only once slightly exceeded 1%). This period was characterised by falling tax receipts as a result of negative economic growth and by falling investment due to the political instability that preceded the 1994 political transition. Political conditions also made it difficult to reduce expenditure to stabilise debt. Hence, the debt/GDP ratio increased from roughly 35% to 50%. During the Mandela administration, the $(r - g)/(1 + g)$ gap turned strongly positive, reaching 5% in 1998. It turned negative again under the Mbeki administration. However, the sum of parameters turned strongly positive during both the Mandela and Mbeki administrations, a result that is visible in the decrease in the debt/GDP ratio from roughly 50% to 23% in 2008. The Zuma administration has a strong negative parameter[12] since the debt/GDP ratio increased sharply in the first two years of his administration as a result of the recession affecting the country, while the $(r - g)/(1 + g)$ gap turned positive again. This negative parameter should be interpreted with care, as it only covers a short span of time during an unusual period of international economic and financial instability. Note that, in these and all further estimates containing interactive dummies, including the output gap did not yield significant results. Hence it was omitted.

Table 2. **The deficit reaction function with interactive dummies**

Sample 1949-2010; p values in brackets

	B/Y
(D/Y)(−1)	−0.054 (0.000)
D4954*(D/Y)(−1)	0.032 (0.002)
D5558*(D/Y)(−1)	0.023 (0.073)
D5966*(D/Y)(−1)	0.033 (0.004)
D6778*(D/Y)(−1)	0.022 (0.152)
D7989*(D/Y)(−1)	0.057 (0.000)
D9094*(D/Y)(−1)	0.035 (0.027)
D9599*(D/Y)(−1)	0.090 (0.000)
D0008*(D/Y)(−1)	0.125 (0.000)
Adjusted R^2	0.48

Following Claeys (2008) and Favero and Marcellino (2005), the primary balance was in turn replaced with, respectively, total and non-interest expenditure, total revenue, and various types of taxes. First, Table 3 presents the results for total expenditure and revenue for the period 1968 to 2010. It does not yet include any of the dummies defined above. The results indicate, as expected, a high degree of persistence (the Wald test fails to reject the null hypothesis that the parameter of the lag of the revenue/GDP ratio and the lag of non-interest expenditure equals one; however, for total expenditure it is rejected). Furthermore, both revenue and expenditure react to changes in debt, and both with the right direction. Thus, in reaction to an increase in the debt/GDP ratio, the revenue/GDP ratio increases,

while the two expenditure/GDP ratios decrease. The last two columns of Table 4 also present the long-run values of the parameters, calculated as $\alpha_3/(1 - \alpha_2)$. As can be seen, the long-run parameter for revenue is larger than that of total expenditure, indicating that revenue contributes more to the adjustment. This result is in line with the finding of the IMF (2011) cited above. However, the long-run parameter of non-interest expenditure is larger than that of revenue.

Table 3. **Total revenue and expenditure reaction functions**

Sample 1960-2010, except for the non-interest model which runs from 1971; p values in brackets

		Estimated models			Long-run parameters $[\alpha_3/(1 - \alpha_2)]$		
		Revenue/Y	Expenditure/Y	Non-interest expenditure/Y	Revenue/Y	Expenditure/Y	Non-interest expenditure/Y
(Revenue/Y)(−1)		0.967 (0.000)					
(Expenditure/Y)(−1)			0.860 (0.000)				
(Non-interest expenditure/Y)(−1)				0.972 (0.000)			
(D/Y)(−1)		0.023 (0.039)	−0.060 (0.014)	−0.095 (0.001)	0.697	−0.429	−3.373
C			0.060 (0.003)	0.045 (0.013)		0.429	1.602
Adjusted R^2		0.93	0.87	0.89			
Wald	t-statistic	0.155	0.006	0.681			
Test	F-statistic	0.155	0.006	0.681			
(Prob)	Chi-square	0.148	0.006	0.679			

Table 4. **Types of revenue reaction functions**

Sample 1968-2010 for income taxes; 1970-2010 for goods and sales taxes; p values in brackets

		Estimated models			Long-run parameters $[\alpha_3/(1 - \alpha_2)]$		
		Income tax/Y	Goods tax/Y	Sales tax/Y	Income tax/Y	Goods tax/Y	Sales tax/Y
(Income tax/Y)(−1)		0.923 (0.000)					
(Goods tax/Y)(−1)			0.976 (0.000)				
(Sales tax/Y)(−1)				0.937 (0.000)			
(D/Y)(−1)		0.028 (0.009)	0.007 (0.222)	0.011 (0.008)	0.363	0.156	0.173
Adjusted R^2		0.78	0.96	0.95			
Wald	t-statistic	0.029	0.388	0.027			
Test	F-statistic	0.029	0.388	0.027			
(Prob)	Chi-square	0.023	0.383	0.021			

Subsequent to the total revenue and total expenditure reaction functions, reaction functions for the main types of taxes were estimated (time series for types of expenditure are not available for long enough samples). These types of taxes are income taxes (corporate and individual), goods taxes, sales taxes (which constitute the largest component of goods taxes), property taxes and trade taxes. In the estimations, all the taxes were expressed as a ratio of GDP. Trade taxes did not yield any significant results, while the reaction of property taxes to the public debt/GDP ratio, though statistically significant, was very small. Thus, trade and property taxes were excluded from the analysis presented below. The parameter for the debt/GDP ratio was positive (as one would expect) and statistically significant for income taxes and sales taxes, with the parameter for income taxes being the largest. These results therefore indicate that the main types of taxes – namely income and sales taxes – increased as a percentage of GDP in the face of an increase in the debt/GDP ratio. Table 4 also presents the long-run values of the parameters

from which it is clear that, in the income tax/GDP ratio equation, the long-run parameter value for the debt/GDP ratio is the largest.

The estimates containing the interactive dummies for the terms of administration of the various prime ministers and presidents yield significant results (presented for the period 1960-2010; see Table 5). Note that the parameter for the debt/GDP ratio itself was statistically insignificantly different from zero (thus indicating no reaction in the Zuma administration – again a result that should be considered with caution since the administration is young and took power during a recession, so the administration has not had the opportunity to demonstrate fully its stance with regard to debt). Therefore, the reaction of each administration is summarised by the parameter for the interactive dummy multiplied by the debt/GDP ratio. Table 5 shows that both revenue and expenditure consistently reacted to increases in debt with the requisite sign (positive for revenue and negative for expenditure). It should also be noted that, once one controls for the different regimes, the Wald test – conducted to determine whether the parameters on the lags of the revenue/GDP and expenditure/GDP ratios equal one – is rejected. Lastly, Table 5 also presents the long-run values of the parameters from which it is clear that, in the revenue/GDP ratio equation, the long-run parameter value for the debt/GDP ratio is larger than in both the expenditure/GDP ratio and the non-interest expenditure/GDP ratio equations. Thus, the finding that the non-interest expenditure/GDP ratio responds with more than the revenue found when the regression was run without the interactive dummies is overturned when including the interactive dummies.

Table 6 presents regressions with the income tax/GDP ratio, the goods tax/GDP ratio and the sales tax/GDP ratio. The income tax/GDP ratio was regressed on its own lag and the dummies for the terms of prime ministers and presidents that interact with the public debt/GDP ratio. Note that the debt/GDP ratio is not included, as it is statistically insignificant when included. The parameters show a consistent reaction of the income tax/GDP ratio, with the lowest reactions in the period 1989-94 (a period of low growth and thus lower tax income due to the political uncertainty preceding the transition to democracy) and, of course, the period 2009-10 when the parameter has a zero value (as indicated by the debt/GDP ratio being omitted from the model due to its statistical insignificance). The Wald test also indicates that the parameter on the lagged value of the income tax/GDP ratio is not equal to one.

Table 6 also presents estimates for the goods tax/GDP and sales tax/GDP ratios. As mentioned above, sales tax constitutes the largest proportion of goods taxes, with the petrol levy being the second-largest component. Estimations with the terms of the various prime ministers did not yield satisfactory results. A possible explanation for this might be the rather fragmented history of sales tax. In 1970, the government imposed a sales tax on goods when the goods left the factory or were imported. According to Browne (1983), this sales tax did not yield the expected income stream for the government. Therefore, the government replaced this first sales tax in 1978 with the general sales tax (GST) levied on final consumers at a rate of 4%. In 1991, the government in turn replaced the GST – then levied at 12% – with the value-added tax (VAT) at a rate of 10%. Thereafter the VAT rate increased to 14% (the debt burden also increased during the same period).[13] Since the ANC government came to power, it has not changed the VAT rate.

Therefore, instead of using the terms of prime ministers and presidents, dummy variables that respectively cover the GST period (1978-90) and the VAT period (1991-2010)

Table 5. **Total revenue and expenditure reaction functions with interactive dummies**

Sample 1960-2010, except for the non-interest model which runs from 1971; p values in brackets

	Estimated models			Long-run parameters $[\alpha_3/(1-\alpha_2)]$		
	Revenue/Y	Expenditure/Y	Non-interest expenditure/Y	Revenue/Y	Expenditure/Y	Non-interest expenditure/Y
(Revenue/Y)(−1)	0.961 (0.000)					
(Expenditure/Y)(−1)		0.573 (0.006)				
(Non-interest expenditure/Y)(−1)			0.548 (0.009)			
D5966*(D/Y)(−1)	0.019 (0.011)	−0.120 (0.023)		0.499	−0.282	
D6778*(D/Y)(−1)	0.025 (0.002)	−0.094 (0.009)	−0.148 (0.009)	0.642	−0.220	−0.327
D7989*(D/Y)(−1)	0.035 (0.006)	−0.089 (0.027)	−0.125 (0.006)	0.897	−0.209	−0.277
D9094*(D/Y)(−1)	0.017 (0.173)	−0.052 (0.015)	−0.057 (0.020)	0.429	−0.122	−0.127
D9599*(D/Y)(−1)	0.025 (0.001)	−0.043 (0.012)	−0.061 (0.002)	0.647	−0.100	−0.135
D0008*(D/Y)(−1)	0.024 (0.125)	−0.071 (0.007)	−0.076 (0.002)	0.622	−0.166	−0.168
C		0.136 (0.021)	0.140 (0.009)		0.318	0.309
Adjusted R^2	0.92	0.87	0.86			
Wald	t-statistic	0.018	0.036	0.029			
Test	F-statistic	0.018	0.036	0.029			
(Prob)	Chi-square	0.014	0.030	0.022			

Table 6. **Types of revenue reaction functions with interactive dummies**

p values in brackets

	Estimated models			Long-run parameters $[\alpha_3/(1-\alpha_2)]$		
	Income tax/Y[1]	Goods tax/Y[2]	Sales tax/Y[2]	Income tax/Y[1]	Goods tax/Y[2]	Sales tax/Y[2]
(Income tax/Y)(−1)	0.943 (0.000)					
(Goods tax/Y)(−1)		0.968 (0.000)				
(Sales tax/Y)(−1)			0.935 (0.000)			
D7890*(D/Y)(−1)		0.018 (0.000)	0.019 (0.000)		0.563	0.292
D9110*(D/Y)(−1)		0.006 (0.035)	0.011 (0.011)		0.188	0.169
D6778*(D/Y)(−1)	0.028 (0.000)			0.485		
D7989*(D/Y)(−1)	0.024 (0.000)			0.416		
D9094*(D/Y)(−1)	0.011 (0.157)			0.195		
D9599*(D/Y)(−1)	0.020 (0.000)			0.353		
D0008*(D/Y)(−1)	0.024 (0.014)			0.425		
Adjusted R^2	0.78	0.97	0.97			
Wald	t-statistic	0.000	0.006	0.024			
Test	F-statistic	0.000	0.006	0.024			
(Prob)	Chi-square	0.000	0.003	0.018			

1. Sample 1968-2010.
2. Sample 1970-2010.

were created and subsequently interacted with the debt/GDP ratio. Table 6 shows that both these dummy variables interacting with the debt/GDP ratio have the correct sign and are statistically significant. The positive value for the VAT dummy interacting with the debt/GDP ratio in the face of an unchanged VAT rate since the mid-1990s possibly follows from the sharp increase in the VAT rate in the early 1990s, during a period in which the debt/GDP ratio also increased sharply.

To conclude, the above discussion shows that, once one controls for different administrations or changes made to the types of taxes levied, as was the case with GST and VAT, almost all the series turned out to be stationary – a finding that concurs with the

arguments of Bohn, Claeys, and Favero and Marcellino that these series are inherently stationary.

More importantly, regarding the question raised above as to whether the government depended on adjustments to revenues or expenditures – or both – when pursuing a fiscal rule, the above analysis indicates that when the debt/GDP ratio increased, both revenue and expenditure adjusted, thereby ensuring the sustainability of fiscal policy in the post-WWII period. However, when comparing the size of the long-run tax and expenditure parameters, calculated as $\alpha_3/(1 - \alpha_2)$, it would appear that the expenditure parameters are smaller than the tax parameters. This finding accords with the IMF finding about the behaviour of G7 country governments (IMF, 2011).

Lastly, irrespective of which set of dummies (political administrations or types of sales taxes) is included in the regressions with the primary balance as dependent variable, it is clear that the size of the parameters mostly reflects the stance of the $(r - g)/(1 + g)$ gap. Thus, although the reaction of the various administrations differed, the extent to which they differed seems to reflect the stance of the $(r - g)/(1 + g)$ gap at the time. Hence, this analysis calls for the use of a time-varying analysis that controls for the movements in the $(r - g)/(1 + g)$ gap. This is done in subsection 4.4 below.

4.3. Allowing for a time-varying reaction to the debt/GDP ratio using a Markov-switching model

Using quarterly data for the period 1972Q1-2010Q4 (*i.e.* 156 observations), this section presents the Markov-switching estimations for fiscal reaction functions as specified in equations 13 and 16. Because of a lack of data, the analysis does not attempt to extend its examination to the period prior to the 1970s. Thus, the analysis uses the primary balance calculated with government data. The following two specifications were estimated for South Africa over the period:

$$(B/Y)_t^{Actual} = \alpha_{0st} + \alpha_{1st}(B/Y)_{t-4}^{Actual} + \alpha_{2st}y_{t-4} + \alpha_{3st}(D/Y)_{t-4} + \varepsilon_{tst} \qquad (13.1)$$

$$(B/Y)_t^{Actual} = \beta_{0st} + \beta_{1st}(B/Y)_{t-4}^{Actual} + \beta_{2st}y_{t-4} + \gamma_{1st}(B/Y)^{Required}_{t-4} + \upsilon_{tst} \qquad (16.1)$$

where subscript s is a state variable that is unobserved and assumed to be generated by a probability distribution that takes into account both the parameters and the variables in the model. In addition, s takes on values of $N = 1, 2$, thus denoting two regimes (*i.e.* the assumption of a two-state Markov chain is made). Transition probabilities are given by $p_{ij} = Pr(s_t = j | s_{t-1} = i)$ and, assuming that the current regime is i, the expected average duration of staying in the same regime is $(1 - p_{ii})^{-1}$. The specification in equations 13.1 and 16.1 allows all of the model parameters to vary across regimes. Lastly, errors ε_t and υ_t are considered to be normally distributed with a zero mean and a constant variance that is allowed to be different in each regime.[14] Note that all of the regressors have been lagged four quarters to capture the annual nature of the national budget process. Tables 7 and 8 below report the estimation results.

The bottom row in Table 7 reports the results obtained making the assumption of a constant fiscal regime over the estimation period. This model uses the same data as the model reported in Table 1, the only difference being that Table 1 uses an annual frequency, while Table 7 is quarterly. The parameters are statistically significant and indicate that fiscal policy has been active and pro-cyclical over the estimation sample. With respect to the Markov-switching model, the results reported in Table 7 show that two fiscal regimes can be identified for South Africa over the estimation sample. Regime 1 has a positive and

Table 7. **Estimation results for equation 13.1**

p values in brackets

	α_0	α_1	α_2	α_3	Probability: p_{11}, p_{22}	Duration of regime
Regime 1	−0.012 (0.013)	0.765 (0.000)	−0.150 (0.000)	0.052 (0.000)	0.97 (0.000)	32.67 quarters
Regime 2	−0.027 (0.341)	0.506 (0.177)	0.495 (0.000)	0.059 (0.201)	0.84 (0.000)	6.37 quarters
Constant	−0.027 (0.001)	0.836 (0.000)	−0.115 (0.012)	0.083 (0.000)	–	–

statistically significant α_3 coefficient (*i.e.* fiscal pacifism) and a negative (*i.e.* pro-cyclical) and statistically significant α_2 coefficient. Regime 2 has a positive and statistically insignificant α_3 coefficient (*i.e.* fiscal activism) and a positive (*i.e.* counter-cyclical) and statistically significant α_3 coefficient. In terms of the durations of the two regimes, Regime 1 is more persistent, with Regime 2 detected in three brief periods: 1980-82, 1992-94 and 2009-10 (see Figure 2 that indicates the probability of being in Regime 1). Notice that especially the last two periods were characterised by relatively sharp increases in the debt/GDP ratio (while in the case of the first period, it marked the end of the longer-run decrease in the debt/GDP ratio).

Figure 2. **The probability of being in Regime 1**
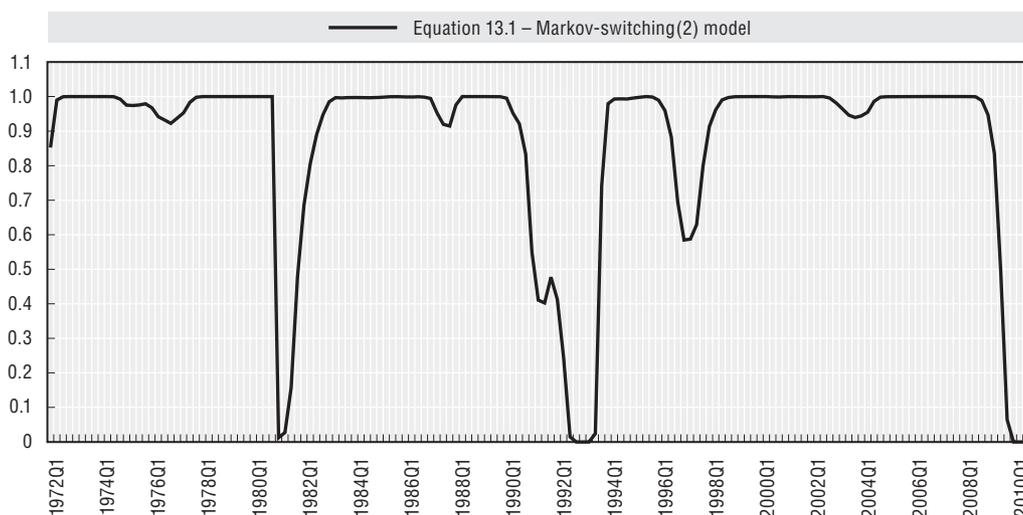
Source: Authors' own calculations using data from the South African Reserve Bank.

The estimates under the assumption of a constant regime, reported in the bottom row of Table 8, indicate that fiscal policy in South Africa has been active and pro-cyclical. However, these results imply that, when *r* > *g*, the government did not run a sustainable fiscal policy by adjusting the size of the actual primary balance to fit the size of the required primary balance. This contradicts the results in Table 7. The results of the estimation for equation 16.1 are also reported in Table 8. Equation 16.1 explores the possibility that γ_1 is also a time-varying parameter (in addition to $\alpha^{Required}$ in equation 16). While the majority of the coefficients are statistically significant, the transition probability estimates are not and thus cast doubt on the time-varying probabilities associated with the assumed two regimes.

Table 8. **Estimation results for equation 16.1**

p values in brackets

	β_0	β_1	β_2	γ_1	Probability: p_{11}, p_{22}	Duration of regime
Regime 1	0.013 (0.022)	0.605 (0.000)	−0.144 (0.001)	0.074 (0.031)	0.95 (0.741)	19.43 quarters
Regime 2	−0.009 (0.652)	0.532 (0.253)	−0.279 (0.002)	−0.723 (0.000)	0.92 (0.866)	12.09 quarters
Constant	0.004 (0.017)	0.706 (0.001)	−0.160 (0.000)	−0.243 (0.000)	–	–

Next, the actual primary balance is compared to the primary balance consistent with Markov-switching estimates of equations 13.1 and 16.1. These two balances are obtained as follows (*i.e.* using the estimates reported in Tables 7 and 8):

Primary balance consistent with equation 13.1 = $[p(Regime\ 1)_t][-0.01 + 0.77(B/Y)_{t-4}$
$- 0.15y_{t-4} + 0.05(D/Y)_{t-4}] + [1 - p(Regime\ 2)_t][-0.02 + 0.51(B/Y)_{t-4} - 0.50y_{t-4} + 0.06(D/Y)_{t-4}]$ (17)

Primary balance consistent with equation 16.1 = $[p(Regime\ 1)_t][-0.01 + 0.61(B/Y)_{t-4}$
$- 0.14y_{t-4} + 0.07(B/Y)^*_{t-4}] + [1 - p(Regime\ 2)_t][-0.01 + 0.53(B/Y)_{t-4} - 0.28y_{t-4} - 0.72(B/Y)^*_{t-4}]$ (18)

where $p(Regime\ 1)_t$ and $p(Regime\ 2)_t$ are the time-varying estimated probabilities associated with Regimes 1 and 2 for each specification. Similarly, primary balances consistent with constant regime estimates of equations 13 and 16 are constructed as (*i.e.* using estimates reported in Tables 7 and 8):

Primary balance consistent with equation 13 =
$-0.03 + 0.84(B/Y)_{t-4} - 0.11y_{t-4} + 0.08(D/Y)_{t-4}$ (19)

Primary balance consistent with equation 16 =
$-0.00 + 0.71(B/Y)_{t-4} - 0.16y_{t-4} - 0.24(B/Y)^*_{t-4}$ (20)

Figures 3 and 4 below present the results of this exercise. For equation 13.1, it can be seen that both the Markov-switching estimate and the constant regime estimate seem to fit the data quite well. For equation 16.1, on the other hand, the constant regime estimate seems to follow the actual primary balance more closely (this can be due to the poor statistical properties of the Markov-switching estimate of equation 16.1 mentioned earlier).

4.4. *Allowing for a time-varying reaction to the debt/GDP ratio using GMM and an interactive dummy*

Using interactive dummies, this section presents the results of the time-varying reaction function (equation 16) that not only allows behaviour to change in line with changes in $\alpha^{Required}$ but also allows for change in γ_1. As discussed above, it is only when the $(r - g)/(1 + g)$ gap is positive that fiscal policy can technically become unsustainable, meaning that, when $r > g$, the government will need to run a primary surplus to prevent the debt/GDP ratio from growing at an increasing rate. Therefore, in terms of the Markov-switching model (equation 16.1), one would expect one regime to be present when $r > g$ and another when $r < g$. The failure of the Markov-switching model above might therefore be ascribed to behaviour that did not comply with this expected behaviour. More specifically, as Figures 5 and 6 show, the late 1990s (1997-99) and the period after 2008 were the only two periods in which the $(r - g)/(1 + g)$ gap was significantly positive for more than one year. Therefore, in these periods the government should have been running primary surpluses if it wanted to prevent the debt/GDP ratio from increasing. However, only during the late 1990s period did the debt/GDP ratio not increase (indeed, it decreased), while in the period after 2008

Figure 3. **Comparison of the actual primary balance and the primary balance consistent with equations 13 and 13.1**
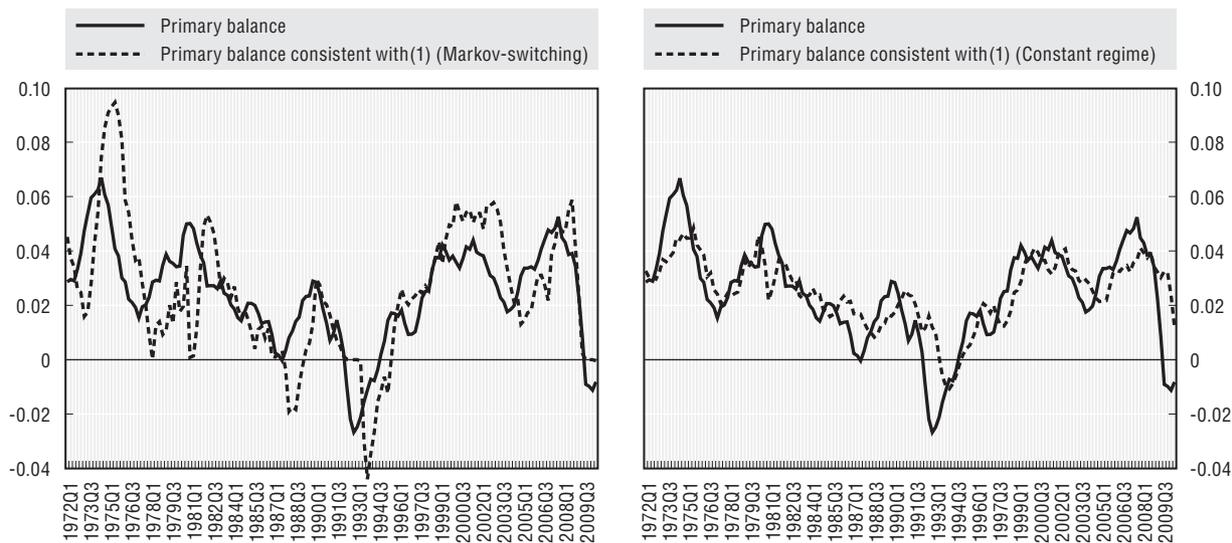
Source: Authors' own calculations using data from the South African Reserve Bank.

Figure 4. **Comparison of the actual primary balance and the primary balance consistent with equations 16 and 16.1**
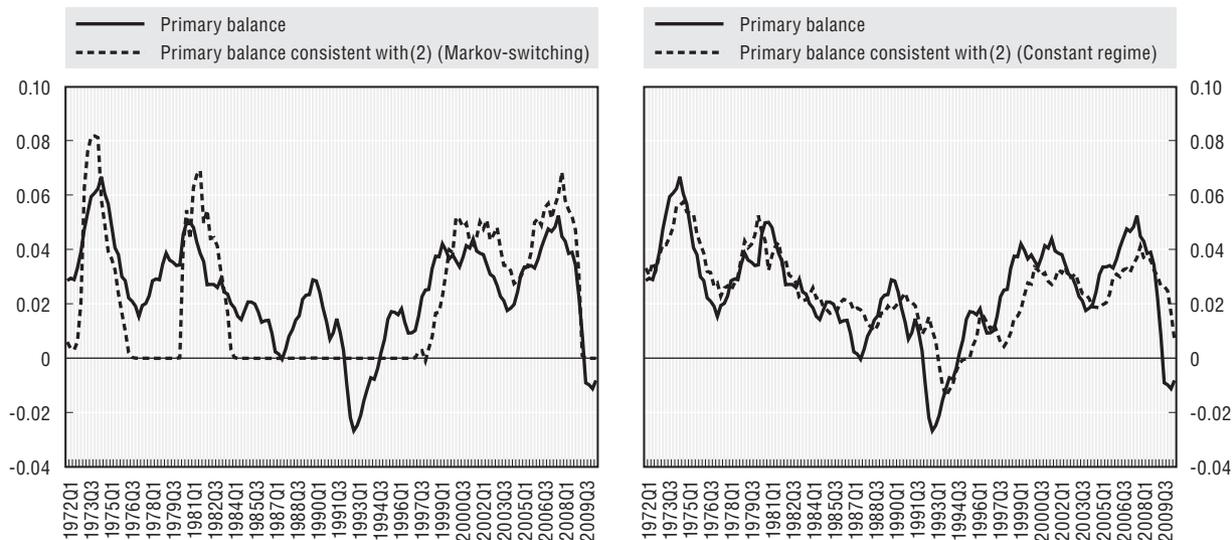

Source: Authors' own calculations using data from the South African Reserve Bank.

it did increase. To deal with these two very different reactions to a positive $(r – g)/(1 + g)$ gap, the analysis created dummies for the two periods that interacted with the required primary balance. Only the dummy for the period 1997-99 yielded statistically significant results (presented below). In addition, since the required primary balance is calculated with the actual effective interest rate of the government obtained from government data, the actual primary balance measure used is the one calculated with government data.

Table 9 shows that, for most of the sample period, the reaction of the actual primary balance/GDP ratio to changes in the required primary balance has been negative, only

Figure 5. **The $(r - g)/(1 + g)$ relationship**
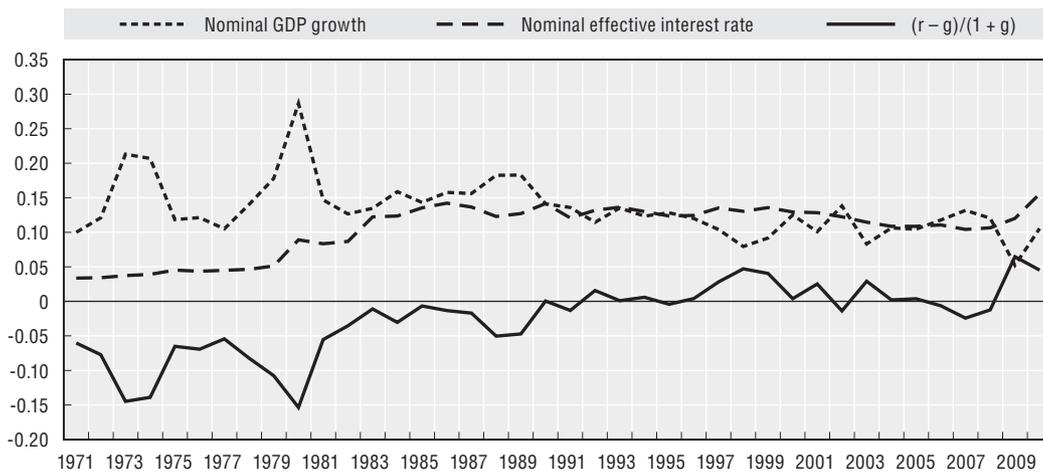
Source: South African Reserve Bank and authors' own calculations.

Figure 6. **The $(r - g)/(1 + g)$ gap and the actual and required primary balances**
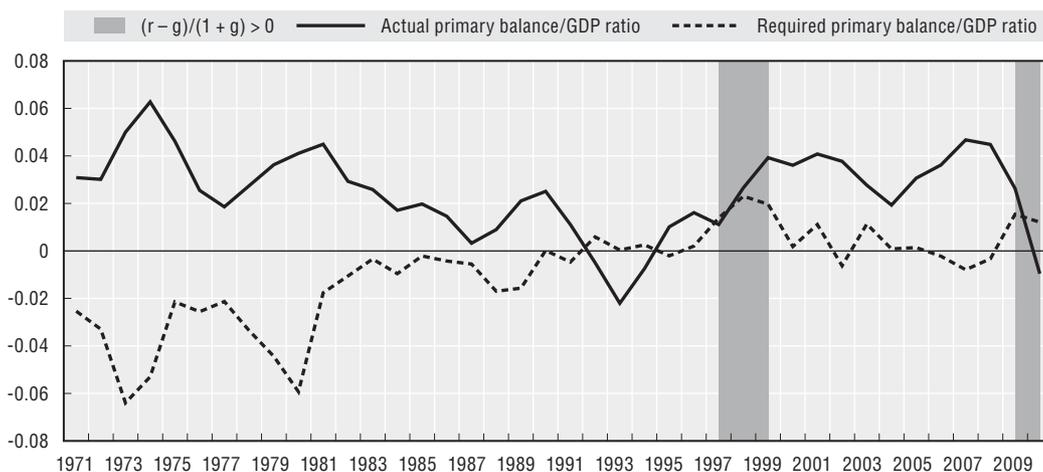
Source: South African Reserve Bank and authors' own calculations.

turning positive for the period 1997-99. As mentioned above, when the $(r - g)/(1 + g)$ gap is positive, the primary balance should increase in response to an increase in the required primary balance. The government's behaviour accorded with this requirement in the late 1990s, but not in the period since 2008. As discussed above, when the $(r - g)/(1 + g)$ gap is positive, the value for the parameter of the required primary balance/GDP ratio is expected to equal 1. The Wald test indicates that the null hypothesis (that $\alpha_2 + \alpha_3 = 1$) cannot be rejected, pointing to the government acting in a fiscally sustainable manner during the budgets for the period 1997-99.

When the $(r - g)/(1 + g)$ gap is negative, the government can run a primary deficit without putting upward pressure on the debt/GDP ratio. Should it run a larger primary deficit than is required to keep the debt/GDP ratio stable, the debt/GDP ratio will increase but at a decreasing rate, thus converging to a higher level – *i.e.* it will not display explosive behaviour.[15] Thus, for periods when the $(r - g)/(1 + g)$ gap is negative, one would expect the parameter for the required primary balance to be statistically insignificant, or negative and

Table 9. **Reaction functions with time-varying debt parameters**

Sample 1971-2010; p values in brackets

		B/Y[1]	Revenue/Y	Expenditure/Y	Non-interest expenditure/Y
(B/Y)(−1)		0.720 (0.000)			
(Revenue/Y)(−1)			0.840 (0.000)		
(Expenditure/Y)(−1)				0.676 (0.005)	
(Non-interest expenditure/Y)(−1)					0.450 (0.006)
(B/Y)^{Required}		−0.484 (0.034)	0.222 (0.055)	0.242 (0.288)	1.146 (0.002)
D9799*(B/Y)^{Required}		1.470 (0.000)		−0.520 (0.045)	−1.377 (0.002)
Y gap(−1)		−0.422 (0.032)			
C			0.037 (0.010)	0.087 (0.146)	0.138 (0.001)
Adjusted R^2		0.21	0.82	0.70	0.78
Wald	t-statistic	0.909			
Test	F-statistic	0.909			
(Prob)	Chi-square	0.909			

1. Wald test H_0: $\alpha_2 + \alpha_3 = 1$.

statistically significant, indicating a government that pursued a counter-cyclical fiscal policy.[16] As indicated by the negative parameter for the required primary balance in times when the $(r − g)/(1 + g)$ gap was negative, this counter-cyclical fiscal policy seems to have been present in South Africa particularly when the $(r − g)/(1 + g)$ gap was negative (also see Figures 5 and 6). Furthermore, given the statistical insignificance of the dummy for the short period after 2008 (and hence its exclusion from the model), counter-cyclical policy might also have dominated the requirement to stabilise the debt/GDP ratio even though the $(r − g)/(1 + g)$ gap was positive. However, what seems to contrast with the counter-cyclical behaviour of the actual primary balance with respect to movements in the required primary balance (*i.e.* the negative parameter on the required primary balance) is the pro-cyclical impact of the output gap (*i.e.* the negative parameter of the output gap).

Table 9 also presents the results for the reaction function estimated with expenditure and revenue. Revenue seems to always move in the same direction as the required primary surplus, with a positive parameter of 0.222. However, both total and non-interest expenditure seem to move counter-cyclically when the $(r − g)/(1 + g)$ gap is negative. Nevertheless, as can be seen from adding the parameter on the required primary balance to that of the required primary balance multiplied by the interactive dummy, both total and non-interest expenditure act to stabilise the actual primary balance by decreasing when the required primary balance increases. In addition, as can be expected given that interest expenditure is non-discretionary, the parameters in the non-interest expenditure model are larger than those in the total expenditure model. Comparing the behaviour of the different models shows that expenditure displays the same behaviour as the primary balance. Re-specifying the models with the different types of taxes did not yield good results, indicating that the behaviour of revenue is mostly displayed on the aggregate level and not so much on the level of individual types of revenue. In addition, the output gap was not significant in any of the expenditure or revenue models; hence it was excluded from the final specification.

4.5. *Explaining the results*

If – following Bohn, Claeys, Favero and Marcellino, and Favero and Monacelli – the primary balance/GDP and debt/GDP ratios are taken as stationary, one can then follow

these authors further by estimating fiscal reaction functions. Indeed, when estimating these reaction functions and controlling for changing behaviour over time, the persistence parameters in these relationships are less than one, whether the relationship is estimated with GMM or a Markov-switching model. In GMM models where the parameters were close to but less than one, the Wald tests indicate that they nevertheless are statistically significantly less than one.

In the reaction functions containing the debt/GDP ratio, the inclusion of interactive dummies multiplied by the debt/GDP ratio indicates that:

● The behaviour of total and non-interest expenditure as well as the different types of revenue changed over time.

● The size of the reaction of the primary balance to changes in the debt/GDP ratio mostly seems to reflect the stance of the $(r - g)/(1 + g)$ gap.

● The reaction of the revenue/GDP ratio to changes in the debt/GDP ratio is larger than that of the expenditure/GDP ratio. This is in accordance with recent findings by the IMF for the G7 countries (IMF, 2011).

Table 10 contains the summary of the different models estimated in subsections 4.1 through 4.4. The first row reports the signs of the $(r - g)/(1 + g)$ gap over the period 1971-2010. Subsequent rows report the government's reaction to an increase in public debt (in the case of the baseline model as well as models 1 and 2) or to an increase in the required primary balance (in the case of model 3). Given that model 3 regresses the actual budget balance on the required budget balance, the sign of the $(r - g)/(1 + g)$ gap needs to be taken into account when interpreting the coefficient estimates. This has been done in the last row of Table 10 where the signs of the estimated coefficients $\gamma_1\alpha^{Required}$ change when the $(r - g)/(1 + g)$ gap is negative (i.e. when fiscal policy can technically not become unsustainable). What is notable is the relatively high degree of consistency in terms of the results, particularly when considering that different frequencies of the data (quarterly and annual) as well as different estimation techniques were used (GMM with dummy variables that impose exogenously determined regimes and Markov-switching estimations where the regimes are endogenously determined). The baseline model indicates that the government has been fiscally passive (indicated by white cells) over the entire sample under consideration, whereas models 1-3 indicate that the government has been largely fiscally passive over the same sample period. Episodes where models 1-3 indicate fiscal activism (indicated by darker cells) and no (or ambiguous) government reaction (indicated by lighter cells) are also consistent for the most part – particularly for the periods 1990-94 and 2008-10. It should be noted that the fiscal activism indicated during the 2008-10 period makes a case for fiscal guidelines (or fiscal rules) given that debt levels are rising and that there are some real pressures on the budget (such as job-creation efforts set out in the New Growth Path as well as the National Health Insurance).

According to the estimates of equations 13, 13.1, 16 and 16.1 that contain an output gap, the reaction of the actual primary balance to the output gap is pro-cyclical. However, it should also be mentioned that the inclusion of the political administration dummies rendered the output gap statistically insignificant. It is also insignificant in the expenditure and revenue models controlling for the $(r - g)/(1 + g)$ gap (i.e. the expenditure and revenue versions of equation 16). The analysis also shows that, when the $(r - g)/(1 + g)$ gap was positive in the period 1997-99, the government did act to contain debt and ensure fiscal sustainability. More specifically, the analysis shows that the actual primary balance

Table 10. **Summary of the estimation results: reaction of the primary balance to either debt (models 1 and 2) or the required primary balance (model 3)**[1]

Sign of the *(r − g)/(1 + g)* gap	1971-90 (−)	1991-96 (0)	1997-99 (+)	2000-08 (+/−)	2009-2010 (+)
Reaction of the government					
Baseline model	1971-2010 (+)				
Model 1	1971-78 (−) / 1979-89 (+)	1990-94 (−)	1995-2008 (+)		2009-10 (−)
Model 2	1972-81 (+) / 1981-82 (0) / 1982-90 (+)	1990-94 (0)	1994-2009 (+)		2009-10 (0)
Model 3	1971-90 (−)(−) = (+)	1991-96 (−)(0) = (0)	1997-99 (+)(+) = (+)	2000-08 (−)(+/−) = (−/+)	2009-10 (−)(+) = (−)

1. The baseline model and model 1 are reported in Table 3 and Table 4, respectively (subsection 4.2 above). Model 2 is the Markov-switching model reported in Table 7 (subsection 4.3 above), while model 3 is reported in the second column of Table 9 (subsection 4.4 above). For model 3, note that the first sign in brackets each time represents the sign of the parameter (*i.e.* the reaction of the primary balance to the required primary balance), while the second sign represents the sign of the *(r − g)/(1 + g)* gap. Thus, the sign in brackets on the right-hand side of the equal sign represents their combined sign and thus the sign of the reaction of the primary balance to debt ($\gamma_1 \alpha^{Required}$).

reacted to the size of the required primary balance to the extent that the public debt/GDP ratio did not increase during that period. However, the same cannot be said for the period after 2008.

5. Adjusting the sensitivity of the automatic stabilisers

The estimations above indicate that the reaction of the revenue/GDP ratio to the debt/GDP ratio is larger than that of the expenditure/GDP ratio. Thus, there might be a need to enhance the reaction of the expenditure/GDP ratio. In addition, the fiscal rule set out above allows for the deficit to move in a counter-cyclical fashion by allowing revenue to drop and expenditure to increase when the economy experiences a recession. With government expenditure and revenue set to vary around a predefined long-run level, the rule very much depends on the workings of the automatic stabilisers. The government's reaction to the cycle is therefore "automated". However, as the reaction of many countries to the 2008/09 financial crisis indicated, governments also change their discretionary fiscal policy. This of course raises the question as to whether or not the burden of reaction should not be shifted to a larger extent to the automatic stabilisers, thereby automating fiscal reaction much more. Automatic stabilisers eliminate the observation and decision lags that hamper discretionary reactions. Shifting the burden of reaction more to the automatic stabilisers, though, may require the enhancement of these stabilisers.

Baunsgaard and Symansky (2009) suggested several ways in which the automatic stabilisers can be enhanced without increasing the size of government. These include permanent and temporary changes to tax and expenditure frameworks. Temporary changes are like trip-switches that are triggered when specific macroeconomic thresholds are crossed (Baunsgaard and Symansky, 2009:6). Baunsgaard and Symansky (2009:8-11) argue that changes to permanent measures, such as increasing the progressiveness of personal income tax or increasing the share of personal income tax in total revenues collected, will not yield a significant enhancement of the automatic stabilisers. Thus, they argue for the use of temporary measures.

Baunsgaard and Symansky (2009:16-17) thus propose the use of temporary measures with high multiplier effects such as temporary tax policies targeted at low-income households that are probably credit or liquidity constrained. These measures could take

the form of rebates on personal income taxes, temporary reductions in VAT, temporary investment tax incentives for businesses that might be credit or liquidity constrained, and temporary tax credits for job creation. On the expenditure side, the government could use temporary transfers, again to credit and liquidity constrained households, as well as temporarily expand existing unemployment benefits (*e.g.* longer period of eligibility, higher benefits). Furthermore, transfers to lower levels of government will alleviate the pressure on lower tiers of government when these are not allowed to run budget deficits (Baunsgaard and Symansky, 2009:17).

In addition to the measures listed by Baunsgaard and Symansky (2009), the government could also create a catalogue of "shovel-ready infrastructure projects". Usually, investment projects do not make for good fiscal stimulus projects. In addition to the observation and decision lags that hamper all discretionary fiscal policy, infrastructure projects also suffer from a long implementation phase. Project specifications must be drawn up and a tender process then followed which, in turn, is followed by contractual negotiations. However, the government could have a catalogue of projects that are already negotiated and concluded with private construction companies that are activated once a recession occurs. Such a catalogue can be modelled on the United Kingdom Strategic Infrastructure Partnership model (SIP). This model is ideal when there are successive phases of similar types of work. In such a model there is certainty about the kind of infrastructure, but there is uncertainty with regard to the timing and exact phases of the work (*cf.* HM Treasury, 2008:21-22).[17] Another measure to use with a trip-switch would be the payment of temporary subsidies to employers not to retrench workers. Thus, the government pays companies directly to keep workers employed. This also means that companies do not lose good workers and are geared to benefit from the upswing the moment conditions improve.

The implementation of temporary measures needs to depend on economic trigger indicators (or trip-switches). Only when the indicator reaches a particular value will the measure be activated. In addition, the trigger also needs to work in the opposite direction, so as to ensure the deactivation of the temporary measure. This will provide an automatic "exit strategy" from such a stimulus policy. GDP, which is usually only available with a lag, might not be the most suitable indicator. More timely data or forward-looking indicators would make for better indicators. Baunsgaard and Symansky (2009:16) mention Feldstein's 2007 proposal for the United States to use a three-month cumulative decline in payroll employment as a trigger point, and Elmendorf and Furman's 2008 proposal for a three-month change in employment that is negative for three successive months. Forward-looking indicators require proper forecasting, and Baunsgaard and Symansky (2009:16) suggest that this be done by an independent agency to prevent manipulation by the government and to ensure credibility.

6. Conclusion

This article contains a proposal for the use of a simple deficit-and-debt fiscal rule. Because of the difficulty of forecasting deficits and macroeconomic variables such as output and potential output with a satisfactory degree of precision, the fiscal framework contained in this article proposes a permanent (fiscal rule) target that targets the standard deviation of the deficit instead of the level of budget deficit. Using historic data about the output gap, as well as estimates of tax and expenditure elasticities, a government can set a band around the structural budget balance within which the actual deficit will be allowed

to fluctuate. The government then needs to ensure that the deficit budgeted for the next year falls within the band. Setting the deficit within a band then allows the automatic stabilisers to act. As discussed, the benefit of this approach is that when the actual deficit then deviates from the budgeted deficit, the probability is high that the actual deficit still falls within the target band. The government is then guided by the fiscal rule but, where deviations still fall within the target band, it will not lose credibility when the actual deficit deviates from the budgeted deficit.

The estimates of the fiscal reaction function showed that, historically, the South African government contained debt and ensured fiscal sustainability. Thus, in general the South African government ran a passive fiscal policy. The exceptions were the early 1990s and the period since 2008, periods during which the debt burden increased. The fiscal activism observed during the 2008-10 period makes a case for fiscal guidelines (or fiscal rules) given that debt levels are rising and that there are some real pressures on the budget (such as job-creation efforts set out in the New Growth Path as well as the National Health Insurance).

Compared to the expenditure/GDP ratio, the revenue/GDP ratio was historically more reactive to changes in the debt/GDP ratio. This is in line with behaviour in G7 countries. The government could also consider measures to increase this reactiveness of revenue and expenditure, both to changes in debt and the business cycle. Thus, the last section of the article contains proposals to increase the reactiveness of revenue and expenditure to both the cyclical movements and the need to restore fiscal sustainability. These proposals aim at the creation of so-called "trip-switches" where a recession causes an increase in expenditure and a reduction in revenue, and thereby enhances the ability of the automatic stabilisers. However, once the economy returns to potential, the trip-switches ensure a decrease in expenditure and an increase in revenue. The latter not only enhances the automatic stabilisers, but defines an "exit clause" for fiscal stimulus that acts as an adjustment policy to ensure fiscal sustainability.

Notes

1. Given the poor track record of forecasters, the best forecast might be as simple as using an autoregressive model (AR). Favero and Marcellino (2005) argue that simple AR models for macroeconomic and fiscal data forecasts still outperform more complex structural models.

2. The problem might be even more serious given that recent values of GDP included in the model estimation are frequently subject to relatively large revisions. Thus, uncertainty not only exists with regard to the forecasts of the GDP gap, but also with respect to the accuracy of recent past values of GDP.

3. One can also measure the average length of recessions, and think of using half-life calculations (*i.e.* setting the proportion that must be corrected equal to a value that will ensure that, for instance, at least half of the deviation is eliminated in half the time that a business cycle lasts).

4. The band can also be set using the half-life calculations mentioned in Note 3.

5. Indeed, in many countries initial plans involve cuts in taxation too, so that expenditure must be cut by more than is necessary to stabilise public finances.

6. If $r = g$, then $D_t/Y_t = t(B/Y) + p$ where p = the initial debt/GDP ratio and B/Y = the primary balance/GDP ratio. Note that as $t \rightarrow \infty$ so will $D_t/Y_t = t(B/Y) + p \rightarrow \infty$.

7. When $r < g$, the economy is said to be dynamically inefficient since government can improve Pareto efficiency by making transfers from the young to the old, while if $r > g$ the economy is said to be dynamically inefficient since such transfers will reduce Pareto efficiency (see Diamond, 1965, as well as Abel *et al.*, 1989).

8. Note that the level to which the ratio converges may itself be high, which in turn might cause interest rates to increase and thereby cause $(r - g)$ to turn positive. However, if the ratio converges to a level acceptable to lenders, this feedback effect on interest rates might be absent or limited.

9. The reason is that there is no criterion for an optimal number of regimes in a Markov-switching model (Claeys, 2005; Afonso et al., 2009).

10. To deal with the end-point problem often encountered with the Hodrick-Prescott filter, this article follows Mise et al. (2005). An AR(n) model was used (with n set at 12 quarters to eliminate serial correlation). The AR model was used to forecast two additional years that were then added to each of the series before applying the Hodrick-Prescott filter. An annual series is then constructed from the quarterly series.

11. Note that equation 10 can be slightly altered to: $(D/Y)t = [(1 + r_t)/(1 + g_t)](D/Y)_{t-1} - (B/Y)_t$ with the difference between r and g usually not more than two percentage points, meaning that $[(1 + r_t)/(1 + g_t)]$ will usually be very close to 1. If the government sets the primary balance B to offset the effect of the first term on the right-hand side, it may render the debt/GDP ratio either level stationary, but too close to a unit root for stationarity tests to establish unambiguously whether or not the series is stationary, or first-difference stationary.

12. No dummy is included for the Zuma administration since nine administrations require eight dummies. Thus, the parameter on the debt/GDP ratio is the value for the Zuma administration.

13. At the time it was argued that, because VAT has a broader base, it could be introduced at a lower rate than GST. Hence, whereas the last GST rate was 12%, the first VAT rate was 10%. However, it soon became clear that the base was not broader, and the government increased the rate until it reached 14%. Our thanks to Estian Calitz, Director General of Finance in the early 1990s, for providing this information to us.

14. See Hamilton (1994) for more on Markov-switching models.

15. Of course, this only occurs provided that lenders are willing to accommodate the higher level at which the debt/GDP ratio will stabilise. If they do not accept it, the interest rate might increase, causing the $(r - g)/(1 + g)$ gap to turn positive, in which case fiscal policy can technically become unsustainable.

16. This can occur provided that the $(r - g)/(1 + g)$ gap moves counter-cyclically, which seems to have been the case in South Africa. See Figure 5 which shows that the growth rate registered much higher variation than the effective interest rate on government debt, thereby dominating the behaviour of the $(r - g)/(1 + g)$ gap.

17. One might also ask, though, why a government would wait for a recession before implementing these projects and not simply make the investment when the yield is expected to be positive, irrespective of the business cycle. However, it should be kept in mind that a government operates under a budget constraint and might not consider it advisable to increase the future tax and debt burden to finance these projects, even when projects are expected to yield a positive return. In a recession and thus in the face of falling demand, there might be scope to increase public investment, thereby offsetting the fall in private investment.

Bibliography

Abel, A.B., N.G. Mankiw, L.H. Summers and R.J. Zeckhauser (1989), "Assessing Dynamic Efficiency: Theory and Evidence", *Review of Economic Studies*, 56:1-20.

Afonso, A., P. Claeys and M.R. Sousa (2009), "Fiscal Regime Shifts in Portugal", School of Economics and Management (ISEG) *Working Paper Series*, WP 41/2009/DE/UECE, Technical University of Lisbon.

Alesina, A. and R. Perotti (1994), "The Political Economy of Budget Deficits", *NBER Working Paper*, No. 4637, National Bureau of Economic Research, Cambridge, Massachusetts, United States, *www.nber.org*.

Baunsgaard, T. and S.A. Symansky (2009), "Automatic Fiscal Stabilizers", *IMF Staff Position Note*, SPN/09/23, International Monetary Fund, Washington, DC.

Bispham, J.A. (1987), "Rising Public Sector Indebtedness: Some More Unpleasant Arithmetic", in M.J. Boskin, J.S. Flemming and S. Gorini (eds.), *Private Saving and Public Debt,* Basil Blackwell, Oxford, United Kingdom, pp. 40-71.

Bohn, H. (1995), "The Sustainability of Budget Deficits in a Stochastic Economy", *Journal of Money, Credit and Banking*, 27(1):257-271.

Bohn, H. (1998), "The Behaviour of US Public Debt and Deficits", *The Quarterly Journal of Economics*, 113(3):949-963.

Bohn, H. (2007), "Are stationary and cointegration restrictions really necessary for the intertemporal budget constraint?", *Journal of Monetary Economics*, 54:1837-1847.

Bohn, H. (2010), "The Economic Consequences of Rising US Government Debt: Privileges at Risk", University of California at Santa Barbara, United States, *http://econ.ucsb.edu/~bohn*.

Boskin, M.J., J.S. Flemming and S. Gorini (eds.) (1987), *Private Saving and Public Debt*, Basil Blackwell, Oxford, United Kingdom.

Browne, G.W.G. (1983), "Fifty Years of Public Finance", *South African Journal of Economics*, 51(1):134-173.

Burger, P., I. Stuart, C. Jooste and A. Cuevas (2011), "Fiscal Sustainability and the Fiscal Reaction Function for South Africa", *IMF Working Paper* WP/11/69, International Monetary Fund, Washington, DC.

Buti, M. and G. Giudice (2002), "Maastricht's Fiscal Rules at Ten: An Assessment", *Journal of Common Market Studies*, 40(5):823-848.

Buti, M. and G. Giudice (2004), "EMU Fiscal Rules: What can and cannot be exported" in G. Kopits (ed.), *Rules-based Fiscal Policy in Emerging Markets: Background, Analysis and Prospects*, Palgrave (Macmillan), Houndmills, United Kingdom.

Caceres, C., A. Corbacho and L. Medina (2010), "Structural Breaks in Fiscal Performance: Did Fiscal Responsibility Laws Have Anything to do with Them?", *IMF Working Paper* No. 10/248, International Monetary Fund, Washington, DC.

Cheung, Y. and U.G. Erandsson (2005), "Exchange Rates and Markov Switching Dynamics", *Journal of Business and Statistics*, 23(3):314-320.

Claeys, P. (2005), "Policy Mix and Debt Sustainability: Evidence from Fiscal Policy Rules", *CESifo Working Paper* No. 1406, CESifo Group (the Center for Economic Studies, the Ifo Institute and the CESifo GmbH), Munich, Germany, *www.cesifo-group.de*.

Claeys, P. (2008), "Rules and their Effect on Fiscal Policy in Sweden", *Swedish Economic Policy Review*, 15:7-47.

Clarke, P. (1988), *The Keynesian Revolution in the Making: 1924-1936,* Clarendon Press, Oxford, United Kingdom.

Corsetti, G. and N. Roubini (1996), "European versus American Perspectives on Balanced-Budget Rules", *American Economic Review*, 86(2):408-413.

De Mello, L. (2005), "Estimating a Fiscal Reaction Function: The Case of Debt Sustainability in Brazil", *OECD Economics Department Working Papers* No. 423, OECD Publishing, *http://dx.doi.org/10.1787/556325773018*.

Diamond, P.A. (1965), "National Debt in a Neo-classical Growth Model", *American Economic Review*, 55:1126-1150.

Drazen, A. (2004), "Fiscal Rules from a Political Economy Perspective" in G. Kopits (ed.), *Rules-based Fiscal Policy in Emerging Markets: Background, Analysis and Prospects*, Palgrave (Macmillan), Houndmills, United Kingdom.

Elmendorf, D.W. and J. Furman (2008), "If, When, How: A Primer on Fiscal Stimulus", *The Hamilton Project Strategy Papers*, January, The Brookings Institution, Washington, DC.

Favero, C. and M. Marcellino (2005), "Modelling and Forecasting Fiscal Variables for the Euro Area", *Oxford Bulletin of Economics and Statistics*, 67 (Supplement [2005] 0305-9049), pp. 755-783.

Favero, C. and T. Monacelli (2005), "Fiscal Policy Rules and Regime (In)Stability: Evidence from the US", *Working Paper* No. 282, Innocenzo Gasparini Institute for Economic Research, Bocconi University, Milan, Italy, *www.igier.unibocconi.it*.

Feldstein, M. (2007), "How to Avert Recession", *The Wall Street Journal*, 5 December.

Friedman, M. (1948), "A Monetary and Fiscal Framework for Economic Stability", *American Economic Review*, 38(3):245-264.

Hamilton, J.D. (1988), "Rational-Expectations Econometric Analysis of Changes in Regime: An Investigation of the Term Structure of Interest Rates", *Journal of Economic Dynamics and Control*, 12:385-423.

Hamilton, J.D. (1994), *Time Series Analysis*, Princeton University Press, New Jersey, United States.

HM Treasury (2008), *Infrastructure Procurement: Delivering Long-term Value*, London, *www.hm-treasury.gov.uk*.

Hume, D. (1742), *Essays, Moral, Political, and Literary*, 1987 edition edited by E.F. Miller, Liberty Fund, Indianapolis, Indiana, United States; accessed 20 April 2010 at *www.econlib.org/library/LFBooks/Hume/hmMPL32.html*.

IMF (International Monetary Fund) (2011), *Fiscal Monitor April 2011 – Shifting Gears: Tackling Challenges on the Road to Fiscal Adjustment*, IMF, Washington, DC.

Kell, M. (2001), "An Assessment of Fiscal Rules in the United Kingdom", *IMF Working Papers* No. 01/91, International Monetary Fund, Washington, DC.

Kopits, G. (2004), "Overview of Fiscal Policy Rules in Emerging Markets" in G. Kopits (ed.), *Rules-based Fiscal Policy in Emerging Markets: Background, Analysis and Prospects*, Palgrave (Macmillan), Houndmills, United Kingdom.

Kopits, G. and S.A. Symansky (1998), "Fiscal Policy Rules", *IMF Occasional Paper* No. 162, International Monetary Fund, Washington, DC.

Kydland, E. and E.C. Prescott (1977), "Rules rather than Discretion: The Inconsistency of Optimal Plans", *Journal of Political Economy*, 85:473-491.

Leeper, E. (1991), "Equilibria under 'Active' and 'Passive' Monetary and Fiscal Policies", *Journal of Monetary Economics*, 27:129-147.

Lerner, A. (1951), *Economics and Employment,* McGraw-Hill, New York, United States.

Milesi-Ferretti, G.M. (2003), "Good, Bad or Ugly? On the effects of fiscal rules with creative accounting", *Journal of Public Economics*, 88:377-394.

Mise, E., T. Kim and P. Newbold (2005), "On suboptimality of the Hodrick-Prescott filter at time series endpoints", *Journal of Macroeconomics,* 27:53-67.

Siebrits, F.K. and E. Calitz (2004), "Should South Africa adopt numerical fiscal rules?", *South African Journal of Economics*, 72(4):759-783.

South African Reserve Bank (SARB) (2010), online data: *www.reservebank.co.za*.

Tanner, E. (2004), "Fiscal Rules and Countercyclical Policy: Frank Ramsey meets Gramm-Rudman-Hollings", *Journal of Policy Modeling*, 16:719-731.