“Twin Deficits” Revisited

Empirical Study of the Effects of Fiscal Policy on Trade Balance and Output in South Africa

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Introduction

Since the regime change in 1994, the South African GDP has grown at an annual rate of more than 3%, having been stagnant from 1980 to 1994. This growth has been accompanied by increasing budget and trade deficits. To what extent can the economic growth and trade deficits be explained by the government's budget deficits? This paper aims to elucidate the effects of fiscal policy on economic growth and the trade balance in South Africa.

This question is particularly relevant as South Africa emerges from the 2008 financial crisis. After a brief recession, economic growth has resumed, albeit at a lower rate than existed just before the crisis. However, the budget and trade balances continue to deteriorate. Can the government end the fiscal stimulus and balance the budget without crippling the nascent recovery? Would balancing the budget affect the trade deficit? We hope to provide a quantitative basis for addressing these questions by measuring the effect of exogenous changes in the budget balance on growth and trade. We also look at the effects of government revenue and spending independent from the budget balance.

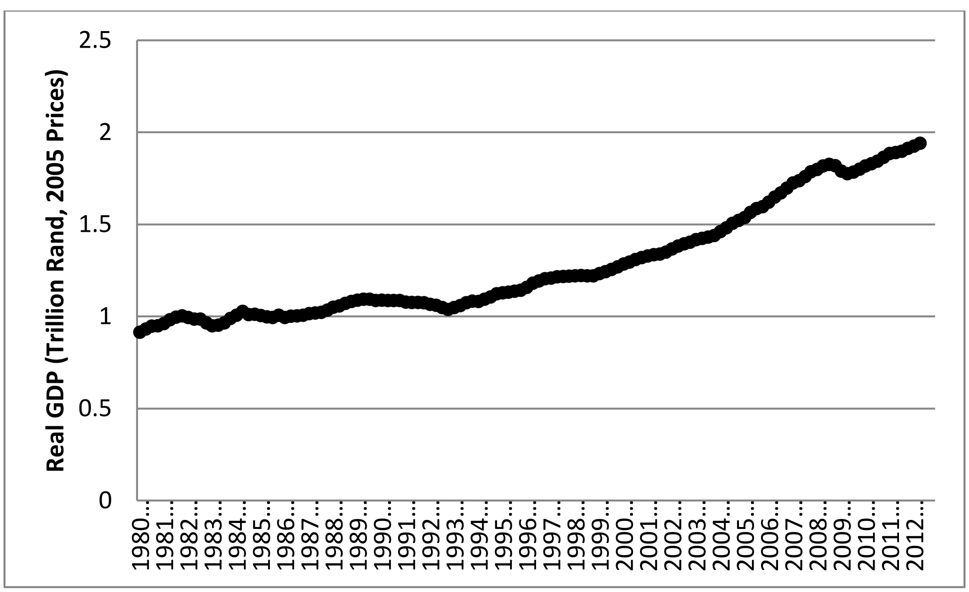

Figure 1. Real GDP, 1980-2012. Source: IMF IFS

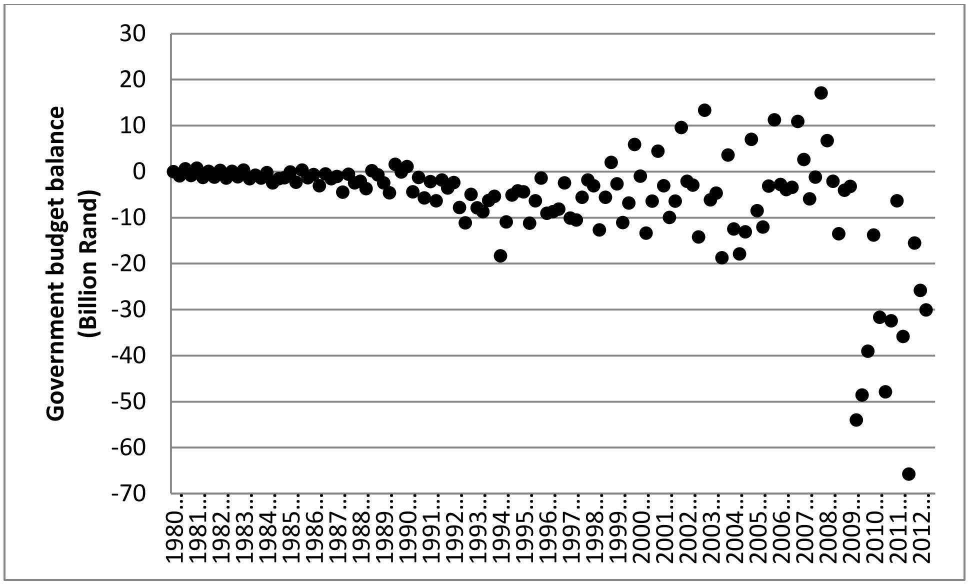

Figure 2. Budget balance, 1980-2012. Source: IMF IFS

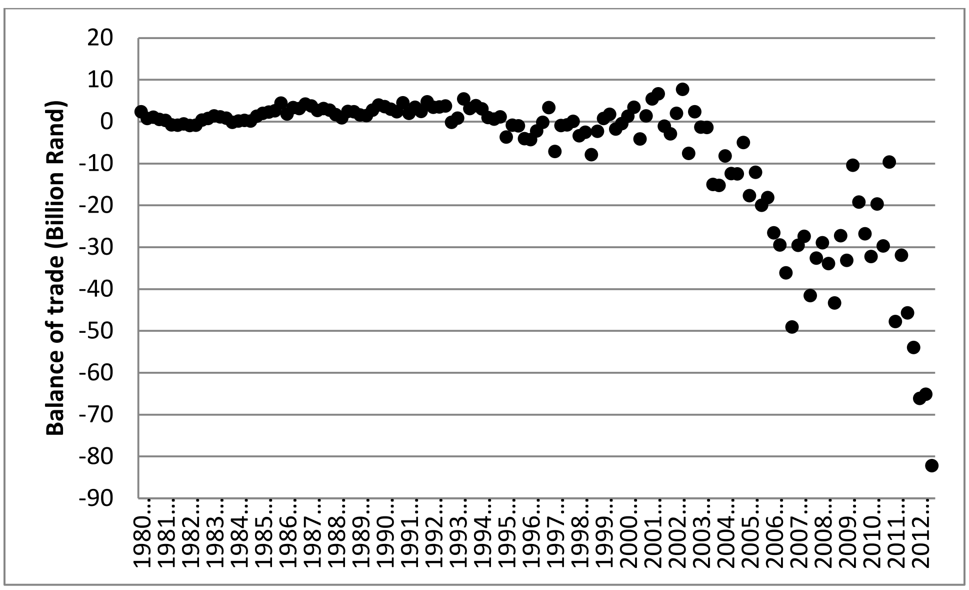

Figure 3. Trade balance, 1980-2012. Source: IMF IFS

Kim and Roubini[1] study the question of "twin deficits" in the U.S. economy. They use a recursive VAR model, meaning that the variables are expressed in terms of current as well as lagged values. They find evidence of "twin divergence:" that expansionary fiscal shocks

[1] Kim and Roubini 2008.

improve the current account balance and depreciate the exchange rate. The improvement in current account balance is found to be due to an increase in private saving and decline in investment. Our study follows Kim and Roubini, using a simplified methodology, to determine whether similar results hold for the much smaller South African economy.

Theory

We begin our analysis by using the Mundell-Fleming model to predict the effects on the trade balance of a change in government spending. We use linear versions of the IS and LM schedules. Here E_y is the marginal propensity to spend, E_r denotes the response of private spending to the interest rate, r is the real interest rate, G is government spending and X is net exports. Rearranging to solve for the real interest rate, we have:[2]

$$r = \frac{-(1 - E_y)}{E_r} y + \frac{G + X}{E_r}$$

Likewise, the LM curve gives money demand as a function of output and the real interest rate. Here L_y denotes the response of money demand to a change in income, L_r is the response of money demand to the interest rate, and M is the money demand (equal to supply at equilibrium). This gives:

$$r = \frac{L_y}{L_r} y - \frac{M}{L_r}$$

The balanced balance of payments schedule can likewise be written in terms of the real interest rate:

[2] Kimbrough and Gardner

$$r = \frac{M_y}{Z_r + M_r} y - \frac{X}{Z_r + M_r}$$

where M_y and M_r are the responses of imports to output and the real interest rate, respectively, and Z_r is the response of capital flows to the real interest rate.

We analyze the effect of a change in government spending through comparative statics. In the case of low capital mobility, Z_r is low: capital flows are relatively unresponsive to changes in the real interest rate. In this case, the B=0 line is more steeply sloped with respect to *y* than the LM line, and we have the following picture:

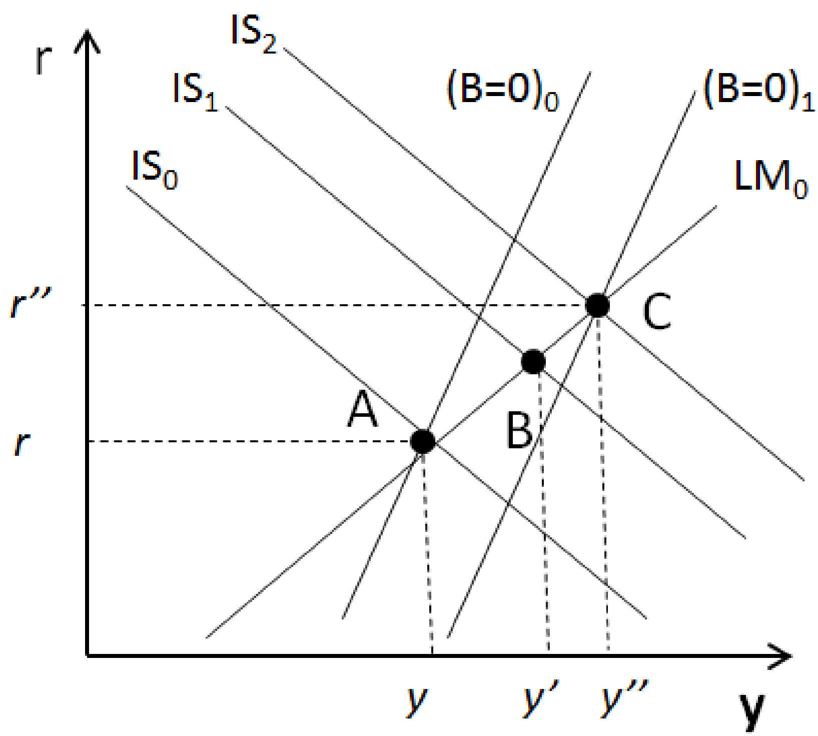

Figure 4. Mundell-Fleming analysis of change in government spending with low capital mobility

The immediate effect of the increase in government spending is a Keynesian rightward shift in the IS curve, moving the equilibrium from A to B. Because the B=0 curve is steeper than the LM curve, this results in a balance of payments deficit, i.e. capital outflows. As a result, the currency depreciates, increasing demand for the country's exports. This moves the IS curve even further to the right, from IS_1 to IS_2, with the final equilibrium at point C, with higher output and interest rate.

For the high capital mobility case, capital flows are strongly affected by the real interest rate, and the B=0 line is drawn more shallowly sloped than the LM line. As a result, the rightward shift in the IS curve from the increase in government spending results in a balance of payments surplus, i.e. inflow of capital, resulting in an appreciation of the local currency. This reduces demand for the country's exports, causing the IS curve to pull back somewhat from IS_1 to IS_2. The final equilibrium at C occurs at a higher output and only modestly higher interest rate than the initial equilibrium.

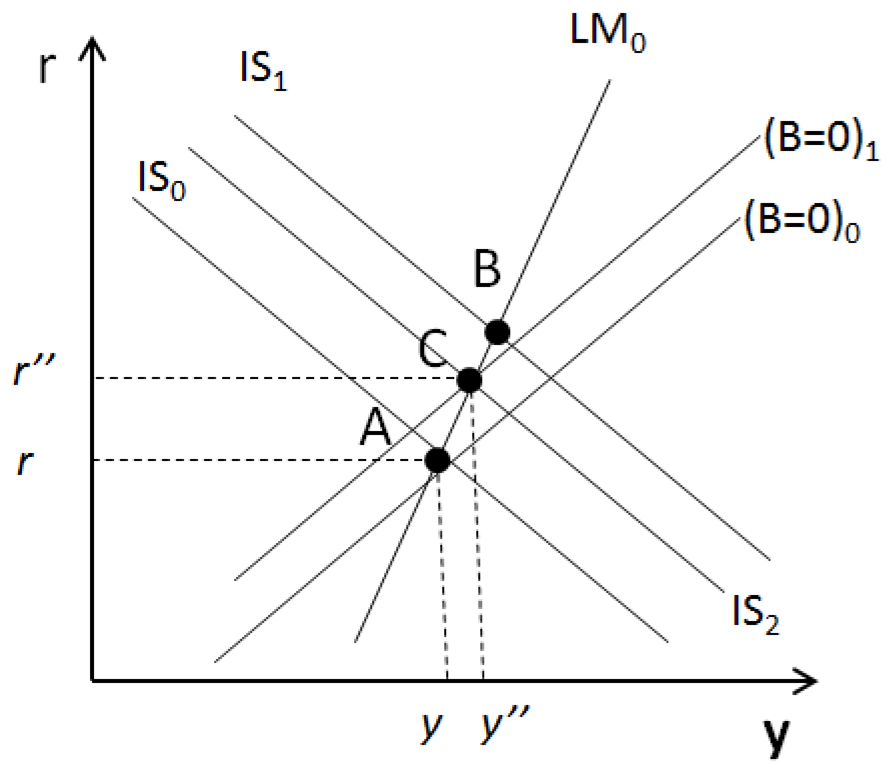

Figure 5. Mundell-Fleming analysis of change in government spending with high capital mobility

In both cases, the Mundell-Fleming model predicts a sustained increase in output and interest rate as a result of an increase in government spending, with a temporary effect on the balance of payments. The difference between the high and low capital mobility cases is that the former shows a temporary balance of payments surplus, and modest long-run increases in output and interest rate; whereas the latter has a temporary balance of payments deficit and strong long-run increases in output and interest rate.

The predictions of the Mundell-Fleming model of the effect of fiscal policy on trade balance then depend on the degree of capital mobility in South Africa. To determine whether South Africa is a high- or low-capital-mobility country, we refer to the Ito-Chinn Capital

Account Openness Index. This metric gauges the intensity of regulatory restrictions on capital account transactions, hence comparing the *de jure* financial openness across countries. The index is constructed annually from the tabulation of constraints on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions for 182 countries during 1970-2010. [3] The index's extensive coverage of countries and time period allows for a comprehensive and consistent comparison benchmark within and across countries.[4] According to the Ito-Chinn Index, South Africa has low capital mobility, with the index below 0 for all years in the study. Values below 0 indicate low capital mobility.

[3] Chinn and Ito 2008
[4] Bui et al 2013

Year	Ito-Chinn Index
1980	-1.86
1981	-1.86
1982	-1.16
1983	-1.16
1984	-1.16
1985	-1.86
1986	-1.86
1987	-1.86
1988	-1.86
1989	-1.86
1990	-1.86
1991	-1.86
1992	-1.86
1993	-0.80
1994	-0.11
1995	-0.11
1996	-1.16
1997	-1.16
1998	-1.16
1999	-1.16
2000	-1.16
2001	-1.16
2002	-1.16
2003	-1.16
2004	-1.16
2005	-1.16
2006	-1.16
2007	-1.16
2008	-1.16
2009	-1.16
2010	-1.16

Table 1. Chinn-Ito Index of de Jure Capital Mobility

In contrast to the Mundell-Fleming framework, models incorporating rational expectations, such as the Dornbusch model, predict that Ricardian equivalence or permanentincome effects will negate the effects of an increase in government spending on output. Our econometric analysis should provide a basis for choosing between these contrasting predictions.

Data Selection and Pre-Processing

The main source of data for this study is the International Monetary Fund's (IMF's) International Financial Statistics (IFS) database. This source was chosen for its canonical quality, having been used in a number of studies.[5] In addition, this database provides quarterly data, allowing for a large sample size.

For GDP, we use the real GDP, seasonally adjusted, at 2005 prices. We used seasonally-adjusted data to prevent predictable seasonal fluctuations (which are not of interest to this study) to obscure more interesting relationships in the data. The local currency is used as the numeraire for GDP to abstract from fluctuations in the dollar-rand exchange rate.[6]

We compute the real interest rate using the Fisher equation:

$$r = i - \pi$$

For the nominal interest rate, we use the rate on 3-month government securities (T-bills).[7] This rate directly reflects the influence of government monetary policy, for which this variable serves as a proxy. The lending rate is available as well, but this variable may include superfluous information on changes in the banking system, which are not of interest to this study.[8]

[5] Such as Burnside et al 2001, Kim and Roubini 2008.
[6] The IFS database code for this series is NGDP_R.
[7] IFS database code: FITB.
[8] It was determined just before the deadline that the lending rate had been used for the regressions by mistake. Under the assumption that the differences between the lending and T-bill rates are i.i.d., this should not affect the results.

For the inflation rate, we use the consumer price index, normalized to 2005. Consumer prices are chosen because they should reflect producer prices as well as incorporating the price of services, and thereby more closely mirror the actual price conditions facing agents within the country. The inflation rate in each quarter is taken as the percent change from the previous year, which is provided as a separate data series in the IFS.[9]

We calculated the trade balance from the value of exports divided by the value of imports.[10] The ratio was used rather than the difference, to allow taking the log. Local currency was used to match the units of GDP. Exports and imports were both inflation-adjusted using the CPI. The current account might also have been chosen instead of the trade balance; the former includes net factor income, which comprises income from foreign investments and remittances, and foreign aid.[11] However, these factors (especially foreign aid) are not seen as likely to be influenced by fiscal policy, and may include exogenous shocks, so we choose instead to focus on the balance of trade.

We used the real exchange rate,[12] rather than the nominal, because it reflects international competitiveness and thereby affects the trade balance. The average over the sampling period is chosen, rather than the value at the beginning or the end of the period, as the average rate is more likely to reflect the conditions prevalent at the time that transactions occur.

The time series used for government fiscal policy were total cash revenue and total cash expenditure.[13] Both were converted to real terms using the CPI. From the real revenue and real expenditure, we calculated three parameters for government fiscal policy. The parameter

[9] IFS database code: PCPI
[10] IFS database codes: TXG and TMG.
[11] Kimbrough and Gardner
[12] IFS database code: EREER
[13] IFS database codes: GBR_G01_CA GBXMTE_G01_CA

reflecting the budget balance was the budget ratio, calculated as (Revenues / Expenditures); we used the ratio rather than the difference to allow taking logs. The parameters reflecting expenditure and revenue were the real expenditure and real revenue, respectively, divided by real GDP.[14] We normalized by GDP because we expect a given change in government fiscal policy to matter not in absolute terms, but relative to the overall size of the economy.[15]

The regression was run on the first difference in logs of each of the variables. Taking the difference in logs removes the exponential trend from variables exhibiting long-term exponential growth, such as real GDP. In addition, it allows the regression relations to hold regardless of the overall size of the economy. For example, the relationship between the exchange rate and GDP should hold regardless of the absolute magnitudes of the values.

The exception is the real interest rate. As seen in Figure 6, the real interest rate has no long-term trend. In addition, according to the Cagan money demand function, the absolute level (rather than the log) of interest rate is what relates the log of money demand and inflation to the log of GDP. Therefore we looked at the first difference, rather than difference in logs, of the real interest rate.

The trade balance and government spending balance were considered as (Exports / Imports) and (Revenues / Expenditures), respectively, to allow taking the log.

[14] Thus if GDP were to increase with revenue held constant, this would appear as a fiscal tightening. This makes sense intuitively.

[15] Our budget ratio parameter is subject to criticism on the grounds that it reflects surpluses or deficits relative to the size of the government budget, rather than relative to the size of the economy.

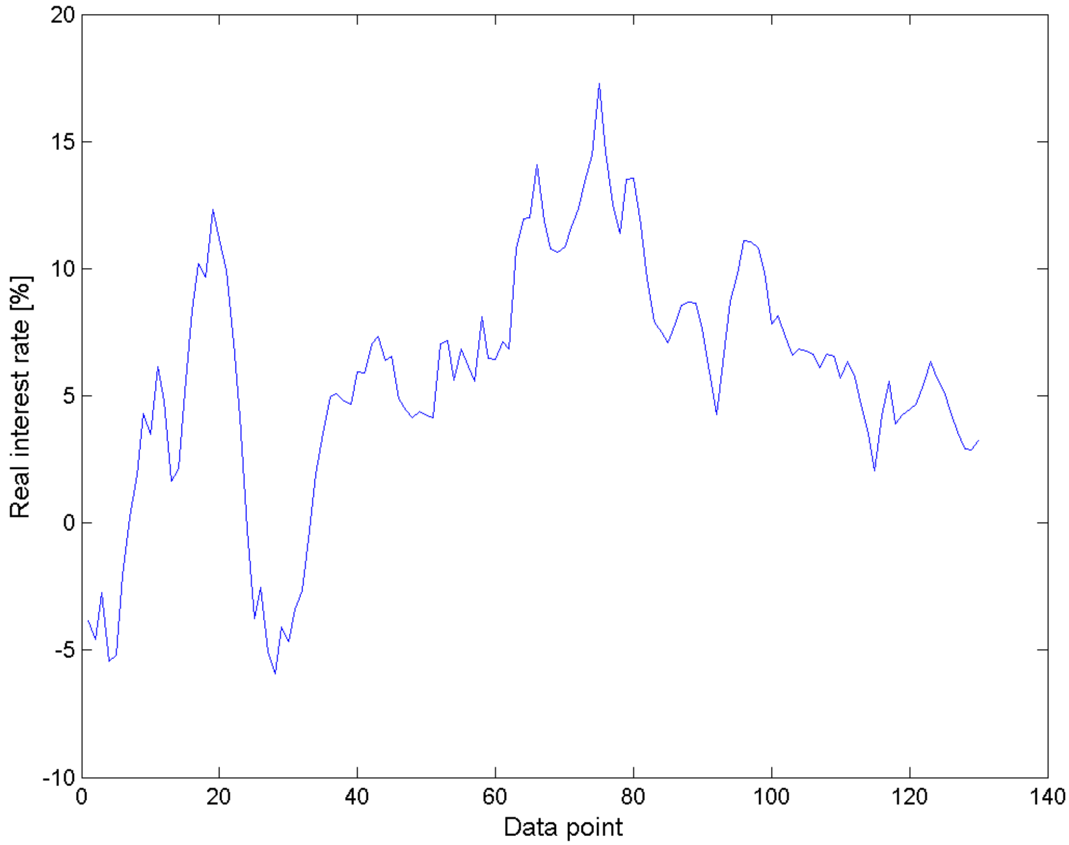

Figure 6. Time series of real interest rate.

Research Methodology

Vector autoregression (VAR) was introduced by Christopher Sims in 1980.[16] A VAR in *n* variables and *p* lags uses ordinary least squares (OLS) to explain the current value of each variable in terms of its own lagged values (in each of the *p* most recent periods), as well as the lagged values of the other *n-1* variables in each of these periods. VAR is used to capture rich dynamic interactions among multiple time series, and has proven to be a powerful tool in data description and forecasting.[17]

[16] Sims 1980

[17] Stock and Watson 2001

Our model, following Kim and Roubini 2008, is intended to determine the effect of fiscal policy on the trade balance, using VAR[18]. This model includes five variables: real GDP, a parameter reflecting government fiscal policy, the ratio of exports to imports, real interest rate, and real exchange rate. The budget balance, trade balance and exchange rate are the main variables of interest. Since we wish to find the effects of exogenous changes in fiscal policy, we include GDP to control for the influence of the business cycle on the budget balance. The real interest rate is included as a proxy to account for the effects of monetary policy.

However, while Kim and Roubini use a recursive VAR model, we use a reduced-form VAR for simplicity.[19] The reduced-form VAR expresses each variable as a linear function of its own lagged values, the lagged values of the other parameters, and a serially uncorrelated (that is, not autocorrelated in time) error term. Since the variables are correlated with one another, the error terms in reduced-form VAR models are typically correlated across equations. This can present an issue when doing impulse responses, as discussed below.

By contrast, Kim and Roubini use a recursive VAR model, in which the variables are ordered {GDP, Budget Balance, Trade Balance, Interest Rate, Exchange Rate}, meaning that GDP is expressed only in terms of lagged values of the variables; budget balance is expressed in terms of the contemporaneous value of GDP, as well as lagged values of all the variables; trade balance in in terms of contemporaneous GDP, budget balance, and lagged values of all variables; and so on. The algorithm for constructing a recursive VAR is equivalent to estimating the reduced form, then computing the Cholesky factorization of the covariance matrix.[20] The result

[18] Sims 1980.
[19] We discovered that neither MATLAB nor STATA have turnkey functionality for recursive VAR, so we used reduced form instead.
[20] Stock and Watson 2001

is that, in a recursive VAR, the error terms are not correlated across equations. This means that recursive VAR models are more useful than reduced form for computing impulse responses, as discussed below.

When the structural parameters of the VAR model have been estimated, the calibrated model will be used to calculate impulse responses to shocks in each of the variables. While the model is specified primarily to elucidate the effects of government spending on the trade balance, the impulse response should also provide insight as to its effect on output and interest rates.

All calculations are performed in MATLAB, using the Econometrics Toolbox add-on package.

The dynamic relations among the five variables (GDP, real interest rate, trade balance, exchange rate, and a government budget parameter) were explored with an unrestricted reduced-form vector autoregression model. Three government budget parameters were used: the ratio of revenues to expenditures, real revenues, and real expenditures. Only one of the three budget parameters was used in each regression; thus, three sets of regressions were run. The full battery of regressions run is summarized in Table 2.

Budget Parameter	***Number of Lags***
Ratio (Expenditure / Revenue)	3, 4
Revenue	3, 4
Expenditure	3, 4

Table 2. Summary of regression tests performed

Lags (#)	1	2	3	4	5	6
AIC	-1123.1	-1105.1	-1222.4	-1200.8	-1197.2	-1202.1

Table 3. Akaike Information Criterion for each number of lags in regression

The Akaike information criterion (AIC) was calculated for one to six lags, and the results appear in Table 3. The AIC for three lags was lowest, indicating that the VAR with three lags would have the most favorable tradeoff between goodness of fit and parsimony. However, we also ran regressions using four lags, to show the sensitivity of the VAR results to the number of lags chosen, as discussed further in the Results section. VAR's were run using three and four lags for each of the three budget parameters, for a total of six VAR estimations.

The impulse responses are the deterministic response of the model to a given input of error terms: they provide the model's answer to the question, "What happens in response to this kind of shock?" Typically these are calculated for a one-period shock to one variable, with all other errors set to zero. This experiment makes the most sense for a recursive or structural VAR, because their error terms are uncorrelated across equations. In the case of a reduced form VAR, the error terms generally are correlated across equations, so the idea of shocking one variable while holding others constant doesn't apply, and therefore the economic content of an impulse response function is limited.

Results and Interpretation

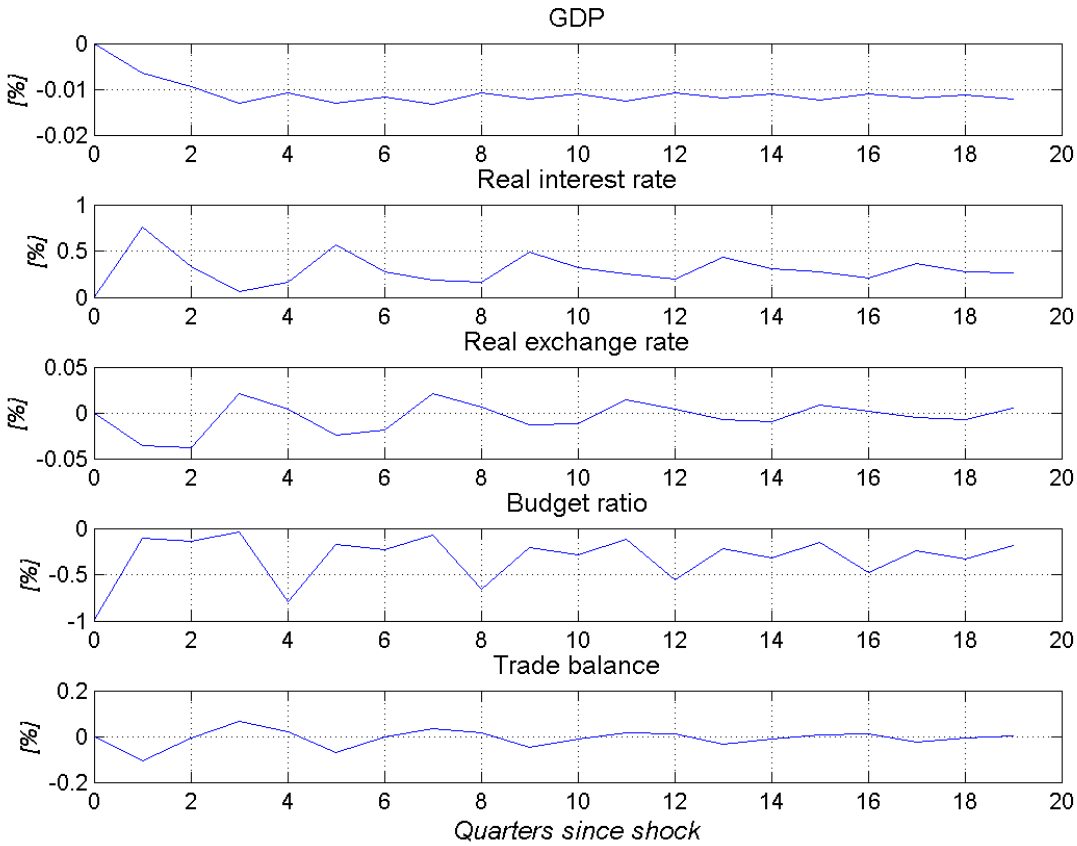

Figure 7. Impulse responses to budget ratio shock, 3 lags

Figure 7 shows the calculated impulse response to a 1% negative shock in budget ratio.[21] Since budget ratio is defined as (Revenue / Expenditure), a negative shock represents expansionary fiscal policy.[22]

The effect on GDP from a 1% expansionary fiscal shock was persistently negative for the 5 years following the shock, which is difficult to reconcile with the Mundell-Fleming model,

[21] The response variables were in differences in logs, so the innovation vector for a 1% negative shock had -0.01 in the current-period position for budget ratio and zeros elsewhere.

[22] No forecast is complete without error bars. However, the impulse response is deterministic, i.e. the shocks are given as an input. Kim and Roubini construct their standard errors using Bayesian inference with pseudorandom error inputs in a Monte Carlo integration with Jeffrey's prior; this analysis is out of the scope of this study.

which predicts an expansionary effect from fiscal stimulus. However, the effect is so small that its economic significance is essentially zero. This is consistent with the Ricardian equivalence outcome of fiscal policy in rational-expectations models, such as the Dornbusch.

The real interest rate is seen to rise persistently following the fiscal shock. This is consistent with the “crowding-out” predicted by both the Mundell-Fleming and Dornbusch models. There is a damped four-period oscillation in the real interest rate response, which is present in many of the impulse responses from our simulation. This will be discussed further in the next section.

The real exchange rate stays within a 0.05% band, or essentially constant, despite the fiscal shock. The Mundell-Fleming model predicts an appreciation in the case of high capital mobility and depreciation in the case of low. Our result here is consistent with a case of intermediate capital mobility, the B=0 line will have a similar slope to the LM curve, and there will be little change in the exchange rate.

By contrast, the trade balance is seen to deteriorate initially before improving and eventually dampening out in a four-period oscillation. This response could be interpreted as an artifact of the four-period oscillations seen in the budget balance parameters, as discussed in the next section, and therefore without economic meaning; in this case, there is no economically significant response of the trade balance to the fiscal shock. This is consistent with the discussion in the above paragraph, where intermediate capital mobility leads to little effect on the balance of payments and exchange rate from a fiscal shock. Alternatively, if the oscillations are considered economically meaningful, then the interpretation is that the balance of trade temporarily deteriorates, which is consistent with the case of low capital mobility in the

Mundell-Fleming model. The oscillations, meanwhile, are consistent with the "overshooting" behavior predicted by the Mundell-Fleming model. Our interpretation is that the oscillations are an artifact of yearly oscillations in the government budget parameter data, as discussed in the next section.

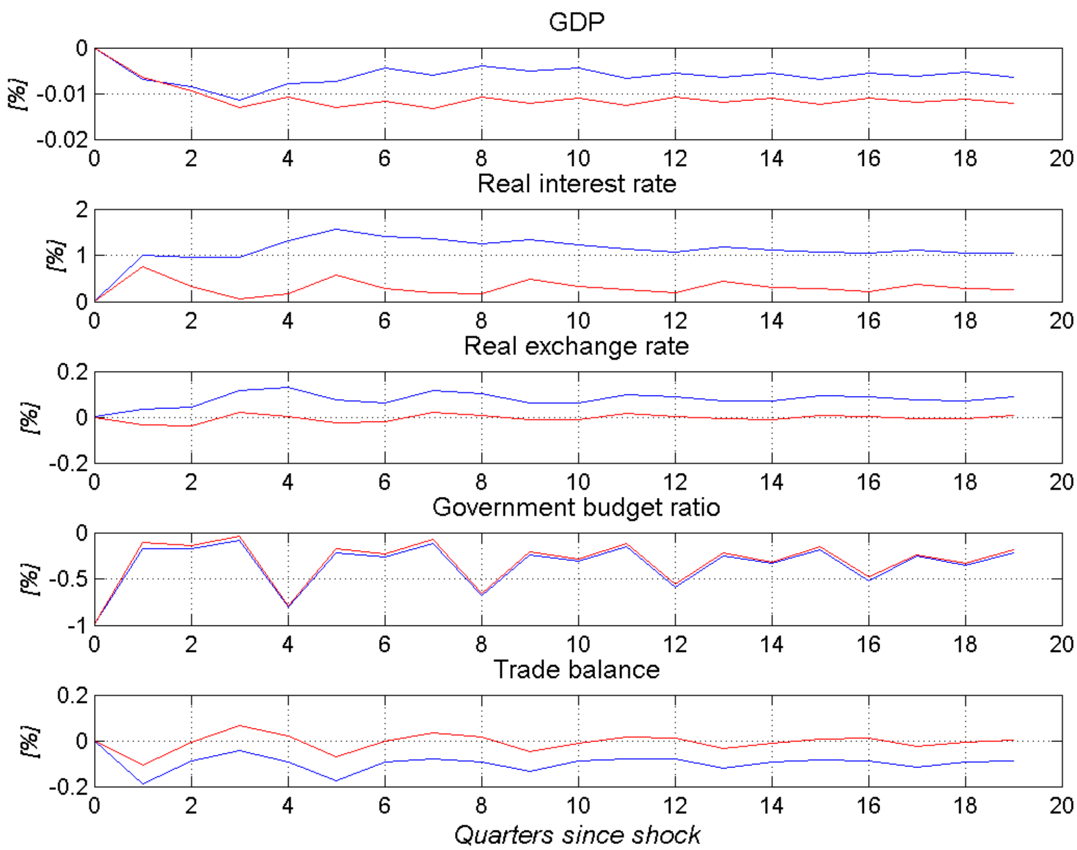

Figure 8. Comparison of impulse responses to budget ratio shocks with 3 (red) and 4 (blue) lags

The government budget ratio is pinned at exactly -1% in the current period; this is the "shock" of which we are modeling the effects. The budget ratio change then returns to zero relative to the baseline, except for gradually decaying echoes of the initial shock every four quarters. This is thought to be an artifact of oscillations in the input data. If the government's budget position were to decline persistently in response to a one-period shock, it would be because the shock led to a substantial increase in the amount of debt to be financed; in this case, the deterioration of the budget parameter should be persistent, rather than oscillatory.

For comparison, the results from the same experiment (a negative shock to the budget ratio) are presented in Figure 8 for the same model fit with four lags instead of three. The response for the model with 3 lags is in red, and for 4 lags in blue. Interestingly, the effect on the real exchange rate is different between the two models, with the 4-lag model showing a stronger and more persistent crowding-out effect, with less evidence of the 4-period oscillation. The oscillation is just as strong in the other responses. The difference in the real exchange rate response between the two models shows that outcome of our experiment is sensitive to the details of the specification chosen.

In addition to the effects of a change in the overall government budget balance, we also calculated impulse responses to changes in revenue and in expenditure, each in real terms as a fraction of GDP. These are plotted together in Figure 9.

The fiscal metric response moves in opposite directions for the revenue and expenditure shocks, because an expansionary shock is negative for revenue and positive for expenditure. The impulse responses to expansionary shocks in expenditure and revenue are broadly similar to those in the overall budget balance. One noticeable difference is that the expenditure shock has a more pronounced crowding-out effect on the real interest rate than does the revenue shock. The expenditure shock also has a more pronounced effect on the real exchange rate. In the Mundell-Fleming model, the increase in interest rate in response to a fiscal expansion is due to the rightward shift in the IS curve. The effect we see in the data could be explained in the context of the Mundell-Fleming model by invoking the standard Keynesian argument about the marginal propensity to consume: when the government increases spending, all the extra spending goes to goods and services, shifting the IS curve rightward; but when taxes are decreased, some of the extra money left to individuals and firms is saved rather than spent, so the effect on the IS curve is less.

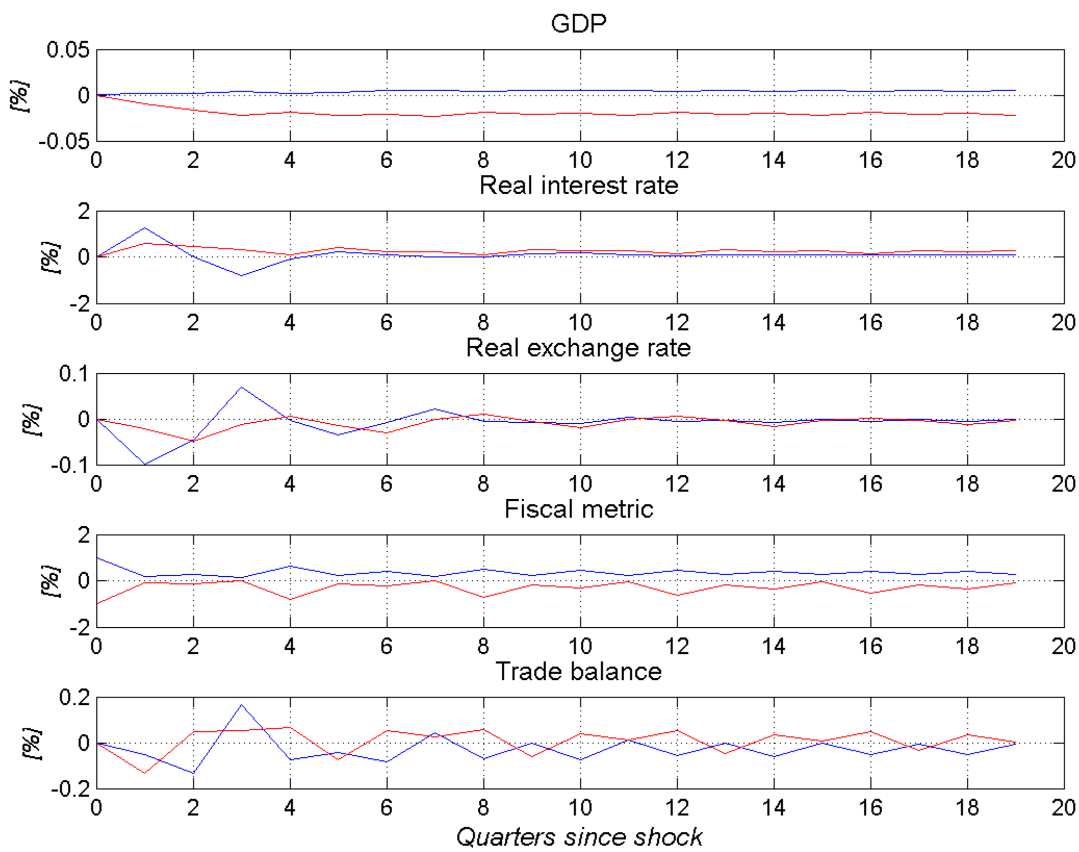

Figure 9. Comparison of impulse responses to positive expenditure (blue) and negative revenue (red) shocks

Economic Significance

The economic significance of the impulse responses of a reduced-form VAR is limited, for reasons discussed in the methodology section. We performed our analysis as an exercise in interpreting the output of an economic simulation with respect to the theoretical predictions of the Mundell-Fleming model, but the regression should be run as a recursive or structural VAR for the relationships uncovered to be useful from a theoretical or policy perspective.

As noted in the previous section, many of our calculated impulse responses show a 4-period oscillation. We discussed in the last section whether these oscillations had economic significance, or were an artifact of periodicity in the budget data. Figure 10 shows the budget ratio parameter, with gridlines every four periods; note the four-period oscillatory trend seen in the data. This four-period oscillation appears in both the revenue and expenditure data, pointing to yearly cycles in government revenue and expenditure. This is likely due to the government tending to regularly collect taxes and pay disbursements more in one quarter than in others each year. Future work should use numerical techniques, such as taking a fourth difference, or making a seasonal adjustment, to remove this oscillation from the data so that it does not affect the results.

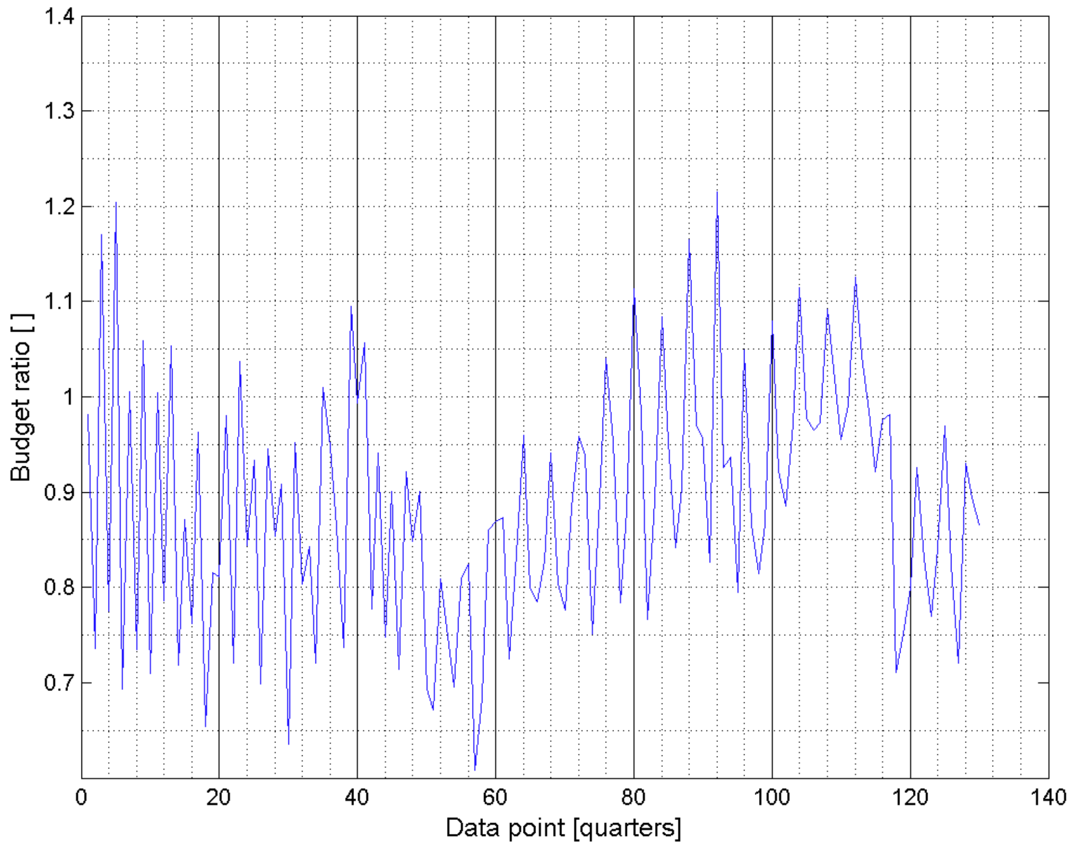

Figure 10. Oscillatory patterns in budget radio data

Our study did not include any tests for stationarity or unit roots in the data, such as the augmented Dickey-Fuller test. The variables (other than interest rate) were log-differenced, which should address concerns about non-stationarity; the interest rate should have been tested for stationarity, since it was not log-differenced. Moreover, the variables should have been tested for co-integration, such as with the Engle-Granger or Johansen test. In the presence of co-integration, a vector error correction model (VECM) would have been appropriate, rather than reduced-form VAR.

In addition to this fundamental concern with the framework used for the model, there could also be issues with omitted variable bias. For ordinary least squares, which is used to determine the VAR coefficients, to be an unbiased estimator, it is necessarily assumed that the error terms are uncorrelated with the included variables, i.e. that the independent variables are exogenous. If the error terms include factors which are omitted from the model and which are correlated with factors which are included, then the estimate will contain omitted variable bias.

An example of omitted variable bias in the historical VAR literature is the "price puzzle": early VAR models showed an increase in inflation following monetary policy tightening. Sims ('92) suggested that the Fed was using forward-looking indicators of inflation to inform its monetary policy, and that the VAR models exhibiting the price puzzle used a structural backward-looking Taylor equation to model the Fed's behavior, omitting these forward-looking factors. Thus when the Fed tightened interest rates in response to an expected increase in inflation, the early structural VAR models interpreted the higher interest rates as monetary shocks, leading to flawed impulse responses.[23]

This study did not include several variables which may have been correlated with the error term. For example, we chose not to include any variables related to mineral prices or discoveries of new mineral reserves. However, as of 2005 the mineral mining industry accounted for 7% of South Africa's GDP and 37% of its exports,[24] so it is possible that exogenous changes in prices or production could have significantly affected our results. For example, a change in the price of exported minerals would cause both the budget balance and the trade balance to move in the same direction: a price drop would reduce tax revenues and the value of exports, causing "twin deficits." Our study showed that the budget balance and tax

[23] Stock and Watson 2001
[24] Yager 2007

revenues did tend to move in the same direction as the trade balance; without including a variable for mineral prices, we cannot be sure whether this result is due to a causative link between the government's budget and the trade balance, or due to the effect of mineral prices on both.

In addition, the unexpected discovery of rich mineral deposits could have led the government to increase its budget deficit to smooth lifetime consumption, in the expectation of higher future revenues. This discovery would also likely stimulate investment in the mining industry, driving up money demand and interest rates. This would cause the appearance of "crowding-out," with higher real interest rates accompanying higher budget deficits, which was indeed what our analysis showed. However, without including a variable to reflect mineral discoveries, we cannot state with certainty whether our result reflects classical crowding-out or is an artifact of exogenous changes in mineral reserves.

As noted in Table 1**,** the degree of de jure capital mobility in South Africa changed significantly over the sample period, with a substantial loosening of restrictions just before the regime change in 1994, followed soon after by a substantial tightening. There was also a smaller but still substantial loosening of restrictions from 1982-1984. It is possible that changes in South Africa's capital controls could change the structural relationships between the variables included in our study.

Our analysis also did not account for changes in world income or interest rates. We expect that world income would be positively correlated with South Africa's income and trade balance. An increase in world income would coincide with higher income and a more favorable trade balance in South Africa, both of which would in turn improve the government's budget balance through higher tax revenues. This is consistent with the "twin deficits" seen in our regression, where a deficit or negative revenue shock was seen to coincide with a worsening of the trade balance. Thus without including a variable for world income, we cannot be sure whether this trend was evidence of a causal relationship between government budget and trade balance, or whether the "twin deficits" were both due to world income shocks.

We also expect that the world interest rate would be positively correlated with South Africa's real interest rate: while earlier work found little evidence to support interest rate parity even in countries with high capital mobility,[25] the presence of any capital flows should produce at least some positive correlation between world and local interest rates due to international arbitrage.[26] In addition, the world real interest rate could affect South Africa's cost of servicing its debt, and thereby the overall budget balance. In this case, a rise in the world interest rate would increase the budget deficit (via expenditures) and the local real interest rate simultaneously, causing the appearance of classical crowding-out. Again, without including the real interest rate, we cannot be sure whether the coincidence of budget deficit (and expenditure) shocks with higher interest rates was due to classical crowding-out, or due to the mutual influence of world interest rates. However, this issue is somewhat mitigated by the fact that negative revenue shocks also were seen to coincide with higher real interest rates; since world interest rates are expected to affect the budget balance through expenditure rather than revenue (South Africa being a net borrower), this fact seems to support the crowding-out explanation.

Conclusion

The motivation of our study was to provide an empirical basis for addressing the question of what effect fiscal policy shocks have on the South African economy, with regard to GDP, the

[25] Bui et al. 2013
[26] Mishkin 1984

trade balance, the real interest rate and the exchange rate. In the previous section, we addressed concerns regarding the economic significance of our results, and identified areas in which our methods could be improved to increase the economic significance of our findings. With these caveats in mind, we proceed to discuss our findings in light of the questions we set out to answer.

Our findings show little to no effect on GDP from a fiscal policy shock, whether in the form of a change in the overall budget balance or a change in expenditure or revenue. A 1% fiscal shock was seen to yield less than 0.05% change in GDP. Our results show that if South Africa were to balance its budget, the effect on growth should be negligible. This result is consistent with rational-expectations models positing Ricardian equivalence.

Consistent with the predictions of the Mundell-Fleming model for a country with low capital mobility, our results show that a fiscal expansion is accompanied by a worsening of the terms of trade and a depreciation of the currency. The Ito-Chinn Index for South Africa indicates that it has relatively low capital mobility, so the Mundell-Fleming predictions for low capital mobility should be applicable. Thus our findings support the notion of "twin deficits." If the South African government wished to reduce the size of their trade deficit, they could do so by reducing the budget deficit, with a 1% deficit reduction resulting in approximately a 0.1% reduction in the trade deficit. Given the relative weakness of this policy instrument, the government might be better served by measures to boost productivity.

Kim and Roubini found that the improvement in current account position accompanying expansionary fiscal shocks was due to a decrease in private investment. It would be interesting in the case of South Africa to see if an increase in private investment generated the worsening in current account position seen in our study.

Appendix A. Sample MATLAB script

```
%One-std positive shock in budget balance, ie contractionary fiscal policy
clear;
load('656_033013_2.mat')

W0 = zeros(20, 5); % Innovations without a shock
W1 = W0;
W1(1,4) = sqrt(EstSpec.Q(4,4)); % Innovations with a shock

%Use vgxproc on model from whole sample
yimpulse = vgxproc(EstSpec,W1,[],Y); % Process with shock
ynoimpulse = vgxproc(EstSpec,W0,[],Y); % Process with no shock

% dgdp=diff(logrealgdp);
% dtb=diff(logxoverm);
% dinterestrate=diff(realinterestrate);
% drer=diff(logrealexchangerate);
% dbudrat=diff(logbudratio);
% Y=[dgdp',dinterestrate',drer',dbudrat',dtb'];

%Last data points as starting points for impulse response
endpt=[logrealgdp(end),realinterestrate(end),logrealexchangerate(end),logbud
r atio(end),logxoverm(end)];
yimp=[endpt;yimpulse];
ynoimp=[endpt;ynoimpulse];

Yimp=cumsum(yimp);
Ynoimp=cumsum(ynoimp);
%Note: tested Yimp with the following:
% test=[logrealgdp';Yimp(:,1)];
% plot(test)

%Remove logs from logged variables for direct comparison
impulse=[exp(Yimp(:,1)),Yimp(:,2),exp(Yimp(:,3)),exp(Yimp(:,4)),exp(Yimp(:,5)
)];
noimpulse=[exp(Ynoimp(:,1)),Ynoimp(:,2),exp(Ynoimp(:,3)),exp(Ynoimp(:,4)),ex
p (Ynoimp(:,5))];

reldif=(impulse-noimpulse)./noimpulse*100;

%take off first element, ie before shock happens
reldif=reldif(2:end,:);

plot([0:1:(length(reldif)-1)],reldif(:,4))
xlabel('Quarters after shock')
ylabel('Impulse response to shock [%]')
```

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