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The fundamental determinants of the rand exchange rate:

a historical and forward-looking analysis

17 November 2003

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Executive Summary

An EPRI research report commissioned by TISA's Strategy and Research Unit

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This study evaluates the major determinants of the rand exchange rate based on a fundamentals analysis of the currency over the past ten and twenty years. The methodology estimates the relationship between the observed real effective exchange rate and its unobserved equilibrium level, using macroeconomic fundamentals as explanatory variables. In addition, this analysis compares the results to other recent studies of the rand exchange rate.

Several policy-related variables consistently demonstrate an important role in determining the time path of the real effective exchange rate. Monetary policy has been an important source of relative rand strength over the past ten years, as the Reserve Bank has implemented initially an informal and currently a formal strategy of inflation targeting. High interest rates employed for disinflation generate a South African premium over international interest rates, leading to capital inflows that tend to appreciate the rand. The evidence points towards a significant impact of the Reserve Bank's monetary policy in 2002 and 2003 contributing to the appreciation of the rand. The five-percentage point increase in the interest rate differential explains between five and fifteen percent of the rand's appreciation. In addition, the increase in capital inflows in 2002 explains between two and five percent of the rand's appreciation in 2002 and 2003.

Fiscal policy that has reduced the fiscal deficit from 1990 to 2002 has tended to offset the impact of monetary policy by contributing to a depreciation of the rand. The budget deficit estimates for the first two quarters of 2003, however, are approximately one percentage point of GDP higher than those for the first two quarters of 2002, and the moving average trend is upwards. This is associated with approximately a two-percentage point contribution to the appreciation of the rand in the first half of 2003.

Restructuring of the real economy has been associated with a stable depreciation of the rand, consistent with theoretical analysis of the impact of trade

liberalisation and economic diversification. The restructuring of the domestic real economy interacts with other economic factors to influence the evolution of the real effective exchange rate. Improvements in the productivity of the tradable goods sector, for instance, tend to appreciate the exchange rate. Restructuring the real economy towards increased export orientation, however, may also be associated with trade liberalisation and a resulting depreciation of the currency. A shift in the composition of exports from commodity dependence to manufacturing value-added intensive goods tends to remedy "Dutch disease", stabilising the currency and reducing the chances of over-valuation.

Empirical evidence demonstrates the significant real restructuring of manufacturing and exports over the past ten years. In 1989, gold exports amounted to approximately half the value of total merchandise exports. By 2001, this had fallen to nearly 12%, although this has since risen to around 15%—due primarily to gold's resurgence. The ratio of primary sector value-added to secondary-sector value-added is more volatile, but reflects the same long-term trend as the gold-to-merchandise exports ratio. The steady decline in the economy's dependence on gold exports, reflecting a broader economic restructuring, has been associated with secular currency depreciation.

Projections over the next eight years require the construction of scenarios specifying values for these economic fundamentals. Given the success of the Reserve Bank's disinflation strategy, it is likely that South Africa's interest rates will reflect a smaller premium over international rates over the next eight years and longer. The National Treasury's recently released Medium Term Budget Policy Statement provides estimates for fiscal policy projections. Historical trends, in light of current strategic direction, provide the basis for forecasting proxies for trade and manufacturing restructuring.

Under both bearish and bullish assumptions, the rand is projected to depreciate—at a rate of 5.5% under the bearish scenario and a rate of 1.6% under the bullish scenario. The baseline scenario, which projects forward current trends, generates an average annual rate of depreciation of 3.35% per year. Actual exchange rates, however, do not necessarily respect their equilibrium levels. Misalignment can persist for years, particularly in the face of distortionary intervention or inefficient markets. While the analysis of the fundamentals implies eventual relief from the rand's current over-valued levels, no mechanism exists to guarantee that the adjustment process will be orderly or free from over- and under-shooting.

1) INTRODUCTION

On 17 November 2003 the nominal rand/dollar exchange rate reached its strongest level in more than three years, underscoring its position as the world's "best-performing" tradable currency this year. This strength arises from a backdrop of substantial volatility. In 2001 the rand lost 34% of its value against the US dollar, and then appreciated 29% the following year. Coinciding with rand strength, the US dollar gold price on 17 November 2003 had reached its highest level in more than six years. Many South African companies have cited the strength of the rand in their profit warnings over the past several months, and economists are brushing up on Nobel Laureate Rudi Dornbusch's prize-winning theory concerning exchange rate over-shooting. In this context this study analyses the major domestic microeconomic and macroeconomic fundamentals as well as the external forces that have influenced South Africa's real effective exchange rate over the past decade. The analysis also explores the impact of alternative forward-looking scenarios regarding these exchange rate determinants in terms of their impact on the rand exchange rate over the next eight years.

2) METHODOLOGY

The methodology of this study combines a review of previous South African exchange rate studies with new econometric analysis of quantitative data measuring the determinants of the real effective exchange rate over multiple time frames, including the past decade and the past twenty years. These baseline regression models support the forecasting of the impact of alternative scenarios on the evolution of the real effective exchange rate.

The econometric model is based on the co-integration (fundamentals) approach to measuring the equilibrium exchange rate, which identifies the fundamental policy variables and external factors determining the equilibrium level. This approach quantifies movements of the exchange rate which diverge from equilibrium and create the potential for misalignment—either over- or under-valuation. The model evaluates the econometric relationships with South African Reserve Bank data from 1983 to 2003. The discussion below focuses on the specific factors contributing to the appreciation of the rand in 2002 and 2003.

The methodology estimates the relationship between the observed real effective exchange rate and its unobserved equilibrium level, using macroeconomic fundamentals as explanatory variables. The technique supports the calculation of misalignment, which generates variability that cannot be explained through these quantifiable fundamentals. The characteristic feature of the methodology is that it allows the real equilibrium exchange rate to vary over time, a major difference from the classical purchasing power parity (PPP) approach. The fundamentals approach used in this study is more appropriate for South Africa because observed exchange rates

can diverge from estimated PPP rates for decades, yet they converge to estimated equilibrium rates much more rapidly. The time path of estimated equilibrium rates provides a more relevant prediction for future exchange rate movements and reflects the impact of the interaction between macroeconomic fundamentals and policy choices. This model estimates a long-run co-integrating relationship that corrects for the non-stationary nature of the exchange rate and its explanatory variables—the details of the estimation technique are reported in the Technical Addendum. In addition, this analysis compares the results to other recent studies of the rand exchange rate.

3) RESULTS: Historical determinants of the exchange rate

The first question this study addresses is: how has macroeconomic restructuring over the past decade affected the determination of the exchange rate?

3.1) Monetary policy

South Africa's monetary policy framework effectively assigns the interest rate to control inflation. The Reserve Bank's policy instruments demonstrate a close correlation with the prime-lending rate, as depicted in the figure below. International investors monitor interest rate differentials between South African assets and alternative international investments, allocating portfolio investment in response to South Africa's interest rate premium. The resulting capital flows affect the level of the rand exchange rate.

Figure 1) The relationship between the South African Prime and Repo rates
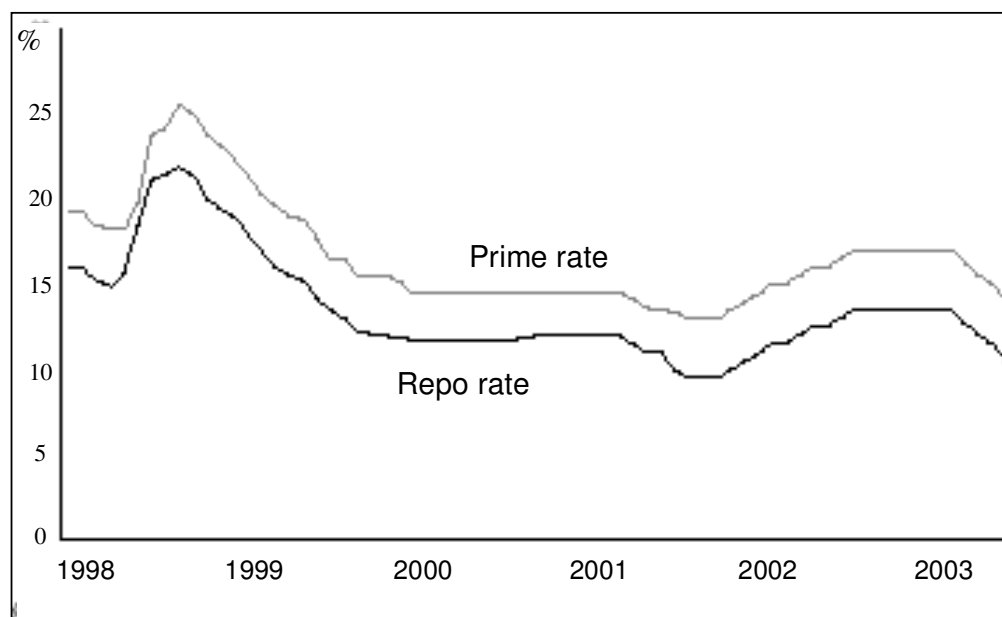
SOURCE: National Treasury Medium Term Budget Policy Statement 2003

Equilibrium interest rate differentials may reflect factors other than the Reserve Bank's policy of disinflation. Higher interest rates in one country may reflect a greater productivity of capital, or excess aggregate demand. Any of these explanations, however, would tend to identify an appreciation of the rand exchange rate. The figure below depicts the evolution of the real effective exchange rate compared to the premium between the predominant real South African prime lending rate and the comparable real prime lending rate for the United States (as a proxy for the international interest rate). The South African interest rate commands a pr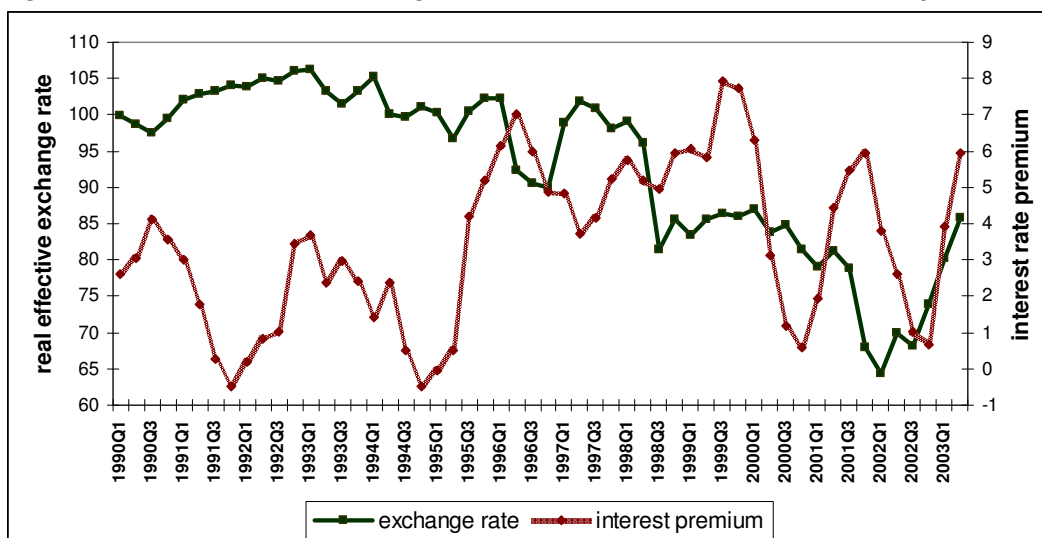emium compensating for market and exchange rate risk, and also reflects the disinflationary policy of the South African Reserve Bank. The exchange rate model identifies a significant positive impact of the interest rate premium on the real effective exchange rate.

Figure 2) The real effective exchange rate and the South African interest rate premium

SOURCE: South African Reserve Bank and EPRI calculations

The clearest example of this impact is seen in the first two quarters of 2003. The South African interest rate premium rose sharply—from less than one percent in the fourth quarter of 2002 to six percent in the second quarter of 2003. This increase coincided with the sixteen- percent appreciation of the real effective exchange rate in the first two quarters of 2003. Other clear examples of this relationship are difficult to discern from the graph. For instance, a much sharper increase in the interest rate premium in 1995 and 1996 coincided with a much smaller appreciation of the rand. However, the abolition of the financial rand at this time probably dampened the

resulting appreciation. Likewise, the increase in the interest rate premium in 1998 failed to elicit a rand appreciation—but it succeeded in stabilising the exchange rate in the face of the East Asian financial crisis.

Based on the estimate from the econometric model, a differential of one percentage point between the South African real interest rate and the United States real interest rate is associated with approximately a one percent appreciation of the real effective exchange rate.[1] This estimate is consistent with the econometric analysis previously commissioned from EPRI by the ERPC unit of the dti.[2] This estimate is significantly lower than the effect identified by a recent International Monetary Fund working paper. That study estimates that "an increase in the real interest rate relative to trading-partner countries of 1 percentage point is associated with an appreciation of the real effective exchange rate of about 3 percent."[3] The evidence points towards a significant impact of the Reserve Bank's monetary policy in 2002 and 2003 contributing to the appreciation of the rand. The five-percentage point increase in the interest rate differential explains between five and fifteen percent of the rand's appreciation.

3.2) Fiscal policy

Fiscal policy can affect the rand in several major ways, all of which have theoretically ambiguous impacts on the exchange rate.[4] First, changes in government spending financed by taxation (so that the fiscal deficit does not rise) can affect the level of the equilibrium exchange rate, depending on the composition of the expenditure. Greater public spending on tradable goods tends to increase the trade deficit, leading to a depreciation of the rand in the long run. However, if the government increases expenditure on non-tradable goods, the greater demand for these goods raises their relative price and appreciates the exchange rate.

The government's Medium Term Budget Policy Statement for 2003 forecasts moderately higher fiscal deficits over the next three years.[5] Theoretically, an increase in the fiscal deficit to finance additional government expenditure would increase aggregate demand while reducing national savings. To the extent that the government increased spending on non-tradable goods, their prices would rise and lead to a real appreciation of the currency. However, to the extent that the fiscal deficit leads to a

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[1] The details of the regression model are provided in the Technical Addendum.
[2] See Samson et. al. (2003).
[3] See MacDonald and Ricci (2002), page 19.
[4] See Hinkle and Montiel (1999) and Montiel (2003) for a thorough theoretical analysis.
[5] National Treasury (2003).

current account deficit, there would be pressure for an exchange rate depreciation to restore trade balance in the long run.[6]

The reductions in the fiscal deficit over the past five years have been achieved in no small part due to more effective tax collection. Theoretically, a decrease in the fiscal deficit resulting from more tax revenue (either through higher tax rates or improved efficiency of collection) reduces pressure for borrowing and/or inflationary finance. The improved fiscal position reduces costs borne by the tradable and/or non-tradable sectors of the economy. Depending on the incidence of this cost reduction, the tax-financed fiscal deficit reduction leads to an appreciation or depreciation. A lifting of the burden on the tradable sector tends to appreciate the rand, while relief for the non-tradable sector tends to be associated with exchange rate depreciation.

Figure 3) The real effective exchange rate and the fiscal deficit
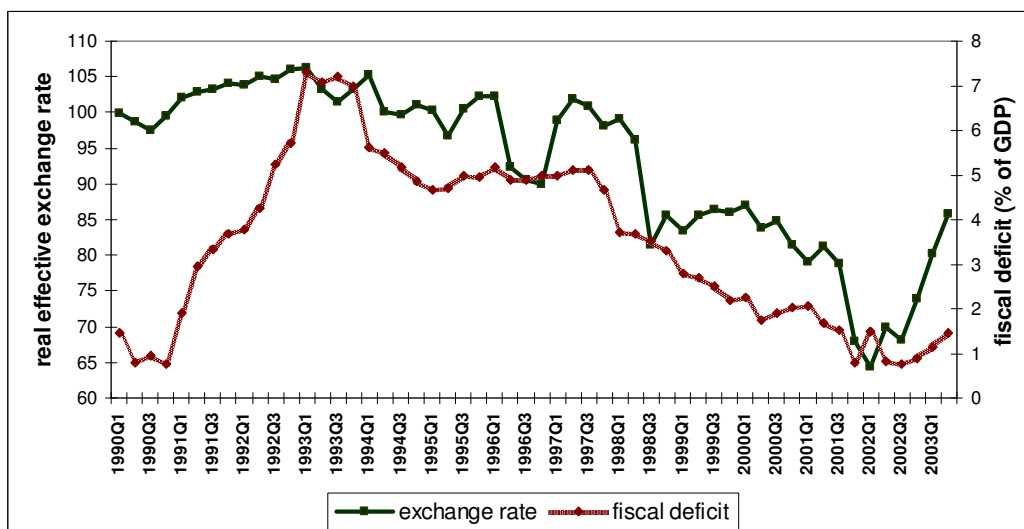
SOURCE: South African Reserve Bank and EPRI calculations

The graph above depicts a significant positive correlation between the fiscal deficit and the level of the real effective exchange rate.[7] The fiscal deficit is graphed here as a four-quarter moving average of the fiscal deficit as a percentage of national income, measured by Gross Domestic Product. From 1993 to 2001, the falling fiscal deficit has been associated with a depreciating rand. Assuming no impact from other factors, this would tend to imply that either the tax cuts have reduced the burden on

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[6] See MacDonald and Ricci (2002) for a theoretical discussion applied to the South African case.
[7] The coefficient of correlation for the quarterly data is 0.46, while the correlation calculated with four-quarter moving averages for the fiscal deficit variable is 0.68.

the non-tradable sector, or else that spending cuts have fallen on the non-tradable sector. The moderate positive impact of the fiscal deficit is apparent in the last two quarters of 2002 and the first two quarters of 2003. The fiscal deficit begins to increase over these four quarters, associated with a strengthening of the rand.

The evidence from this study's econometric model identifies that an increase of one percentage point in the ratio of the fiscal deficit to Gross Domestic Product is associated with an approximately two percent appreciation of the real effective exchange rate.[8] This estimate does not contradict the econometric analysis previously commissioned from EPRI by the ERPC, which focused on the government consumption effect of fiscal policy.[9] This estimate is not significantly different from the effect identified by the recent International Monetary Fund working paper. That study estimates that "an improvement in the fiscal balance of 1 percentage point of GDP is associated with a depreciation of the real effective exchange rate of around 2 percent."[10] In both the current study and the IMF paper, an increase in the fiscal deficit by one percent of GDP is associated with an appreciation of about two- percent. Quarter-to-quarter fiscal deficit figures are volatile—swinging from surplus to deficit and back again, partly due to seasonal factors. The budget deficit estimates for the first two quarters of 2003 are approximately one percentage point of GDP higher than those for the first two quarters of 2002, and the moving average trend is upwards. This is associated with approximately a two-percentage point contribution to the appreciation of the rand in the first half of 2003.

3.3) Trade and financial liberalisation

A critical aspect of South Africa's macroeconomic reform over the past ten years has centred on increased trade and financial liberalisation. The graph below, depicting South Africa's international capital flows over the past two decades, underscores the dramatic increase in financial openness over the past ten years. Likewise, the government has considerably liberalised international trade since 1994. The average import tariff has fallen from approximately 14% in 1994 to less than 5% in 2002, leading to an approximately fifty percent increase in merchandise import penetration. Conventional measures of "openness", such as the ratio of imports and exports to national income, rose from 40% in 1994 to 65% in 2002. Exports account for a substantial share of South Africa's economic growth over the past decade.

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[8] The details of the regression model are provided in the Technical Addendum.
[9] See Samson et. al. (2003).
[10] See MacDonald and Ricci (2002), page 20.

Figure 4) South Africa's international capital flows, 1985 to 2003
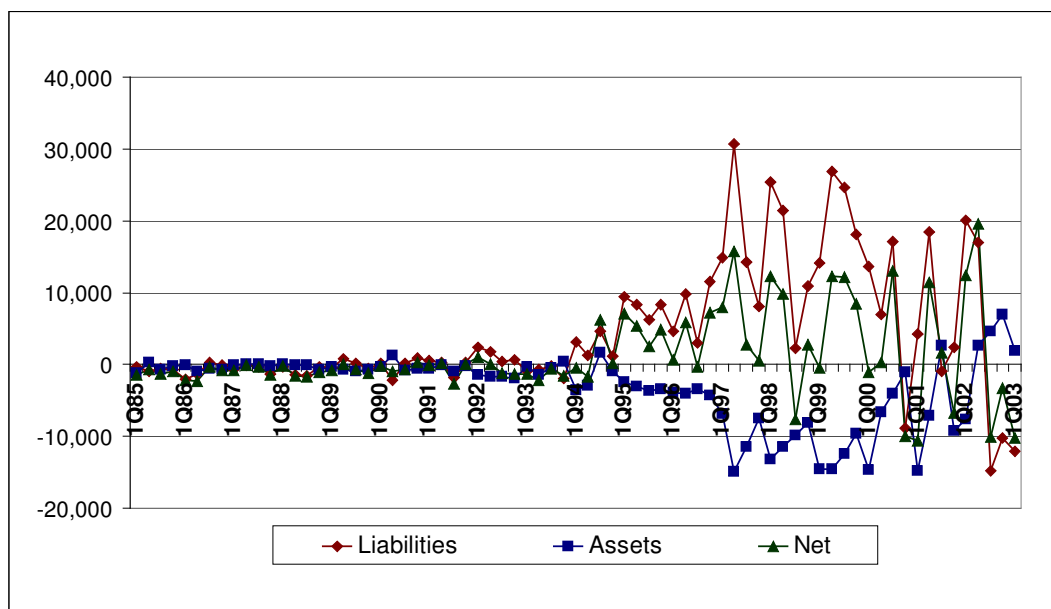
Economic theory documents that greater trade openness and international capital market liberalisation can be associated with either an exchange rate appreciation or depreciation. Barriers to trade undermine competitive pricing of tradable goods, raising their prices domestically. This generates competing effects— the tendency to shift consumption into non-tradable goods (the substitution effect) supports a currency appreciation, while the income effect tends to depreciate the exchange rate. Empirical evidence generally supports a stronger substitution effect, so that trade liberalisation that reduces trade barriers is associated with a depreciating exchange rate.[11] Likewise, trade liberalisation associated with a reduction in export subsidies tends to be associated with an exchange rate depreciation.[12]

Financial liberalisation that relaxes capital controls can lead to greater capital inflows, appreciating the currency, but creating a future repayment liability that would require an eventual exchange rate depreciation to balance the current account.[13] The time path of the exchange rate depends on the pattern of net capital inflows. During the net inflow period, the demand for non-tradables tends to rise and appreciates the real exchange rate. The currency will depreciate when net capital flows out of the

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[11] See Asfaha and Huda (2002), MacDonald and Ricci (2002), Edwards (1988), and Goldfajn and Valdes (1999) for a discussion of alternative viewpoints on the impact of trade liberalisation on the exchange rate.

[12] For a detailed development of this finding, see Hinkle and Montiel (1999), pages 288-289.

[13] See Hinkle and Montiel (1999) and MacDonald and Ricci (2002).

country.[14]   An alternative theory supporting the same result is that capital inflows resulting from financial liberalisation support a greater trade deficit, allowing a country to cope with the loss of competitiveness resulting from an over-valued exchange rate.[15]   At least initially, financial liberalisation can be associated with an appreciation of the real effective exchange rate. Combined, the effects of increased financial and trade openness can offset each other—the net effect depends on the sequencing and pace of liberalisation.

The graph below depicts the relationship between the real effective exchange rate and capital flows, as reflected by the balance on financial account of the balance of payments. The stability of the capital flows from 1990 to 1994 coincided with a stable real exchange rate, but the rapid inflows in 1994 and 1995 had little impact on the level of the rand. Movements in capital flows after 1995 have tracked the real exchange rate very closely[16], and the strong capital inflows in early 2002 were associated with the initial strengthening of the rand after the depreciation of 2001. The subsequent downturn in capital inflows had no countervailing impact on the exchange rate.

Figure 5) Exchange rate and the balance on the financial account
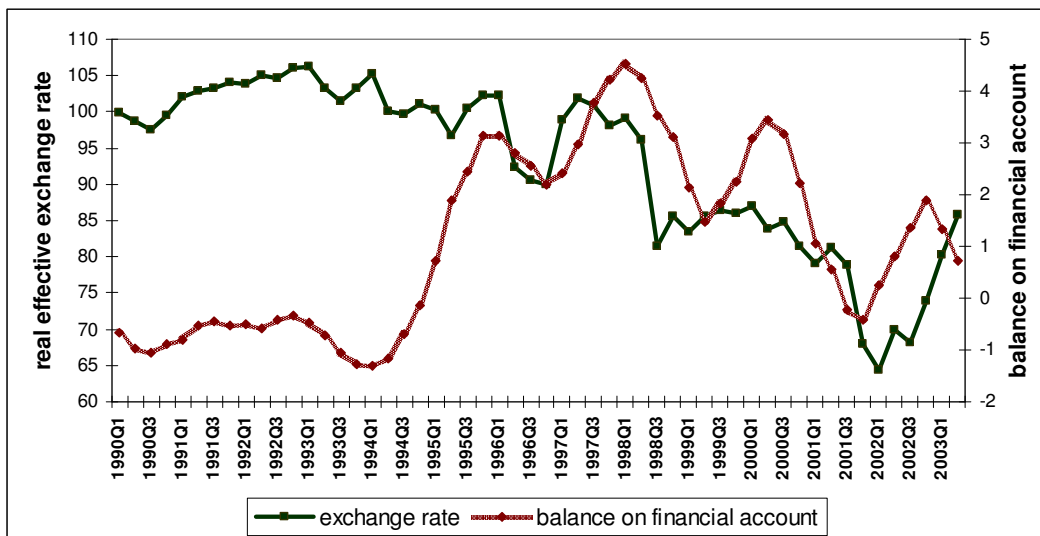
SOURCE: South African Reserve Bank and EPRI calculations

The evidence from this study's econometric model identifies that an increase of one percentage point in the ratio of the net financial balance to Gross Domestic

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[14] See Asfaha and Huda (2002), Edwards (1989) and Chowdhury (1999).

[15] See MacDonald and Ricci (2002).

[16] The correlation coefficient between the level of the real effective exchange rate and the four-quarter moving average of the financial account balance is 0.74.

Product is associated with an approximately two percent appreciation of the real effective exchange rate.[17] This estimate is consistent with the econometric analysis previously commissioned from EPRI by the ERPC, which yielded a similar two percent impact.[18] This estimate is somewhat greater than the effect identified by the recent International Monetary Fund working paper, but that study used a different measure of financial openness. That study estimates that "an increase in net foreign assets of 1 percentage point of GDP is associated with an appreciation of the real effective exchange rate of around 1 percent."[19] A recent study presented at the TIPS Forum further corroborates the IMF estimate.[20] In the light of these estimates, it is likely that the increase in capital inflows in 2002 explained between two and five percent of the rand's appreciation in 2002 and 2003.

The findings from this study's econometric model confirm the theoretical evidence of the link between trade liberalisation and exchange rate depreciation. This empirical and theoretical evidence is consistent with the econometric analysis previously commissioned from EPRI by the ERPC, which found a similar impact.[21] These findings are confirmed by the recent International Monetary Fund working paper, which estimates that "an increase in openness of 1 percentage point of GDP is associated with a depreciation of the real effective exchange rate of about 1 percent."[22] The research presented at TIPS, however, contradicts this finding—the evidence in that paper suggests that increased openness leads to currency appreciation. The contradictory findings underscore the difficulty in quantifying the impact of some important variables—such as trade liberalisation. The conventional measure—exports and imports expressed as a percentage of national income—is an imperfect proxy subject to statistical problems complicated in the South African context.[23]

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[17] The details of the regression model are provided in the Technical Addendum.

[18] See Samson et. al. (2003).

[19] See MacDonald and Ricci (2002), page 20.

[20] Asfaha and Huda (2002) estimate that the real effective exchange rate appreciates by 1.32% for a one- percent decrease in domestic absorption, associated with an increase in net capital inflows. This is consistent with the findings of Edwards (1989), Elbadawi and Soto (1995) and Baffes et. al. (1999).

[21] See Samson et. al. (2003).

[22] See MacDonald and Ricci (2002), page 20.

[23] It is assumed, somewhat imperfectly, that the total volume of trade (imports and exports) reflects a country's openness, particularly with respect to trade policy. While the exchange rate may depend on the total volume of trade, the volume of trade certainly depends on the exchange rate, indicating a statistical condition of endogeneity of an explanatory variable. In most countries, imports and exports move in opposite directions in response to exchange rate movements, but in South Africa, because of the structure of export industries, they tend to move together.

3.4) The restructuring of the domestic real economy: manufacturing and exports

The restructuring of the domestic real economy interacts with other economic factors to influence the evolution of the real effective exchange rate. Improvements in the productivity of the tradable goods sector, for instance, tend to appreciate the exchange rate. This effect, commonly referred to as the Balassa-Samuelson effect, operates through wages in the tradable goods sector. Higher labour productivity leads to real wage increases, pushing up the price of non-tradable goods and appreciating the real exchange rate. Restructuring the real economy towards increased export orientation, however, may also be associated with trade liberalisation and a resulting depreciation of the currency, as discussed in the previous section. A shift in the composition of exports from commodity dependence to manufacturing value-added intensive goods tends to remedy "Dutch disease", stabilising the currency and reducing the chances of over-valuation.[24]

Econometric variables measuring restructuring are imperfect proxies, and in economies undergoing integrated industrial restructuring, the time paths tend to move together, dampening independent statistical significance. Proxies for restructuring include: (1) GDP growth relative to trading partners, since effective restructuring is likely to promote economic growth; (2) the ratio of primary sector value-added relative to secondary sector value-added, (3) the ratio of manufacturing value-added to total value-added across sectors, and (4) the value of gold exports as a percentage of total merchandise exports.

Figure 6) Measures of manufacturing and export restructuring
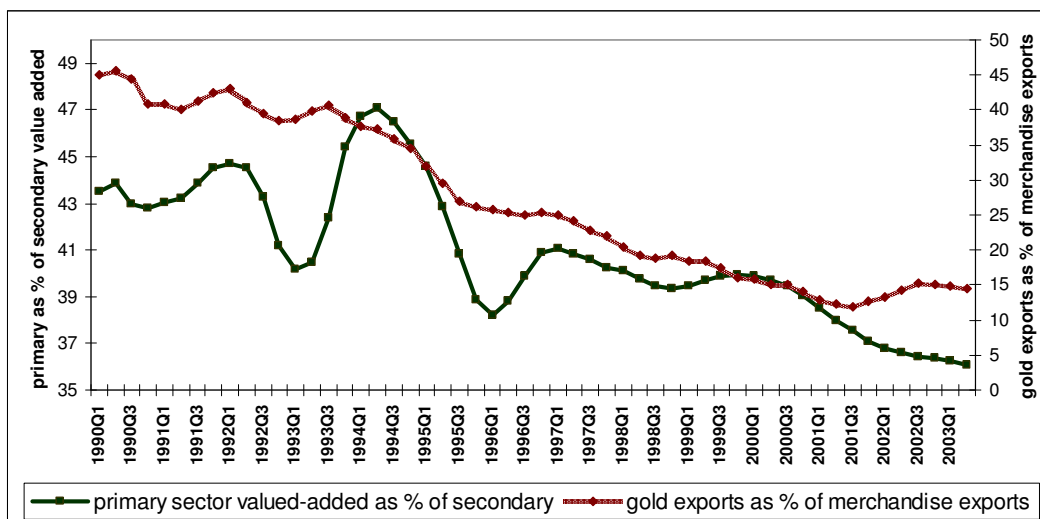
SOURCE: South African Reserve Bank and EPRI calculations

The figure above depicts the close empirical relationship between primary sector value-added (as a percentage of secondary sector valued-added) and the ratio

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[24] See Samson et. al. (2003).

of gold exports (measured as a percentage of merchandise exports).[25] A similarly close relationship is observed between the ratio of manufacturing value-added to total value-added for the primary and secondary sectors and primary sector value-added (as a percentage of secondary sector valued-added).[26]

The time paths of the variables demonstrate the significant real restructuring of manufacturing and exports over the past ten years. In 1989, gold exports amounted to approximately half the value of total merchandise exports. By 2001, this had fallen to nearly 12%, although this has since risen to around 15%—due primarily to gold's resurgence. The ratio of primary sector value-added to secondary-sector value-added is more volatile, but reflects the same long-term trend as the gold-to-merchandise exports ratio. The figure below shows the strong empirical relationship between economic restructuring (as measured by the gold-to-merchandise exports ratio) and the real effective exchange rate.[27] The steady decline in the economy's dependence on gold exports has been associated with secular currency depreciation.

Figure 7) Restructuring the South African economy: the impact on the exchange rate
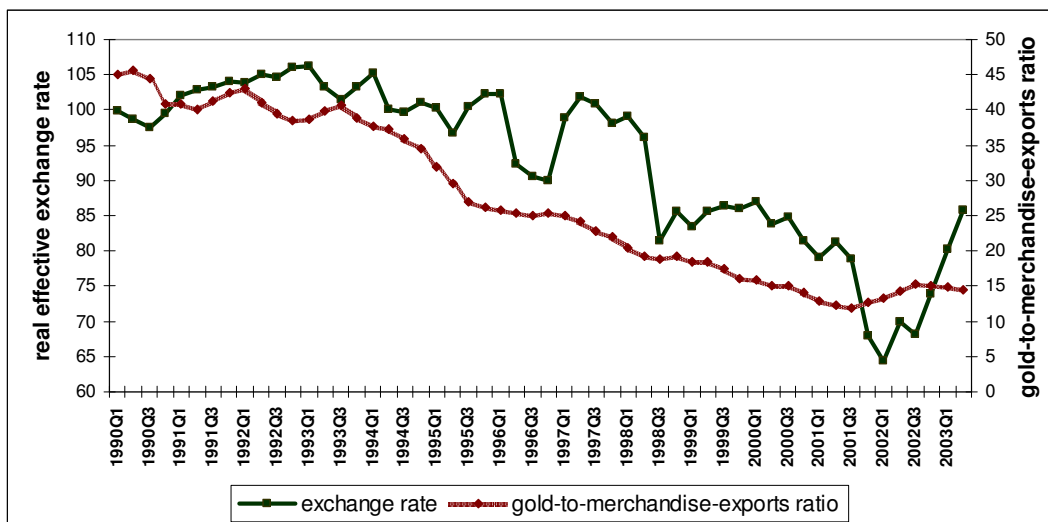
SOURCE: South African Reserve Bank and EPRI calculations

The empirical results from the econometric model confirm the strong relationship between the restructuring proxy and the real effective exchange rate. The magnitude of the impact combined with the high degree of co-movement among the restructuring variables (including trade liberalisation) suggest that the measured effect reflects the broad impact of manufacturing and trade reform. This empirical and theoretical evidence is consistent with the econometric analysis previously commissioned from EPRI by the ERPC, which found a similar relationship between the

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[25] The correlation coefficient for the two series is 0.84.
[26] The correlation coefficient for these two series is 0.87.
[27] The correlation coefficient between the two variables is 0.82.

exchange rate and a trade liberalisation proxy.[28] The International Monetary Fund study identified a small but positive direct effect from productivity growth (as measured by relative per capita growth rates, compared to trading partners), but that study identified the trade liberalisation effect separately. The IMF study estimates that "an increase in real GDP per capita relative to trading-partner countries of 1% is associated with an appreciation of the real effective exchange rate of 0.1-0.2 percent."[29] The study presented at the TIPS forum, however, contradicts the IMF estimate—the impact of productivity growth is positive but much stronger.[30]

The stability of South Africa's microeconomic reform strategy, combined with the significant impact of most of the study's restructuring proxies, suggests that manufacturing and trade policies have had a stabilising influence on the rand over the past two years. South Africa's relatively strong growth rates in 2001 and 2002 (average 2.9%) were significantly above those of its trading partners (an average of 1.3% for the US, 1.3% for Western Europe, zero for Japan, less than 2% for the rest of the world). Reflecting labour productivity growth, these effects may have contributed moderately to the strengthening of the rand, although the IMF estimates of this impact are negligible.

3.5) Other factors

Other factors have also contributed to the determination of the rand exchange rate, particularly those emanating from international market forces such as commodities prices and the terms of trade. The econometric analysis previously commissioned from EPRI by the ERPC found a statistically insignificant impact from terms of trade shocks, in part because competing effects from these price changes tended to offset each other. Likewise, the gold price did not exert a consistent impact on the rand exchange rate.[31] Nevertheless, the IMF study finds a significant positive effect, estimating that "an increase in real commodity prices of 1 percent is associated with an appreciation of the real effective exchange rate of around 0.5 percent."[32]

One particularly noteworthy determinant of the observed exchange rate is the tendency for misalignment. In the models discussed above, the fundamentals account for about 80% of the variability in the actual exchange rate. The remaining 20% is not uniformly distributed across time but rather occurs in intense episodes of misalignment, as exemplified by South Africa's experience over the past three years. Misalignment can have adverse consequences for the economy—misalignment often results in a correction, and Rudi Dornbusch's theory asserts that corrections are usually over-reactions, leading to over-shooting or under-shooting. For instance, within this context, the depreciation of 2001 led to misalignment—the rand was substantially

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[28] See Samson et. al. (2003).
[29] See MacDonald and Ricci (2002), page 20.
[30] Asfaha and Huda (2002) estimate that the real effective exchange rate appreciates by 9% for a one- percent improvement in production technology.
[31] See Samson et. al. (2003).
[32] See MacDonald and Ricci (2002), page 20.

under-valued. This misalignment led to a correction in 2002. The question is, did the market overshoot the equilibrium—is the rand now over-valued? And if it is over-valued, would a correction lead to more volatility than is necessary—that is, under-shooting?

The prospect of misalignment confounds the task of predicting the real exchange rate. Given the estimated relationship between the equilibrium exchange rate and the macroeconomic fundamentals, the equilibrium exchange rate can be predicted. But since at any point in time, the actual exchange rate may be misaligned in an unpredictable manner, the actual exchange rate cannot be accurately predicted. The failure of any economist to predict the magnitude of the 2001 depreciation underscores this point. Estimates of misalignment can be calculated as the percentage difference between the observed exchange rate and the estimated equilibrium level, and the results from the model's first specification are depicted in the figure below.

Figure 8) Rand misalignment and correction (model specification 1), 1983 to 2003
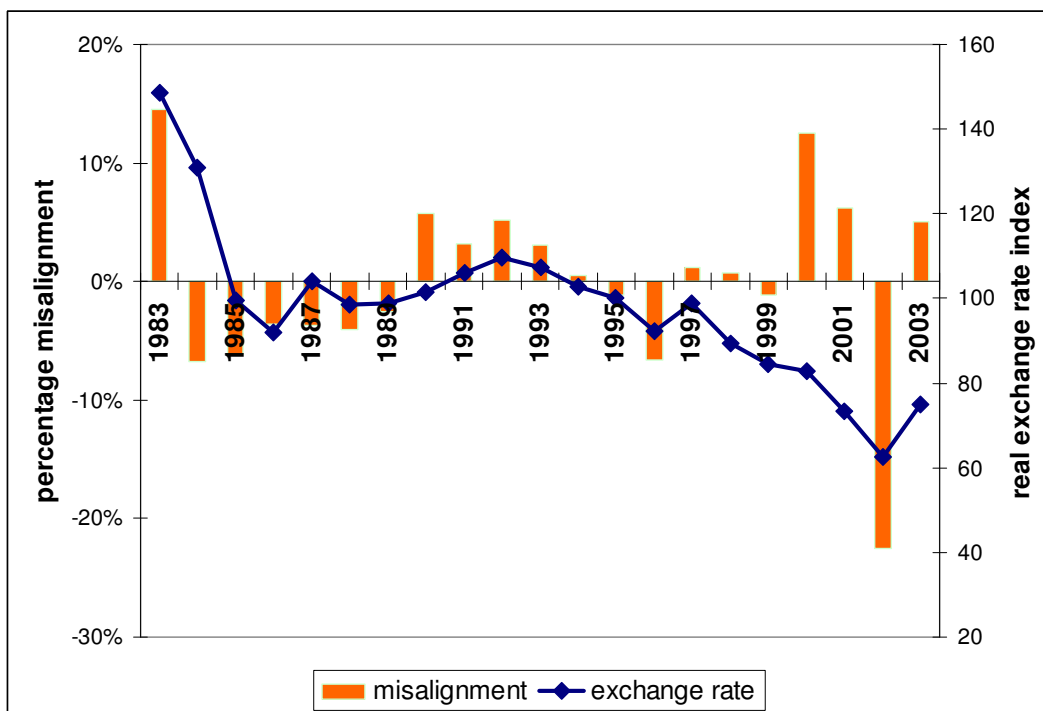
SOURCE: South African Reserve Bank and EPRI calculations

The estimates from this model indicate a significant over-valuation of the rand in 1983, which preceded its sharp decline in 1984 and 1985. Moderate over-valuation in the early 1990s preceded the 1996 devaluation. By comparison, the estimates do not indicate significant over-valuation prior to the 1998 depreciation—implying that drop in the rand that year was more a result of contagion from the East Asian financial

crisis than a consequence of South African policy fundamentals. The past several years, however, are characterised by significant misalignment.

The estimates of misalignment are sensitive to the model specified. This is common for equilibrium exchange rate estimates for developing countries, and is largely a result of the state of the science.[33] The figure below shows the estimated misalignment using a second specification of the model, which places a greater emphasis on the time trend of trade liberalisation. The major patterns of misalignment are similar to those calculated with the first specification.

Figure 9) Rand misalignment and correction (model specification 2), 1983 to 2003
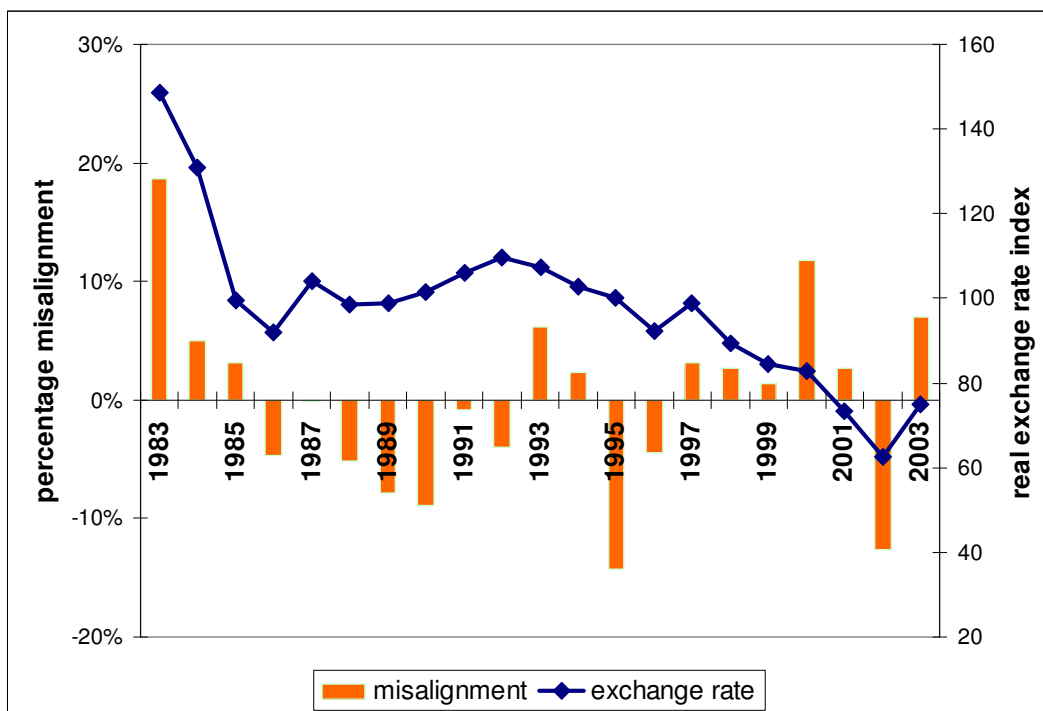
4) RESULTS: Forecasting the exchange rate over the medium term

The second question this study addresses is: what will be the impact of South Africa's structural reform interventions on the strength or weakness of the currency up until 2011? This analysis builds on the empirical analysis of the exchange rate determination models discussed in the previous section.

The first implication of the historical analysis is the high likelihood of misalignment, with resultant over-shooting and under-shooting and consequent unpredictable

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[33] For instance, Montiel (2003) cites different estimates for the degree of misalignment in Thailand prior to the East Asian financial crisis ranging from 30% over-valuation to no misalignment at all (page 393).

exchange rate volatility. Equilibrium-based models can identify the path of the long run equilibrium exchange rate, and estimate the speed at which the actual exchange rate tends to converge to this equilibrium. However, these models cannot predict speculative factors that can cause the actual exchange rate to diverge from the equilibrium. The projections in this section represent the estimated impact of South Africa's structural reform interventions on the strength or weakness of the currency up until 2011, not predictions of what the exchange rate will actually be.

The starting point for these projections is the identification of the key policy variables that constitute fundamental determinants of the real equilibrium exchange rate. The models discussed in the section above identify four key areas of policy interventions:

(1) monetary policy, focusing on interest rate differentials;

(2) fiscal policy, with an emphasis on the fiscal deficit;

(3) trade and financial liberalisation, addressing capital flows and openness; and

(4) restructuring of the real economy, with a focus on manufacturing and exports.

This study constructs three scenarios—

(1) a baseline scenario which projects forward current trends;

(2) a bearish scenario in which policy variables and fundamentals evolve along time paths associated with a weaker rand than in the baseline scenario; and

(3) a bullish scenario in which policy variables and fundamentals evolve along time paths associated with a stronger rand than in the baseline scenario.

4.1) The baseline scenario

The baseline scenario employs the first of the model specifications[34] to forecast the equilibrium values of the real exchange rate associated with projected values of the policy variables and fundamentals, as follows:

(1) For monetary policy, the interest rate differential is projected forward at a constant level of two percentage points, roughly in line with the current differential between the real South African interest rate and the real United States prime lending rate.[35]

(2) The fiscal deficit projections are consistent with the Medium Term Budget Policy Statement 2003 forecasts, translated from fiscal year to calendar year through an average weighting process. The steady state budget deficit after 2005 is assumed to be the final projected fiscal deficit in the Medium Term Budget Policy Statement. The calculations are all based on fiscal deficits expressed relative to national income, measured by Gross Domestic Product.

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[34] The details of the econometric model are documented in the technical addendum.

[35] The prime rate in September 2003 was 12% in South Africa and 4.24% in the US. The South African projected inflation rate for 2003 is 6.9% according to the Medium Term Budget Policy Statement, and approximately 1% in the United States.

(3) Financial liberalisation is measured by the balance on the financial account, projected forward based on historical trends for the past twenty years. Capital inflows increase from approximately 3% of national income in 2002 to about 5% in 2011.

(4) The restructuring proxy for the economy is projected forward based on the historical trend for the past twenty years. Growth in merchandise exports exceeds the pace of commodity exports to the extent that the ratio of gold exports to merchandise exports falls from 11.5% in 2002 to 5% in 2011.

These assumptions uniquely identify the values of the explanatory variables for the real effective exchange rate, allowing the econometric model to provide estimates of the equilibrium level from 2003 until 2011. The actual and predicted values from 1983 to 2002 and the forecast values from 2003 to 2011 are graphed in the figure below. The temporary increase in the fiscal deficit over the next three years stabilises the exchange rate over this period, and then it depreciates at a moderate rate until 2011. The average rate of depreciation from 2002 to 2011 is 3.35% per year, compared to an average depreciation from 1992 to 2002 of 5.45%. The slower rate of depreciation is due to the stabilisation of the interest differential and the fiscal deficit. If the interest differential and the fiscal deficit were to continue to fall, the rate of depreciation would be more rapid. The impact of the pace of financial liberalisation (leading to greater capital inflows) offsets some of the impact of the restructuring of the real economy—the net impact of these interventions is a moderate pace of currency depreciation.

Figure 10) Simulation 1
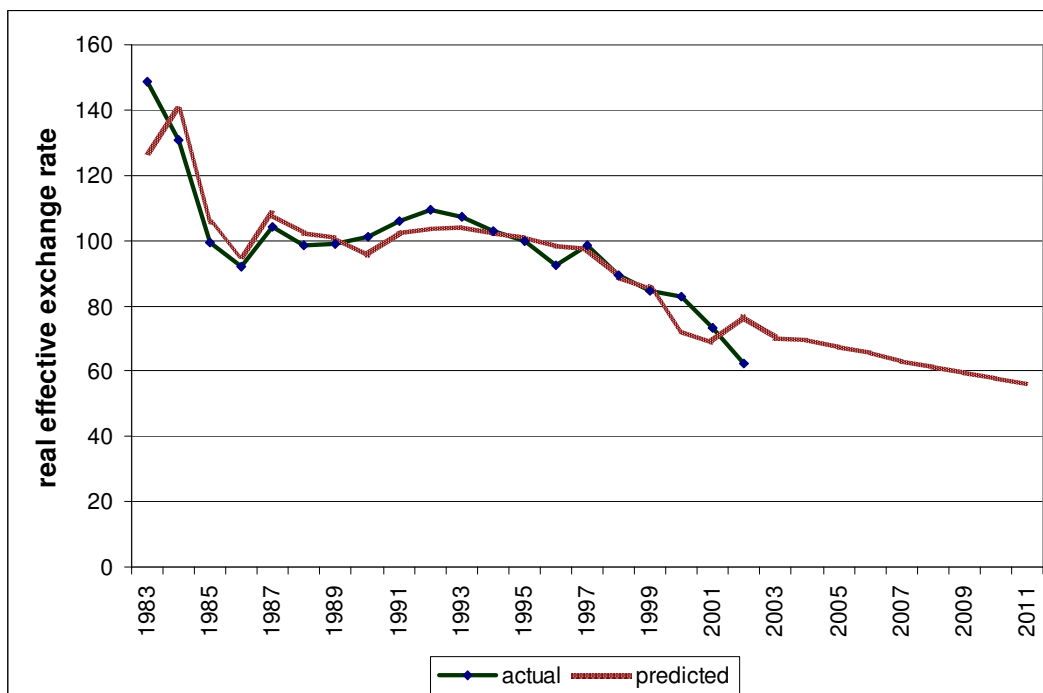
4.2) The bearish scenario

The bearish scenario employs the same model specification to forecast the equilibrium values of the real exchange rate associated with projected values of the policy variables and fundament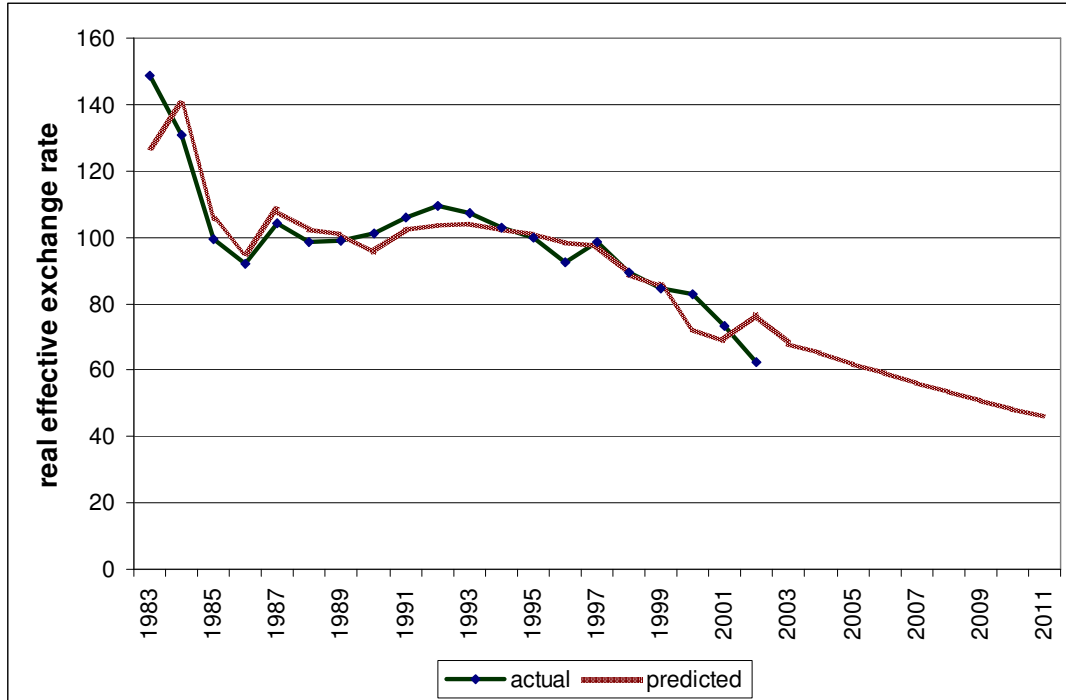als calibrated to generate a weaker rand than in the baseline scenario. The assumptions for the fundamentals are as follows:

(1) For monetary policy, the interest rate differential is projected forward at a constant level of one percentage point, half the level of the baseline scenario. (This is, however, approximately equal to the actual differential from 1983 to 2002.)

(2) The fiscal deficit projections assume greater fiscal austerity than forecast in the Medium Term Budget Policy Statement. The budget deficit is reduced at a faster rate so that that there is a steady time path lowering the figure to 1.5% of national income in 2011.

(3) Financial liberalisation, as measured by the balance on the financial account, is projected forward to 2011 based on the average rate of capital inflows from 2000 to 2002, equal to 1.75% on national income.

(4) The restructuring proxy for the economy is projected forward based on an accelerated historical trend for the past twenty years, at a rate 25% faster than the historical pace. Growth in merchandise exports exceeds the pace of commodity exports to the extent that the ratio of gold exports to merchandise exports falls from 11.5% in 2002 to approximately 4% in 2011.

As in the baseline scenario, these assumptions uniquely identify the values of the explanatory variables for the real effective exchange rate, allowing the econometric model to provides estimates of the equilibrium level from 2003 until 2011 under this bearish scenario. The actual and predicted values from 1983 to 2002 and the forecast values from 2003 to 2011 are graphed in the figure below. The steady decline in the fiscal deficit in this scenario generates a steadier depreciation over the projected time frame. The average rate of depreciation from 2002 to 2011 is 5.5% per year, compared to an average depreciation from 1992 to 2002 of 5.45% and a baseline average depreciation of 3.35%. The more rapid rate of depreciation is due to the smaller interest differential and fiscal deficit. If the interest differential and the fiscal deficit were larger, the rate of depreciation would be slower. The impact of the pace of financial liberalisation (leading to greater capital inflows) is relatively weak in this scenario, while the impact of the restructuring of the real economy is very strong—the net impact of these interventions is a more rapid pace of currency depreciation.

Figure 11) Simulation 2

4.3) The bullish scenario

The bullish scenario again employs the same model specification to forecast the equilibrium values of the real exchange rate associated with projected values of the policy variables and fundamentals calibrated to generate a stronger rand than in the baseline scenario. The assumptions for the fundamentals are as follows:

(1) For monetary policy, the interest rate differential is projected forward at a constant level of three percentage points, fifty percent greater than the level of the baseline scenario.

(2) The fiscal deficit projections are consistent with the Medium Term Budget Policy Statement 2003 forecasts, translated from fiscal year to calendar year through an average weighting process. The steady state budget deficit after 2005, however, is assumed to be the highest level forecast during the time frame of the Medium Term Budget Policy Statement, namely 3.2%.

(3) Financial liberalisation, as measured by the balance on the financial account, is projected forward based on historical trends for the past twenty years, but at a rate that is twice as rapid. Capital inflows increase from approximately 3% of national income in 2002 to about 7.3% in 2011.

(4) The restructuring proxy for the economy is projected forward based on an accelerated historical trend for the past twenty years, at a rate 25% slower than the historical pace. Growth in merchandise exports exceeds the pace of commodity exports to the extent that the ratio of gold exports to merchandise exports falls from 11.5% in 2002 to approximately 6% in 2011.

Figure 12) Simulation 3
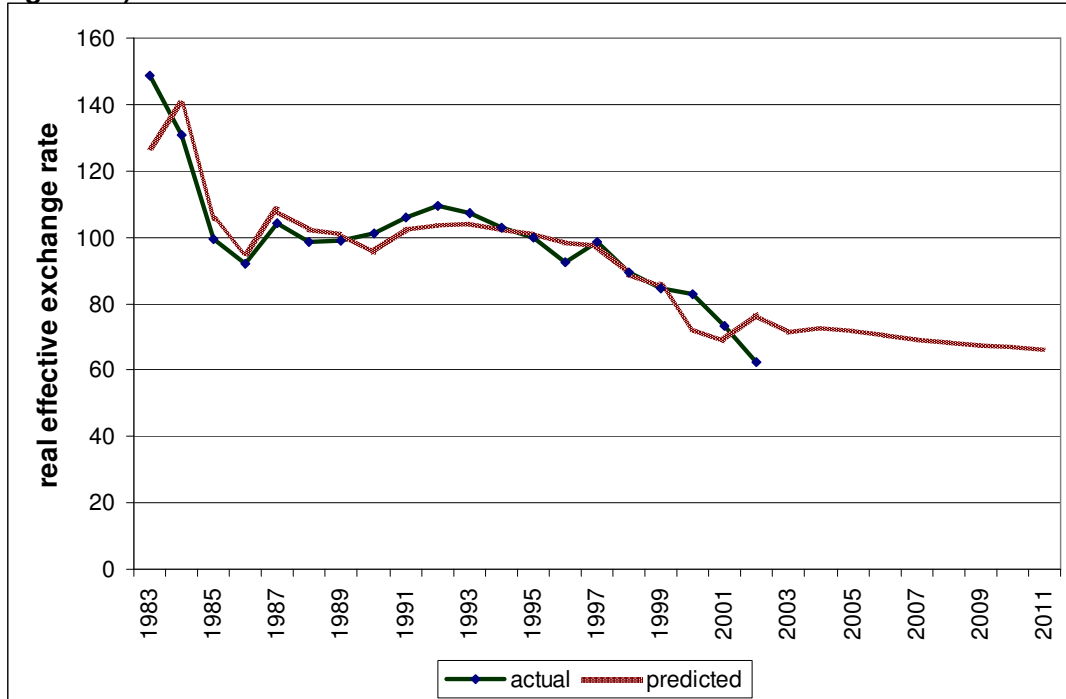
As in the two scenarios above, these assumptions uniquely identify the values of the explanatory variables for the real effective exchange rate, allowing the econometric model to provides estimates of the equilibrium level from 2003 until 2011 under this bullish scenario. The actual and predicted values from 1983 to 2002 and the forecast values from 2003 to 2011 are again graphed in the figure above. The temporary increase in the fiscal deficit over the next three years stabilises the exchange rate over this period, and then it depreciates at a slow rate until 2011. The average rate of depreciation from 2002 to 2011 is 1.6% per year, compared to an average depreciation from 1992 to 2002 of 5.45% and a baseline average depreciation of 3.35%. This is less than a third the rate of depreciation under the bearish scenario. The slower rate of depreciation is due to the larger interest differential and fiscal deficit. If the interest differential and the fiscal deficit were smaller, the rate of depreciation

would be faster. The impact of the pace of financial liberalisation (leading to greater capital inflows) is very strong in this scenario, while the impact of the restructuring of the real economy is relatively weak—the net impact of these interventions is a slower pace of currency depreciation.

5) Conclusions

This study evaluates the major determinants of the rand exchange rate based on a fundamentals analysis of the currency over the past ten and twenty years. Several policy-related variables consistently demonstrate an important role in determining the time path of the real effective exchange rate. Monetary policy has been an important source of relative rand strength over the past ten years, as the Reserve Bank has implemented initially an informal and currently a formal strategy of inflation targeting. High interest rates employed for disinflation generate a South African premium over international interest rates, leading to capital inflows that tend to appreciate the rand. Fiscal policy that has reduced the fiscal deficit from 1990 to 2002 has tended to offset the impact of monetary policy by contributing to a depreciation of the rand. Restructuring of the real economy has been associated with a stable depreciation of the rand, consistent with theoretical analysis of the impact of trade liberalisation and economic diversification.

Projections over the next eight years require the construction of scenarios specifying values for these economic fundamentals. Under both bearish and bullish assumptions, the rand is projected to depreciate—at a rate of 5.5% under the bearish scenario and a rate of 1.6% under the bullish scenario. The baseline scenario, which projects forward current trends, generates an average annual rate of depreciation of 3.35% per year. Actual exchange rates, however, do not necessarily respect their equilibrium levels. Misalignment can persist for years, particularly in the face of distortionary intervention or inefficient markets. While the analysis of the fundamentals implies eventual relief from the rand's current over-valued levels, no mechanism exists to guarantee that the adjustment process will be orderly or free from over- and under-shooting.

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Technical Addendum

This appendix provides technical details describing the model that estimates a long-run co-integrating relationship that corrects for the non-stationary nature of the exchange rate and its explanatory variables.[36]

This appendix presents several of the alternative specifications of the models that explain the real exchange rate, using the following variables:

• a proxy for the differential between South African interest rates and world interest rates (the interest rate differential);

• a proxy for financial capital flows, represented by the net financial balance of the balance of payments;

• a trend variable from 1994 to present, representing a shift towards greater trade and financial liberalisation and openness;

• proxies reflecting the restructuring of the real economy, including the ratio of manufacturing valued-added to total primary and secondary sector value-added, the ratio of primary sector valued-added to secondary sector value-added (and is reciprocal), and the value of gold exports measured as a percentage of total merchandise exports;

•the fiscal deficit expressed as a percentage of Gross Domestic Product; and

• the ratio of the average price of exports to the average price of imports (the terms of trade).

Using data from the South African Reserve Bank and the International Monetary Fund, a co-integrating relationship between the real effective exchange rate and these explanatory variables over the past twenty years was estimated. The data sources are detailed below. The table below presents the results of the regression, with the log of the real effective exchange rate as the dependent variable. The independent variables include the differential between the US and the South Africa real prime interest rates, the fiscal deficit expresses as a percentage of national income, the ratio of gold exports to total merchandise exports, and the balance on the financial account expressed as a percentage of national income. The sample extends from 1983 to 2002 with annual data. Alternative specifications were tested with quarterly data from 1990 to 2003. The coefficients are all significant at least the 90% level. The estimated coefficients, standard errors, t-statistics and associated P-values are documented in the table below.

Coefficient estimators and statistics for specification 1

Explanatory variable	Estimated coefficent	Standard Error	t-statistic	P-value
--------------------------------------	------------------	------------------	--------------	--------------
Constant term	3.2810	0.1731	18.9600	0.0000
Interest differentials	0.0118	0.0066	1.8000	0.0920
Fiscal deficit (% of GDP)	-0.0248	0.0123	-2.0200	0.0620
Gold exports to merchandise exports	0.3375	0.0485	6.9600	0.0000
Balance on financial account	0.0242	0.0110	2.1900	0.0450

The table below presents key statistics on the regression. The F-statistic tests the overall significance of the regression. The F-value of 17.59 is significant at the 99.9% level. The R-squared of 82.4% indicates that the regression explains 82% of the variance in the log of the real effective exchange rate.

Regression summary statistics for specification 1

Sample period	1983 - 2002
F-statistic for overall model	17.59
Significance of model	99.9%
R-squared	82.4%
Adjusted R-Squared	77.7%

In order to test the cointegration equation, Dickey-Fuller statistics were calculated for the dependent and explanatory variables, with levels and first differences, as well as for the residuals from the regression. The results of the tests are presented in the table below. The hypothesis of non-stationarity could not be rejected for any of the dependent or explanatory variables. The hypothesis of non-stationary residuals from the cointegration equation, however, could be rejected at the 95.0% level, with a test statistic of –3.367.

Augmented Dickey-Fuller statistics for specification 1

Explanatory variable	Augmented Dickey-Fuller statistic	
	Level	First difference
--------------------------------------	------------------------	------------------------
Real exchange rate	-0.329	-3.572 *
Interest differentials	-1.812	-4.369*
Fiscal deficit (% of GDP)	-1.891	-4.734*
Gold exports to merchandise exports	-0.083	-3.201*
Balance on financial account	-2.884	-6.611*
Residual	-3.367 *	

[36] For a more detailed technical exposition, see Hinkle and Montiel (1999), Montiel (2003), MacDonald and Ricci (2002) Samson (2003), and Johansen(1988).

A second specification of the co-integrating relationship between the real effective exchange rate and these explanatory variables over the past twenty years was also estimated, to test the robustness of the common explanatory variables. The table below presents the results of the regression, with the log of the real effective exchange rate as the dependent variable. The independent variables include the differential between the US and the South Africa real prime interest rates, the fiscal deficit expresses as a percentage of national income, the ratio of gross value added in the secondary sector (expressed relative to gross valued added in the primary sector), a trend variable beginning in 1994 (zero prior to 1994, one in 1994, and incrementing each year by a unit thereafter), and the balance on the financial account expressed as a percentage of national income. The sample extends from 1983 to 2002 with annual data. Alternative specifications were tested with quarterly data from 1990 to 2003. The estimated coefficients, standard errors, t-statistics and associated P-values are documented in the table below.

Coefficient estimators and statistics for specification 2

Explanatory variable	Estimated coefficent	Standard Error	t-statistic	P-value
Constant term	-0.4761	3.4477	-0.1400	0.8920
Interest differentials	0.0038	0.0065	0.5800	0.5720
Fiscal deficit (% of GDP)	-0.0026	0.0151	-0.1800	0.8640
Gross value-added ratio (log)	0.9505	0.6286	1.5100	0.1530
Trade liberalisation trend	-0.0774	0.0128	-6.0700	0.0000
Balance on financial account	0.0219	0.0143	1.5400	0.1470

The table below presents key statistics on the regression. The F-statistic tests the overall significance of the regression. The F-value of 12.06 is significant at the 99.9% level. The R-squared of 81.2% indicates that the regression explains 81% of the variance in the log of the real effective exchange rate.

Regression summary statistics for specification 2

Sample period	1983 - 2002
F-statistic for overall model	12.06
Significance of model	99.9%
R-squared	81.2%
Adjusted R-Squared	74.4%

In order to test the cointegration equation, Dickey-Fuller statistics were calculated for the dependent and explanatory variables, with levels and first differences, as well as for the residuals from the regression. The results of the tests are presented in the table below. The hypothesis of non-stationarity could not be rejected for any of the dependent or explanatory variables. The hypothesis of non-stationary residuals from the cointegration equation, however, could be rejected at the 95.0% level, with a test statistic of –3.025.

Augmented Dickey-Fuller statistics for specification 2

Explanatory variable	Augmented Dickey-Fuller statistic	
	Level	First difference
Real exchange rate	-0.329	-3.572*
Interest differentials	-1.812	-4.369*
Fiscal deficit (% of GDP)	-1.891	-4.734*
Gross value-added ratio (log)	-1.631	-5.752*
Trade liberalisation trend	4.874	-0.809*
Balance on financial account	-2.884	-6.611*
Residual	-3.025*	

A third specification of the co-integrating relationship between the real effective exchange rate and these explanatory variables over the past twenty years was also estimated, to test the robustness of the common explanatory variables. The independent variables include the differential between the US and the South Africa real prime interest rates, the fiscal deficit expresses as a percentage of national income, the log of the US gold price, the ratio of gold exports to total merchandise exports, and the balance on the financial account expressed as a percentage of national income. The sample extends from 1983 to 2002 with annual data. The table below presents the results of the regression, with the log of the real effective exchange rate as the dependent variable. The sample extends from 1983 to 2002 with annual data. Alternative specifications were tested with quarterly data from 1990 to 2003. The estimated coefficients, standard errors, t-statistics and associated P-values are documented in the table below.

Coefficient estimators and statistics for specification 3

Explanatory variable	Estimated coeffient	Standard Error	t-statistic	P-value
Constant term	3.6447	1.2679	2.8700	0.0120
Interest differentials	0.0111	0.0072	1.5500	0.1440
Fiscal deficit (% of GDP)	-0.0268	0.0144	-1.8600	0.0850
U. S. dollar gold price	-0.0690	0.2382	-0.2900	0.7760
Gold exports to merchandise exports	0.3474	0.0606	5.7300	0.0000
Balance on financial account	0.0253	0.0121	2.1000	0.0550

The table below presents key statistics on the regression. The F-statistic tests the overall significance of the regression. The F-value of 13.23 is significant at the 99.9% level. The R-squared of 82.5% indicates that the regression explains 82% of the variance in the log of the real effective exchange rate.

Regression summary statistics for specification 3

Sample period	1983 - 2002
F-statistic for overall model	13.23
Significance of model	99.9%
R-squared	82.5%
Adjusted R-Squared	76.3%

In order to test the cointegration equation, Dickey-Fuller statistics were calculated for the dependent and explanatory variables, with levels and first differences, as well as for the residuals from the regression. The results of the tests are presented in the table below. The hypothesis of non-stationarity could not be rejected for any of the dependent or explanatory variables. The hypothesis of non-stationary residuals from the cointegration equation, however, could be rejected at the 95.0% level, with a test statistic of –3.519.

Augmented Dickey-Fuller statistics for specification 2

Explanatory variable	Augmented Dickey-Fuller statistic	
	Level	First difference
Real exchange rate	-0.329	-3.572*
Interest differentials	-1.812	-4.369*
Fiscal deficit (% of GDP)	-1.891	-4.734*
U. S. dollar gold price	-1.506	-4.304*
Gold exports to merchandise exports	-0.083	-3.201*
Balance on financial account	-2.884	-6.611*
Residual	-3.519*	

South African Reserve Bank (SARB) sources

Time series	Start date	End date	Frequency	Description
KBP4420K	Jan-60	Feb-03	Quarterly	Budget deficit as % of GDP
KBP4595M	Apr-90	Jun-03	Monthly	Revenue: Total tax revenue (net)
KBP4597M	Apr-90	Jun-03	Monthly	Revenue: Total revenue
KBP4788K	Feb-91	Feb-03	Quarterly	Consolidated central government: Cash surplus (+) / deficit (-)
KBP4788K	Feb-91	Feb-03	Quarterly	Consol central govt: Cash surplus (+) / deficit (-)
KBP5000K	Jan-60	Feb-03	Quarterly	Balance of Payments : value of merchandise exports, f.o.b
KBP5001Q	Feb-60	Feb-03	Quarterly	Balance of Payments : value of net gold exports
KBP5007K	Jan-60	Feb-03	Quarterly	Balance of Payments : balance on current account
KBP5020K	Jan-60	Feb-03	Quarterly	BoP : change in net gold & other reserves owing to BOP
KBP5023K	Jan-60	Feb-03	Quarterly	BoP : change in gross gold & other foreign reserves
KBP5036Q	Feb-60	Feb-03	Quarterly	Terms of trade excluding gold
KBP5356M	Jan-78	Jul-03	Monthly	London gold price in rand
KBP5357M	Jan-78	Jul-03	Monthly	London gold price in USA dollar
KBP5364Q	Feb-70	Feb-03	Quarterly	Nominal effective exchange rate of the rand : Average for period
KBP5366Q	Feb-70	Apr-02	Quarterly	Real effective exchange rate of the rand: Average for period
KBP5366X	1971	2002	Yearly	Real effective exchange rate of the rand: Average for period
KBP5367J	1990	2002	Yearly	Real effective exchange rate of the rand consistently excl. Zimbabwe: Average for period
KBP5367M	Jan-90	May-03	Monthly	Real effective exchange rate of the rand consistently excl. Zimbabwe: Average for period
KBP5369J	1990	2002	Yearly	Nominal effective exchange rate of the rand consistently excl. Zimbabwe: Average for period
KBP5687K	Jan-60	Feb-03	Quarterly	Memo item; Change in capital transfer and financial accounts including unrecorded transactions
KBP5688K	Jan-85	Feb-03	Quarterly	Change in financial account
KBP6006K	Jan-60	Feb-03	Quarterly	Gross domestic product at market prices
KBP6006Z	1947	2002	Yearly	Gross domestic product at market prices
KBP6013L	Jan-60	Feb-03	Quarterly	Exports of goods & services
KBP6014L	Jan-60	Feb-03	Quarterly	Imports of goods & services
KBP6086Y	1946	2002	Yearly	Gross fixed capital formation: Construction (contractors)
KBP6281L	Jan-60	Feb-03	Quarterly	Ratio of final consumption expenditure by General government to GDP
KBP6282L	Jan-60	Feb-03	Quarterly	Ratio of gross fixed capital formation to GDP
KBP6283L	Jan-60	Feb-03	Quarterly	Ratio of public sector expenditure to GDP
KBP6286L	Jan-60	Feb-03	Quarterly	Ratio of gross savings to GDP
KBP6616J	1946	2002	Yearly	Total exports of goods and services
KBP6630D	Jan-60	Feb-03	Quarterly	Gross value added at basic prices of primary sector
KBP6633D	Jan-60	Feb-03	Quarterly	Gross value added at basic prices of secondary sector
KBP6634D	Jan-60	Feb-03	Quarterly	Gross value added at basic prices of manufacturing
KBP6637D	Jan-60	Feb-03	Quarterly	Gross value added at basic prices of tertiary sector
KBP6637Y	1946	2002	Yearly	Gross value added at basic prices of tertiary sector
KBP7032Q	Feb-86	Feb-03	Quarterly	Total consumer prices (Metropolitan areas)
KBP7113A	Jan-98	Jul-03	Monthly	CPIX (Metropolitan and other urban areas)
KBP7113J	1997	2002	Yearly	CPIX (Metropolitan and other urban areas)

Full details of the variables can be found on the online data facility of the South African Reserve Bank at www.resbank.co.za. The SARB code refers to the key used to browse and/or download the data series.