9

South Africa's Real Exchange Rate Performance

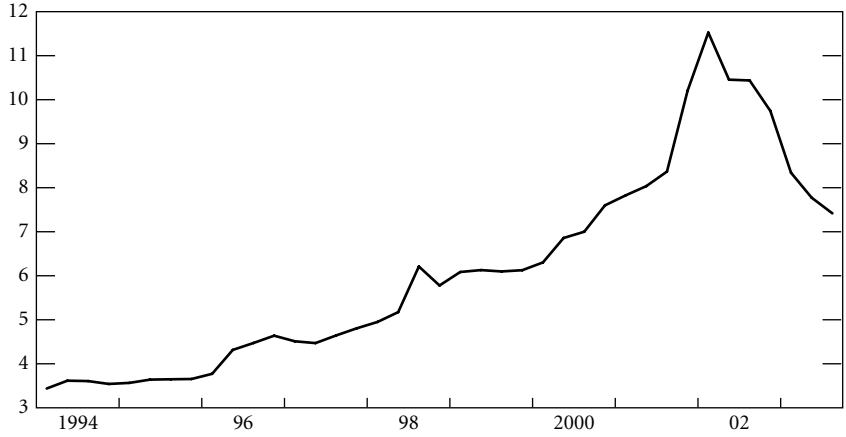
Luca Antonio Ricci

The rand has depreciated substantially since the end of apartheid. By the end of 2003, it lost about 50 percent of its value (Figure 9.1). Most of this depreciation reflected South Africa's higher inflation rate than those in its trading partners. In real effective terms, the rand went down by almost 15 percent between 1994 and the end of 2003, having peaked at 35 percent at the end of 2001 (Figure 9.2). The currency experienced considerable volatility during this time, as some crisis patterns developed in 1998 and in 2001, with sudden depreciation followed by a recovery (Chapter 10 analyzes these events in detail).

Fluctuations in the real exchange rate may be of great concern to policymakers and businesses. They may have a disruptive impact on trade flows if hedging is costly or incomplete. They may also deter investment decisions associated with such trade flows. It is therefore appropriate to investigate whether these movements in the real exchange rate are an equilibrium phenomenon or not.

This chapter investigates several issues related to real exchange rate dynamics in South Africa. First, it studies the extent to which the persistent real depreciation since the mid-1990s can be explained by fundamentals, that is, whether it is an equilibrium phenomenon. Second, it examines the magnitude of deviations in the real exchange rate from equilibrium levels, especially in recent years. Third, it evaluates the time it takes for the real rate to revert to equilibrium. Before tackling these issues, this chapter will place the analytic approach in the perspective of what has been done before.

Figure 9.1. Rand per U.S. Dollar



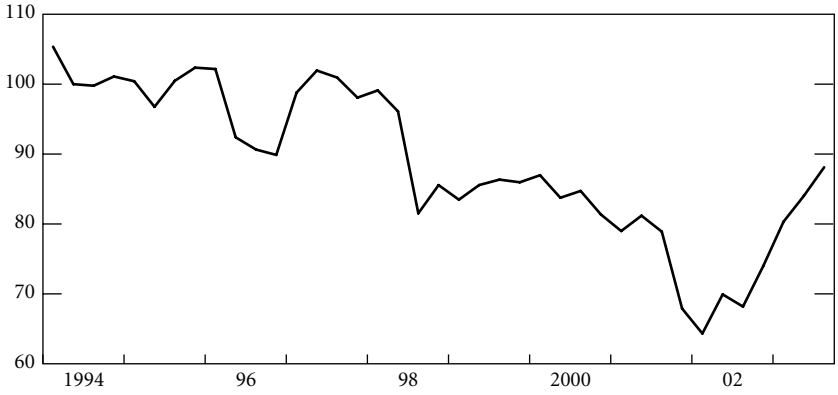
Source: South African Reserve Bank.

Literature

There is a considerable body of literature on estimating the equilibrium real exchange rate, some of which has been surveyed in MacDonald (1995) and Rogoff (1996). This literature indicates that purchasing power parity (PPP) is not an appropriate model for determining equilibrium exchange rates, mainly because of the slow mean reversion of real exchange rates to a constant level (which is the long-run equilibrium implied by the PPP assumption). Shifting away from PPP-based measures of the equilibrium exchange rate, the literature has focused on the equilibrium relationship between the real exchange rate and various economic fundamentals (see, for example, MacDonald and Stein, 1999; and Hinkle and Montiel, 1999). Most of this work uses cointegration techniques to identify persistent patterns of comovements among variables.

The main explanatory variables identified in the literature for developing countries includes commodity price movements (or the terms of trade), productivity and real interest rate differentials vis-à-vis trading partner countries, measures of openness of the trade and exchange system, the size of the fiscal balance or of government spending, and the country's net foreign assets. Other variables often include the ratios of investment and net capital inflows to GDP ratio. The rationale for the use of most of these variables is based on a simple neoclassical theoretical framework which assumes that the prices of tradable goods are equalized across countries and attempts

Figure 9.2. Real Effective Exchange Rate
(1990 = 100)



Source: South African Reserve Bank.

to explain how changes in the real exchange rate reflect mainly movements in the relative price of nontradables across countries. For an explanation of the intuition behind the role of these variables, see Box 9.1.

An early attempt to estimate the equilibrium real exchange rate for South Africa is Aron, Elbadawi, and Kahn (2000). The authors derive a theoretical formulation for the long-run determinants of the real exchange rate and then estimate this relationship as a cointegrating vector in a single equation error correction mechanism, using data from 1970 to 1995. The main determinants are found to be the terms of trade, the price of gold, the extent of trade protection, the magnitude of official reserves, long-run capital flows, and government expenditure. The authors find that the half-life of the deviation of the real exchange rate from its equilibrium level is less than one year. More recently, Aron, Muellbauer, and Smit (2003) estimated the real exchange rate within the context of a six-equation macroeconometric model.

MacDonald and Ricci (2004) use data from 1970 to the first quarter of 2002 to estimate the long-run cointegrating relationship between the real exchange rate and several fundamentals in a vector error correction mechanism.[1] The authors find that persistent movements in the real effective exchange rate of South Africa are explained by commodity prices, produc-

[1]Such methodology has several advantages, such as the ability to check for the number of cointegrating relationships present in the data and to correct the endogeneity that is likely to affect several of the fundamentals.

Box 9.1. Effect of Variables on the Real Exchange Rate

This box provides a simple intuition for the effect of the variables employed in the study. For a more detailed analysis, see MacDonald and Ricci (2004).

- The classic example of an equilibrium deviation from PPP is the Balassa-Samuelson effect. If a country experiences an increase in the productivity of the tradable sector (relative to its trading partners), its real exchange rate would tend to appreciate. For given prices of tradables, such stronger productivity would induce higher wages in the tradable sector. If wages are equalized across sectors, this would be reflected into higher prices of nontradables, and, hence, an increase in the consumer price index relative to trading partners.
- An increase in the world price of the commodities that a country exports would also tend to appreciate the real exchange rate. There would be a positive wealth effect, which would raise aggregate domestic demand, expenditure on nontradables, and the price of nontradables.
- The real interest rate differential could generally represent either productivity or aggregate demand, both pointing to a positive relationship with the real exchange rate. First, real interest rate differentials may reflect productivity differentials and provide another proxy for the Balassa-Samuelson effect. Second, an increase in absorption relative to savings would put upward pressure on the real interest rate and increase aggregate demand, which, in turn, would result in an appreciation of the real exchange rate.
- An improvement in the fiscal balance could induce a depreciation to the extent it reduces aggregate demand, spending on nontradable goods, and nontradable prices.
- A more open trade regime is likely to be associated with a more depreciated real exchange rate. Trade restrictions increase the domestic price of tradable goods, thereby raising the overall price level and the real exchange rate.
- The size of net foreign assets is likely to be associated with a more appreciated exchange rate in the long run. A country that reaches a higher level of net foreign assets can afford to finance a worse current account balance and can therefore sustain a loss in competitiveness associated with a more appreciated real exchange rate.

tivity and real interest rate differentials vis-à-vis trading partners, the size of the fiscal balance, the extent of trade openness, and the country's net foreign assets (including the central bank's open position in the forward market). According to the analysis, in early 2002—following the large depreciation that occurred in 2001—the rand was about 25 percent more depreciated than its equilibrium level of that time.

This chapter updates the work of MacDonald and Ricci (2004; henceforth MR), with more recent data. Using data up to the third quarter of 2003, allow an assessment of deviations of the real exchange rate from equilibrium during the past few years when the rand experienced considerable volatility.

Estimation

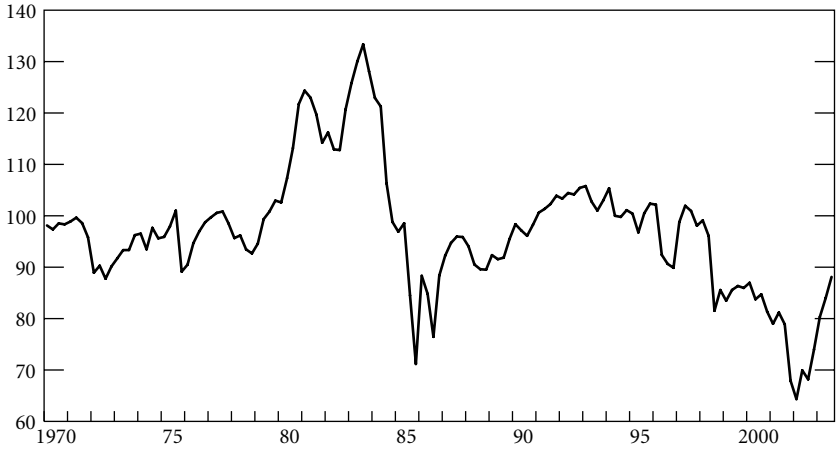
The variables employed in the study are the real effective exchange rate in logarithmic terms *(LREERS)*; the real interest rate relative to trading partners *(RIRR)*; logarithm of the real GDP per capita relative to trading partners *(LRGDPPCR)*, proxying for the Balassa-Samuelson effect; logarithm of real commodity prices *(LPR2COMM5)*; openness *(OPENY)*, captured by the average ratio to GDP of exports and imports; the ratio of fiscal balance to GDP *(FBYA)*; and the ratio to GDP of net foreign assets of the banking system *(NFAOFPY)*.[2] The variable definitions and sources are presented in the Appendix. Figures 9.3 and 9.4 plot the data (not in logarithmic terms) over the 1970–2003 (third quarter) period and show interesting patterns, particularly for the recent period:

- The rand has experienced a significant real depreciation since 1995, which was particularly pronounced in 2001;
- The real interest rate differential rose in the 1990s and declined recently;
- The real GDP per capita persistently declined with respect to trading partner countries, before stabilizing in the mid-1990s;
- The real prices for South Africa's main commodity exports experienced a steady decline from the beginning of the 1980s until end-1990s, and then stabilized;[3]
- The economy became more closed during the 1980s, largely due to trade sanctions, and then opened up dramatically from the early 1990s;

[2]Variables are expressed in log form when the acronym begins with L. The study focuses on the main commodity price indicator employed by MR. The net foreign asset variable relates to commercial banks as well to the monetary authorities, and includes the open forward position of the latter.

[3]Notice that the recent increase in the U.S. dollar price of commodities has been largely offset in real terms by the increase in the U.S. price deflator of developed countries' exports.

Figure 9.3. Real Effective Exchange Rate, 1970Q1–2003Q3
(1995 = 100)



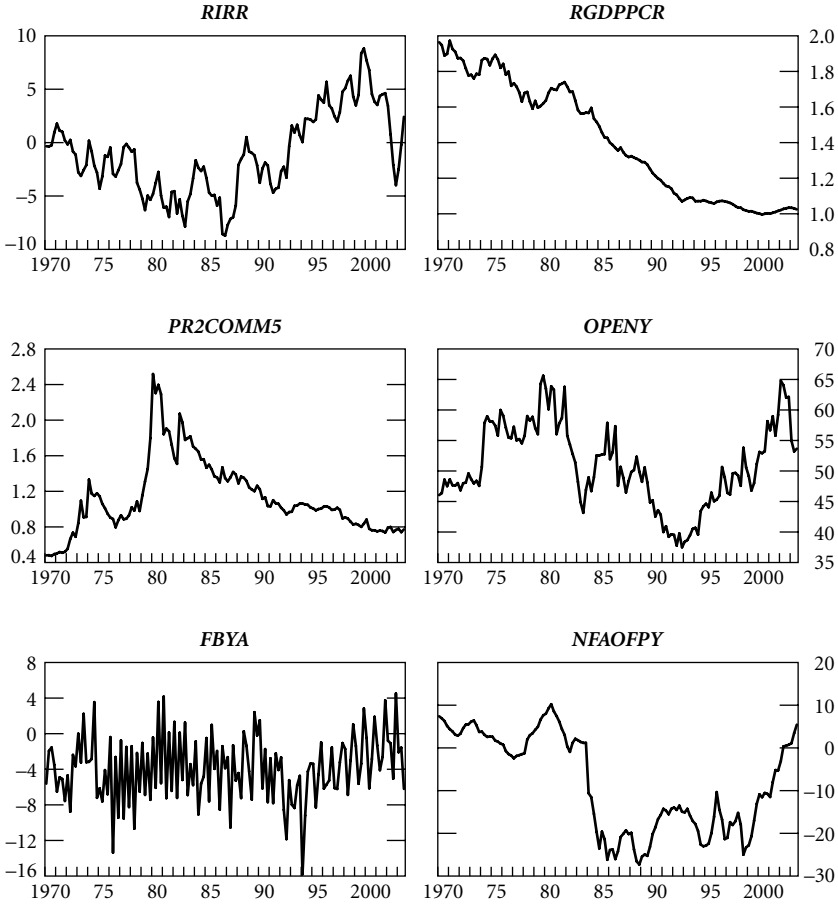
Source: South African Reserve Bank.

- Fiscal performance, as measured by the overall fiscal balance, strengthened significantly in the post-apartheid period; and
- The net foreign asset position improved substantially in recent years, reflecting the reduction of the forward book.

The main results relating to the long-run relationship between the real exchange rate and the fundamentals can be described as follows (the methodology is described in Box 9.2):

- 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 around 2–3 percent;
- An increase in real GDP per capita relative to trading partner countries of 1 percent is associated with an appreciation of the real effective exchange rate of 0.1 percent.;
- 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;
- 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;
- 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; and

Figure 9.4. Determinants of the Real Effective Exchange Rate, 1970Q1–2003Q3



Source: South African Reserve Bank.

- An increase in net foreign assets of 1 percentage point of GDP is associated with an appreciation of the real effective exchange rate of somewhat less than 1 percent;

Short-run effects are generally found to be insignificant across the various specifications (and therefore not reported), with the exception of *D(NFAOFPY(–1))*. An increase in net foreign assets is likely to lead to depreciation of the real exchange rate in the short run (i.e., one quarter). When considering both the short-run and the long-run effects of this variable, one would conclude that an improvement in the net foreign asset position

Box 9.2. Methodology

The existence of a long-run, cointegrating relationship between the real exchange rate and the fundamentals is investigated via a maximum likelihood vector error-correction mechanism (VECM) estimator (see Johansen, 1995), which corrects for autocorrelation and endogeneity parametrically. The specification includes four lags for the changes in each variable and centered seasonal dummies, which is a common structure when employing quarterly data. The estimation presented includes dummies that control for the presence of outliers in the first quarter of 1984, the fourth quarter of 1985, the first quarter of 1986, and the first quarter of 1994.

The accompanying table presents the key results of both the main MR specification (see MR, Table 1, column 2), as well as the same specification estimated with the updated sample. The cointegration tests indicate the presence of one cointegrating vector using a 1 percent significance level. On this specification, MR perform various diagnostic and robustness tests. First, a Johansen cointegration test—which (unlike standard stationarity tests) takes into account the cointegration space—suggests that cointegration analysis is justified as the individual variables are found to be nonstationary. Second, no explanatory variable can be excluded from the cointegrating vector, with the possible exception of *LRGDPPCR*, which occasionally fails the test, but is retained for its theoretical importance (proxying for the Balassa-Samuelson effect). Third, the hypothesis that the residuals have a normal distribution is rejected due to excess kurtosis, which—unlike skewness—does not affect the results (Paruolo, 1997). Fourth, all four lags are necessary in our VECM specification; if a fifth lag is introduced, the test accepts the hypothesis that the additional lag is jointly insignificant across equations.

VECM Results

		MR, Table 1, Col. 2 (1970Q1: 2002Q1)	Current (1970Q1: 2003Q3)
Number of cointegrating vectors:			
Trace statistic	5%	1	1
	1%	1	1
Max eigenvalue statistic	5%	1	1
	1%	1	1
Estimates of the cointegrating relationship with the real exchange rate			
LREERS		1	1
RIRR		–0.03	–0.02
		[–7.03]	[–7.58]
LRGDPPCR		–0.13	–0.10
		[–1.75]	[–1.97]
OPENY		0.01	0.01
		[5.87]	[7.4]

Box 9.2 *(concluded)*

VECM Results *(concluded)*

	MR, Table 1, Col. 2 (1970Q1: 2002Q1)	Current (1970Q1: 2003Q3)
FBYA	0.02 [5.60]	0.02 [6.05]
NFAOFPY	–0.01 [–4.50]	–0.01 [–6.62]
LPR2COMM5	–0.45 [–11.75]	–0.43 [–15.41]
C	–4.95 [–56.66]	–4.99 [–65.89]
Estimates of the short term impact of net foreign assets		
D(NFAOFPY(–1))	–0.01 [–2.35]	–0.01 [–2.00]
Estimates of the speed of adjustment of the real exchange rate		
Cointegrating vector	–0.07 [–0.92]	–0.11 [–1.22]
Half lifetime of the deviation from equilibrium exchange rate in years	2.4	1.5

Note: *t*-statistics in square brackets.

arising, for example, from the reduction in the central bank's forward market exposure, is likely to induce a temporary depreciation of the exchange rate (or to prevent a temporary appreciation), but to be associated with an appreciation of the equilibrium real exchange rate in the long run.

The Equilibrium Exchange Rate and the Deviation from Equilibrium

The model allows one to estimate the equilibrium real exchange rate on the basis of the explanatory variables. As evident from Figure 9.2, however, the explanatory variables can exhibit a substantial degree of "noise" or fluctuation.

One way of neutralizing the impact of the temporary fluctuations in the fundamentals on the evaluation of the equilibrium real exchange rate is the application of smoothing techniques. Figure 9.5 shows an example of the equilibrium real exchange rate derived when fundamentals are smoothed through the use of moving averages and compares the outcome with the

actual real effective exchange rate.[4] According to Figure 9.5, from 1994 to late 2003, the equilibrium exchange rate declined by around 22 percent, in response to a variety of opposing forces. On the one hand, the decline in commodity prices, the increase in openness, and the improvement in the fiscal balance accounted for a depreciation of the equilibrium real exchange rate in the order of 11 percent, 15 percent, and 9 percent, respectively. On the other hand, the increase in net foreign assets partly contributed to an appreciation of around 13 percent, while the real interest rate differential did not move much.

At any point in time, the real exchange rate is likely to differ from the equilibrium level. For example, the currency crisis of 2001 left the rand undervalued by 20 percent with respect to its equilibrium level (in early 2002), while the subsequent rand recovery brought the rand close to equilibrium.[5]

One can also evaluate the equilibrium real exchange rate on the basis of a set of economic priors or educated guesses for the equilibrium values of the explanatory variables. This approach is generally useful if one is interested in evaluating the equilibrium exchange rate at particular values of the fundamentals, either because they could represent policy targets (e.g., for fiscal balance or net foreign assets) or because sharp changes in the fundamentals have occurred at the end of the sample and may persist. In particular, one may want to evaluate the equilibrium exchange rate consistent with the actual values of the fundamentals at the end of the sample (i.e., the third quarter of 2003) and with the policy target for the fiscal balance of negative 3 percent of GDP. In this case, the equilibrium real exchange rate turns out to be close to its actual value for the third quarter of 2003, suggesting that the rand was in broad equilibrium.

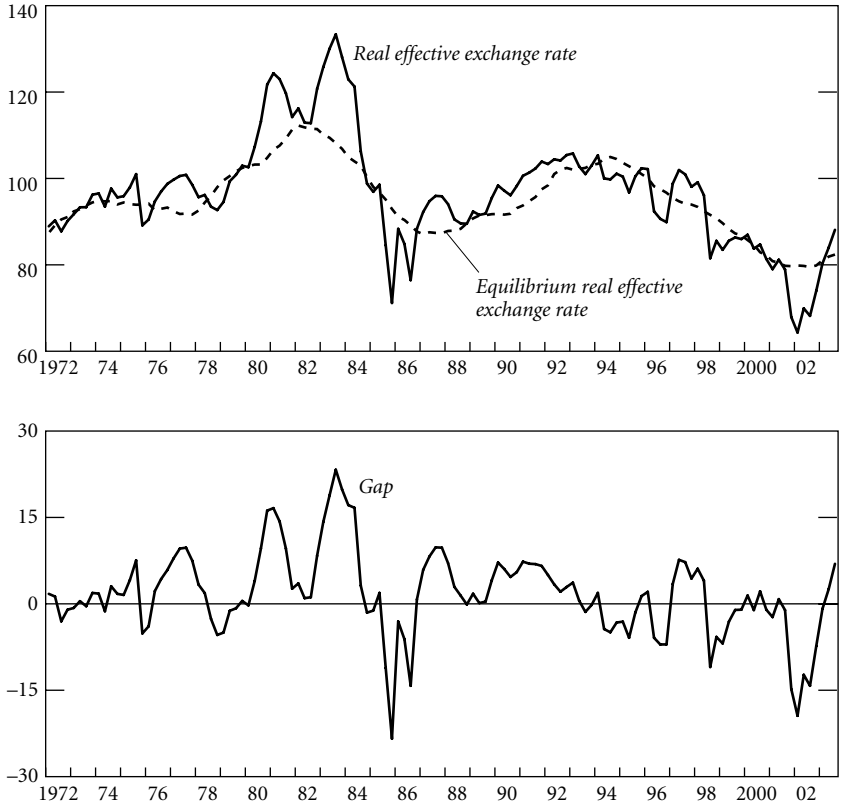
Adjustment

When a gap between the real exchange rate and its equilibrium level arises, the real exchange rate will tend to converge back to its equilibrium

[4]A four-year moving average (eight quarter backward and seven forward) is used in this exercise. To construct smoothed series for the end of the sample, future values of the fundamentals have been set equal to the latest observation, with the exception of: fiscal balance, which was set at minus 3 percent; and net foreign assets including the forward book, which was increased by 3 percent of GDP over three quarters (to reflect improvements in the NOFP) and then set constant.

[5]This exercise suggets a smaller gap in 2002 than the one estimated by MR, mainly because of data revisions. For an analysis of the 1998 and 2001 rand crises see Chapter 10.

Figure 9.5. Actual and Equilibrium Real Effective Exchange Rate, 1972–2003Q3



Sources: South African Reserve Bank; and IMF staff estimates.

level. The estimates derived in this study (see table in Box 9.2) suggest that, on average, about 11 percent of the gap is eliminated every quarter, implying that, in the absence of further shocks, about half of the gap would be closed within one and a half years. However, large deviations, such as those experienced since 2001, could take less time to absorb, as suggested by the recent literature on nonlinear exchange rate models (see Sarno and Taylor, 2002).

Conclusions

Drawing on existing literature, this study estimates a long-run equilibrium real exchange rate path for South Africa. The main explanatory variables were found to be commodity price movements, productivity and real

interest rates differentials vis-à-vis trading partner countries, measures of openness, the size of the fiscal balance, and net foreign assets position. The analysis suggests that during the 1990s the real exchange rate was reasonably close to its equilibrium level, so that most of its decline can be accounted for by movements in fundamentals. Sizable deviations from equilibrium are evident in 1996, 1998, and especially in 2001–02. An evaluation of the equilibrium real exchange rate (on the basis of smoothing techniques for evaluating the equilibrium levels of fundamentals) suggests that the 2001 exchange rate crises left the rand undervalued by around 20 percent, but the subsequent recovery brought the currency close to equilibrium in late 2003.

If the real exchange rate deviates from its equilibrium level owing to temporary factors, it can be expected to revert to equilibrium fairly quickly, in absence of further shocks. The study suggests that about half of the gap is normally eliminated within one and a half years. However, large deviations are likely to be absorbed at a faster pace. The paper also shows that the rapid improvements in the net open forward position operated in recent years may have placed only temporary downward pressure on the rand. In the long run, such an improvement in the reserve position is likely to be associated with an appreciation of the equilibrium real exchange rate.

Appendix. Variables: Definitions and Sources

The data set consists of quarterly data from 1970 to the third quarter of 2003 for South Africa and the four major trading partners.

- *LREERS*: Real effective exchange rate. In logarithmic terms. Source: South African Reserve Bank (SARB).
- *RIRR*: Real interest rate relative to trading partners. Nominal interest rate on 10-year bond, minus inflation in past four quarters. Foreign variable calculated as the weighted average of four major trading partners, based on the SARB weights for the real effective exchange rate: Germany (proxy for European Union, 47 percent), United States (20 percent), United Kingdom (20 percent), and Japan (13 percent). Sources: SARB and IMF, *International Financial Statistics* (*IFS*).
- *LRGDPPCR*: Real GDP per capita relative to trading partners. In logarithmic terms. Normalized for each country to 1 in 2000. Foreign variable calculated as above. Sources: SARB, *IFS*, and World Bank.
- *LPR2COMM5*: Real commodity prices. In logarithmic terms. Weighted average of the five most exported commodities—excluding diamonds,

for which a price series is not available—deflated by the price deflator for developed countries' exports. Sources: Cashin, Céspedes, and Sahay (2002); and IMF, World Economic Outlook and commodity prices databases.

Main commodities exported and relative weights

Commodity	Weights (1990–99)	Weights Normalized
Gold	0.604	0.710
Coal	0.151	0.177
Iron	0.033	0.039
Copper	0.032	0.038
Platinum	0.031	0.036

- *OPENY*: Openness. Ratio of exports and imports to GDP. Sources: SARB, and *IFS*.
- *FBYA*: Fiscal balance. Ratio of the annualized fiscal balance to GDP. Sources: SARB and *IFS*.
- *NFAOFPY*: Net foreign assets including the forward book. Ratio of the end of period net foreign assets of the banking system (monetary authorities and commercial banks) to GDP. The numerator includes the open forward position, as a liability, from the first quarter of 1984 onward, when data become available. Sources: SARB, *IFS*, and author's calculations.

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