Exchange Rate Volatility, Inflation and Competitiveness

Prof. E. Schaling*

*South African Reserve Bank Chair, University of Pretoria, CentER for Economic Research, Tilburg University, The Netherlands and CDMA, University of St. Andrews, U.K.

8 April 2008

1. INTRODUCTION

A weaker exchange rate increases the CPI inflation rate. We show that the degree of exchange rate pass-through (from NEER to CPI) is about 20 percent across the 94-06 sample.

We show that for a weaker real exchange rate to increase growth (in addition to increasing CPI inflation) it should boost net exports (exports minus imports, or the trade balance) as otherwise the export sector gains via implicit subsidization at the expense of other sectors in the economy; possibly the poor (inflation tax).

So, there may be a trade-off between inflation and competiteveness (and then possibly growth).

We show that over the 1994-2006 sample period real depreciations did not improve the trade balance and therefore had no positive effect on growth! One reason is that SA exports are priced to market (PTM instead of PCP).

We also find that the volatility of SA output growth (via the trade balance) is largely driven by international business cycles (0.25), rather than by real exchange rate variability (0.02).

2. EXPORTS, NET EXPORTS AND THE TRADE-OFF BETWEEN INFLATION AND GROWTH

It is common knowledge that a weaker real exchange rate tends to increase the CPI inflation rate (Δp_C) as a result of higher domestic currency prices of imported final goods (denoted by p_F) and/or higher wage inflation.

However, a popular idea is that a weaker currency will support exports.[1]

We explain that for a weaker real exchange rate to increase growth (in addition to increasing CPI inflation) it should boost net exports (exports minus imports) as otherwise the export sector gains at the expense of other sectors in the economy; possibly the poor.

Intuition:

$$\hat{y} = \hat{c} + \hat{i} + \hat{g} + \left(\hat{b} - \hat{m}\right) \qquad \textbf{(1)}$$

$$p_C = (1-\gamma)p_H + \gamma p_F \Leftrightarrow p_C = p_H + \gamma(p_F - p_H) \qquad \textbf{(7)}^2$$

Table 2 Real Exchange Rate Depreciation: The Trade-Off Between Inflation and Growth*

Effect on inflation	Effect on GDP growth	Net effect
Unambiguous: $\Delta p_c \uparrow$	Ambiguous: $\Delta y \uparrow$ <u>if</u> $(\Delta b - \Delta m) \uparrow$	?
Role of the Marshall-Lerner condition	$\Delta y \uparrow$ <u>if</u> $\eta_x > 1 + \eta_m$ as then $(\Delta b - \Delta m) \uparrow$	?

* Here Δp_c is the CPI inflation rate and $\Delta y_t = y_t - y_{t-1}$ (the first difference of the log of output) is GDP growth.

To make this clear, assume that $(b-m)=0$. Then, the economy as a whole does not gain in terms of growth (the size of the cake does not increase), although the economy as a whole does end up with a higher inflation rate.

As gross export volumes go up, what we have is that the export sector gains at the expense of other sectors in the economy that are not indexed to inflation such as pensioners, the unemployed and the poor.

So in this case a real exchange rate depreciation works as an implicit subsidy for exporters, a subsidy that is being paid for (financed) by other sectors of the economy (the inflation tax).

In order to generate the growth effects policymakers typically have (long run) imports and exports relations - in volume terms - like **(3)** and **(4)** at the back of their minds:

$$b_t = \alpha_0 + \eta_x s_t + \alpha_2 y_t^* + \varepsilon_{1t} \qquad \textbf{(3)}$$

$$m_t = \beta_0 + \eta_m s_t + \beta_2 y_t + \varepsilon_{2t} \qquad \textbf{(4)}$$

where α_0, β_0 are constants and variables are in natural logs, more specific $s = p_F - p_H$ is the real exchange rate of the rand, p_H is the price that home (SA) firms charge home and foreign consumers (in rand), p_F is the price that foreign firms charge SA consumers (also in rand), y is SA GDP, y^* is

foreign expenditure (economic activity), and $\varepsilon_{1,2t}$ are error terms.[3]

For a real depreciation to increase net exports – the real trade balance – and thereby GDP growth (second column of Table 1) a further condition - the Marshall-Lerner condition - needs to be satisfied in terms of equations **(3)** and **(4)**. It says that the sum of the absolute values of the price elasticities of exports and imports is larger than 1 or, $\eta_x > 1 + \eta_m$ [4]

3. SYMMETRIC PRODUCER CURRENCY PRICING

The traditional idea that a weaker exchange rate boosts export volumes is based on the assumption that exports are invoiced in domestic currency – that is that SA exporters engage in what is known in the literature as producer currency pricing (PCP).

This mechanism also underlies the NT and BER macro models of the SA economy. The consequence is that the recommendations of e.g. Frankel, Smit and Sturzenegger (2006) with respect to the current account - in so far as they rely on the BER model - are flawed.

PCP implies that the price that foreigners pay for SA goods (in foreign currency terms) fluctuates when the nominal exchange rate changes. If this is the way the world works, a home nominal depreciation implies a real depreciation (that is an increase or improvement in the terms of trade), which will then boosts foreign demand for SA exports.

Another implication of PCP – the fact that the export price of the home (SA) good, p_H, is set in domestic currency/rand terms - should be that the latter price, is independent of the level of the nominal exchange rate (completely uncorrelated with the level of the nominal exchange rate):

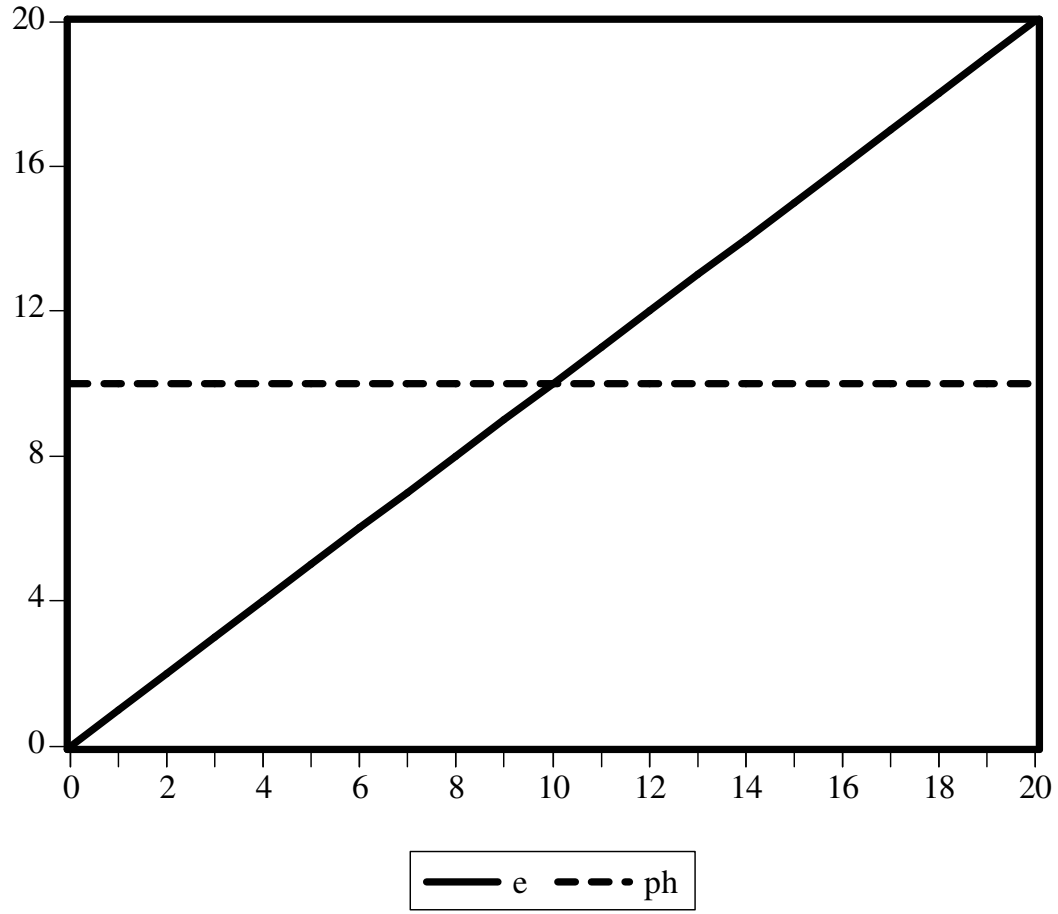
$$p_H = \underline{p_H} \qquad \text{where} \qquad \frac{\partial p_H}{\partial e} = 0 \qquad \textbf{(6)}$$

This implication of PCP will be tested later in this presentation.

Later in this presentation we will show that there is not much empirical evidence suporting the presence of PCP for South Africa. Consistent with this we find that a real depreciation does not increase net exports.

Chart 1 illustrates.

Chart 1 Export Price: Producer Currency Pricing



PCP: The Trade-Off Between Inflation and Growth

- A nominal depreciation increases the rand price of imports, which then pushes up the CPI. This is unconditionally bad for inflation.

- Because of PCP SA becomes more competitive versus ROW. Then if the Marshall-Lerner condition is satisfied then SA's net exports would go up. This would be good for growth.

4. ASYMMETRIC PRICING: PCP VERSUS PTM

One reason why in South Africa the relation between the real exchange rate and export volumes may be so weak is because in reality a lot of SA's exports are not invoiced in rand, but in dollars or euros.

This is called pricing to market (PTM). More specific, we assume that SA exports (of final goods) are priced to market according to 'export parity pricing' (EPP); that is invoiced in dollars:

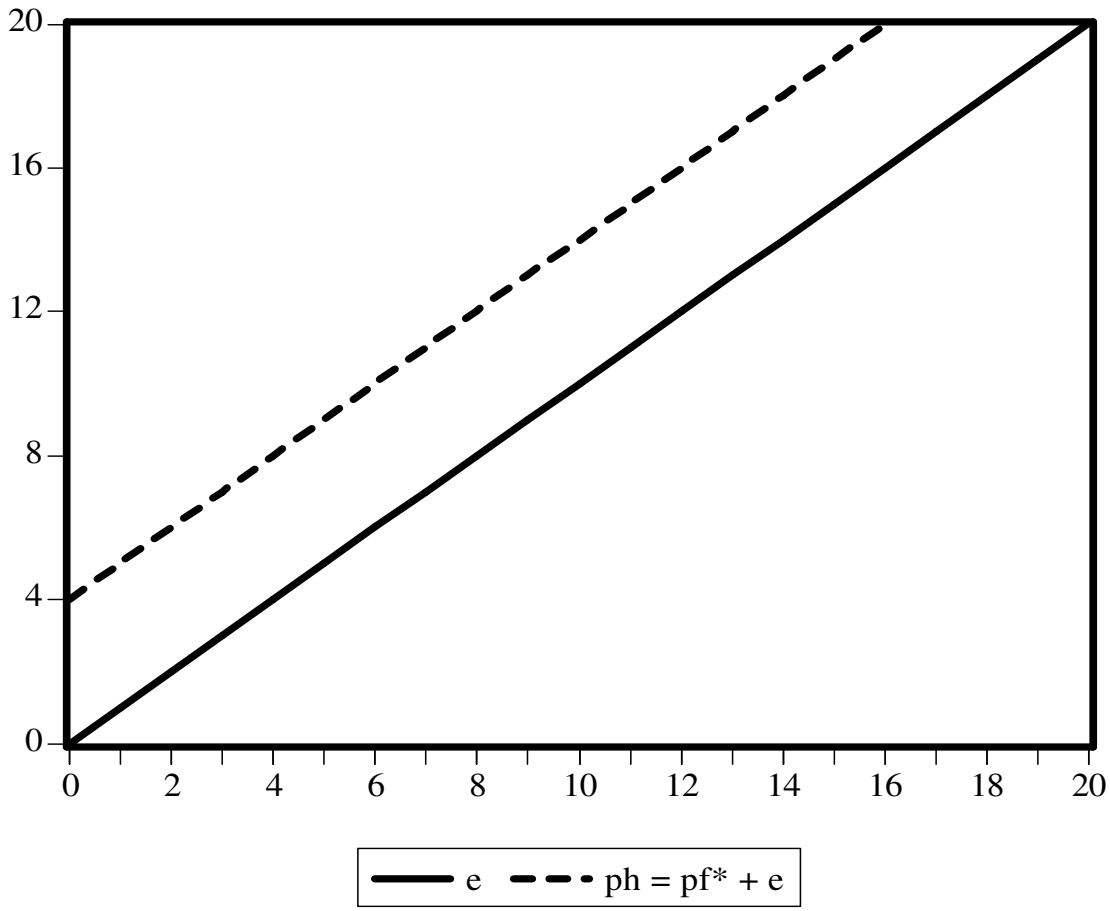
$$p_H^* = p_F^* \qquad \textbf{(8)}$$

One implication of EPP is that SA's export price in rand, p_H, should be perfectly correlated with the level of the nominal exchange rate:

$$p_H = p_F = p_F^* + e \quad \text{where} \quad \frac{\partial p_H}{\partial e} = 1 \qquad \textbf{(10)}$$

This implication of EPP will be tested later in this presentation. Chart 2 illustrates.

Chart 2 Export Price: Export Parity Pricing



From equation **(10)** it also follows that under EPP a weaker nominal exchange rate (higher value of e) increases unit revenue and thereby – ceteris paribus – profitability.[5]

This result is broadly in line with empirical results for SA by Rodrik (2006, p. 20) who finds that 'the real exchange rate, which stood at a more depreciated level post-1994, makes a positive contribution to manufacturing's relative profitability'.

It is also in line with Aghion, Braun, and Fedderke (2006) who find that markups in South African manufacturing are both high by international standards and have refused to come down since the 1990s.

PTM/EPP: No Trade-Off Between Inflation and Growth

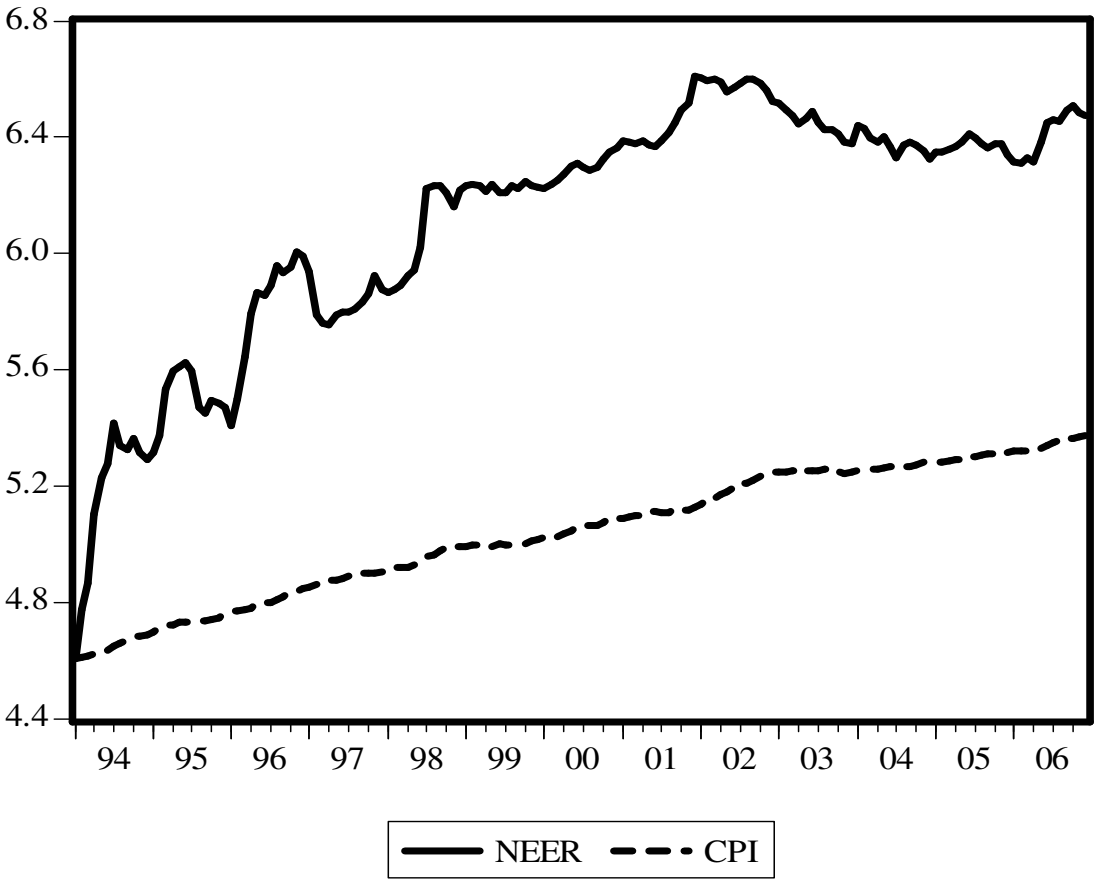
- A nominal depreciation increases the rand price of imports, which then pushes up the CPI. This is unconditionally bad for inflation.

- Because of EPP SA does not becomes more competitive versus ROW. ROW is not more likely to source their imports from SA. No effect on growth.

5. THE LINK BETWEEN EXCHANGE RATE DEPRECIATION AND INFLATION

We know that a weaker exchange rate increases inflation. Some evidence for this adverse effect for South Africa is provided by Chart 3 below.

Chart 3 SA CPI and NEER (in logs) – Monthly Data



Further, we estimated the following equation (over our 94-06 sample):

$$p_{C,t} = \alpha_0 + \lambda e_t + \varepsilon_t \qquad \textbf{(12)}^6$$

Estimation results are reported in Table 7. Key result is that the degree of exchange rate pass-through (from NEER to CPI) is about 20 percent across the 94-06 sample.[7]

Table 7 Model Specification with Quarterly Data: CPI Price Level and NEER

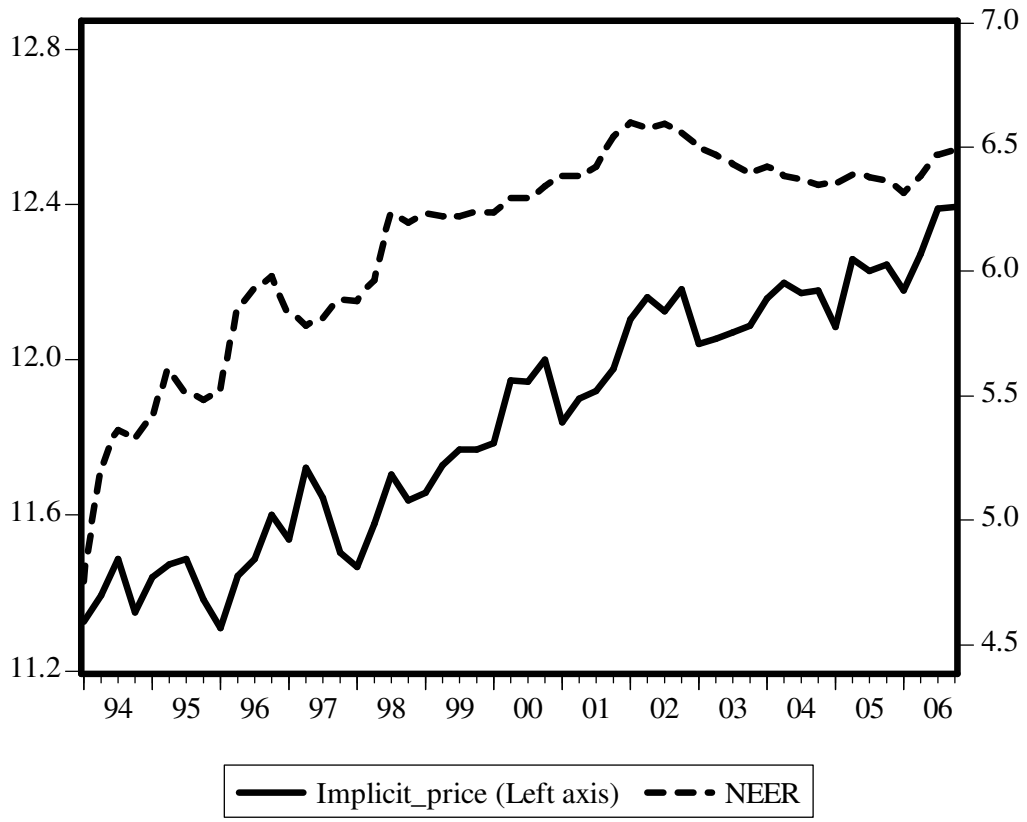
Dependent Variables (Right)	CPI[8]
Independent Variables (Down)	
EQUATION #	**(12)**
Constant	4.426*
NEER[9]	0.194*
ECM coefficient	-0.042*

* Indicates significance.

6. SOME EVIDENCE ON PRODUCER CURRENCY PRICING VERSUS PRICING TO MARKET

Some evidence on PCP versus PTM is provided by Chart 8 below.

Chart 8 Implicit Price and NEER (Logs) – Quarterly Data[10]



Further, we estimated the following equation:

$$p_{H,t} = \alpha_0 + \lambda e_t + \varepsilon_t \qquad \textbf{(13)}$$

Estimation results are reported in Table 8. Key result is that the correlation between the implicit export priceand the NEER is about 90 percent across the 94-06 sample.

This provides strong empirical support for the presence of PTM (EPP) instead of PCP in South Africa!

Table 8 Model Specification with Quarterly Data: Implicit Export Price and NEER

Dependent Variables (Right)	Implicit Export Price
Independent Variables (Down)	
EQUATION #	**(13)**
Constant	6.829*
NEER[11]	0.903*
ECM coefficient	

* Indicates significance.

7. THE LINK BETWEEN EXCHANGE RATE DEPRECIATION, COMPETITIVENESS AND GROWTH

We find that net exports (the trade balance) is either not boosted by a weaker real effective exchange rate (1994-2001), or the REER has the opposite effect (1994-2006).

Exports volumes are more driven by the international economy than by the real exchange rate.

Also, we find that the empirical relationship between the exchange rate and export volumes is quite weak. Charts 4-6 illustrate.

Chart 4 Export Index Excluding Gold – Quarterly Data[12]

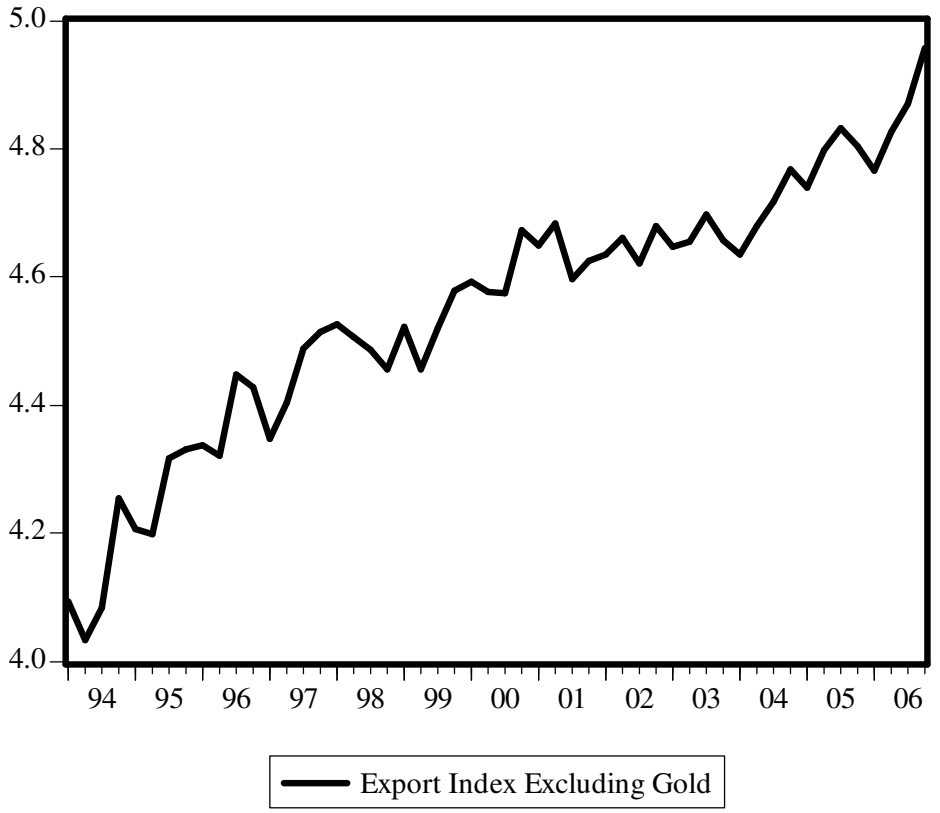


Chart 5 Import Index – Quarterly Data[13]

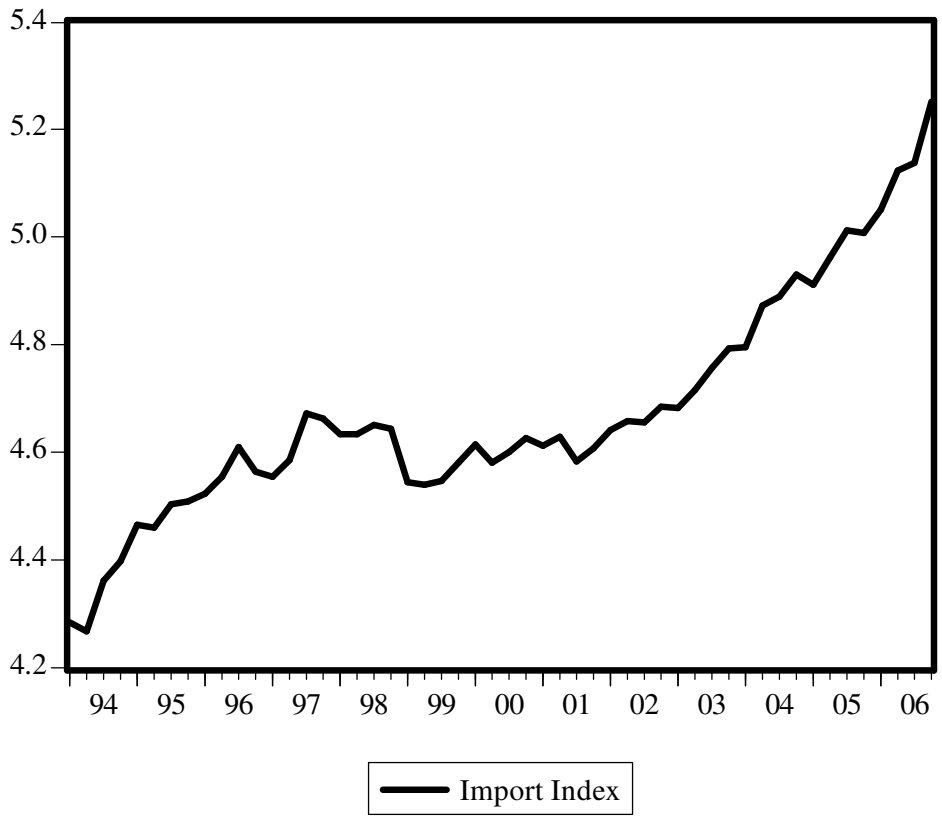
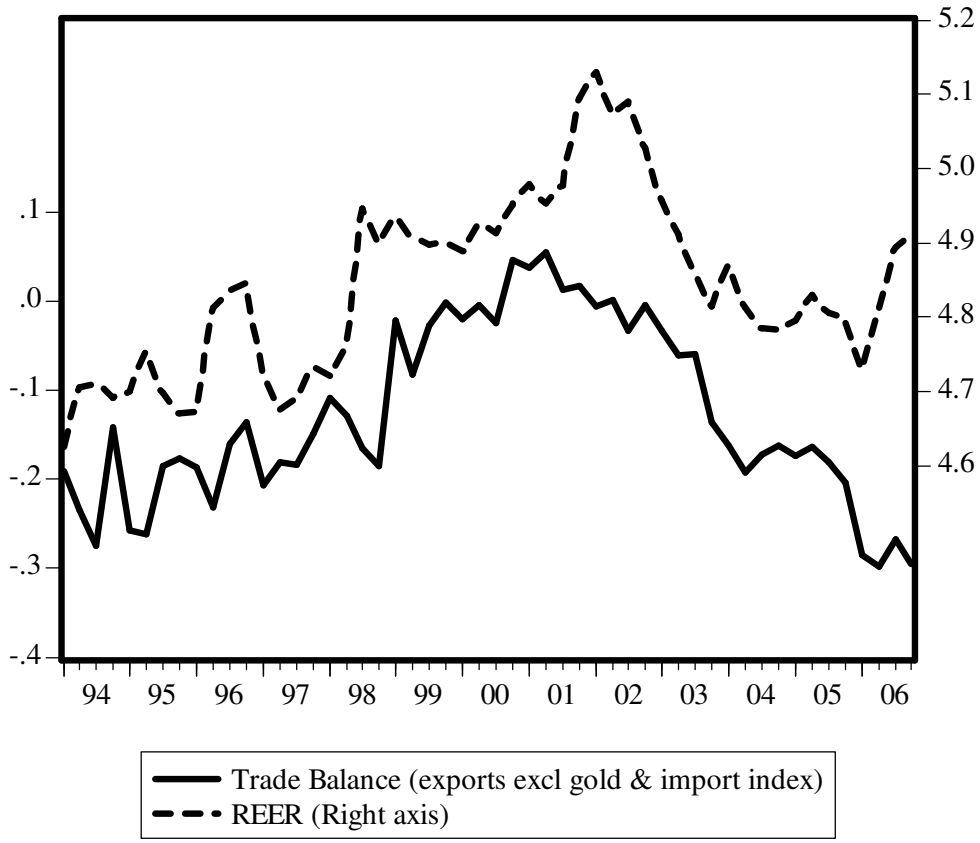


Chart 6 Trade Balance and REER – Quarterly Data[14]



Further, we estimated the following equations:

$$b_t = \alpha_0 + \eta_x s_t + \alpha_2 y_t^* + \varepsilon_{1t} \quad \textbf{(3)}$$

$$m_t = \beta_0 + \eta_m s_t + \beta_2 y_t + \varepsilon_{2t} \quad \textbf{(4)}$$

Estimation results are reported in Table 9.[15]

Key results are that the empirical relationship between the exchange rate and export volumes is quite weak and that exports volumes are more driven by the international economy than by the real exchange rate.

Table 9 Preferred Model Specifications with Quarterly Data: Exports and Imports

Dependent Variables (Right)	Export index excluding gold[16]	Import index[17]
Independent Variables (Down)		
EQUATION #	**(3)**	**(4)**
Constant	-4.883*	-1.888*
REER[18]	0.359*	0.336*
Foreign leading indicator[19]	1.680*	
South Africa's coincident indicator[20]		1.042*
ECM coefficient	-0.463*	-0.241*

* Indicates significance.

As can be seen from Table 9, the long-term price elasticity of the demand for imports was found to be 0.336. Note that this elasticity is positive rather than negative. The long-term price elasticity of exports (excluding gold) was found to be 0.359, which has the expected sign.[21]

Plugging these numbers into the standard version of the Marshall Lerner condition we have 0.359 >? 1+ 0.336. Thus, the standard version of the ML condition is not satisfied.

This means that over the 1994-2006 sample period real depreciations did not improve the trade balance and therefore had no positive effect on growth!

8. THE LINK BETWEEN EXCHANGE RATE VOLATILITY AND GROWTH

Note that equation **(3)** also allows us to tell a story about real exchange rate volatility.

This can be seen after we take variances which yields:

$$Var(b) = (\eta_x)^2 Var(s) + (\alpha_2)^2 Var(y^*) + \sigma_{\varepsilon 1}^2 .$$

Similarly, for the variability of import volumes we get

$$Var(m) = (\eta_m)^2 Var(s) + (\beta_2)^2 Var(y) + \sigma^2_{\varepsilon 2} .$$

Taking variances of equation

$$y = \gamma_c c + \gamma_i i + \gamma_g g + \mu(b - m) \qquad \textbf{(2)}^{22}$$

where we have set $c = i = g = 0$ - and using the results above for the trade balance/GDP (essentially the difference between **(3)** and **(4)**) we get

$$Var(y) = \mu^2 \left[\{ (\eta_x)^2 + (\eta_m)^2 \} Var(s) + (\alpha_2)^2 Var(y^*) + (\beta_2)^2 Var(y) + \sigma^2_{\varepsilon 1} + \sigma^2_{\varepsilon 2} \right]$$

Using the estimated coefficients $\eta_x = 0.359$, $\eta_m = 0.336$, $\alpha_2 = 1.680$, $\beta_2 = 1.042$, $\mu = 0.296$ - and setting - $Var(y) = \sigma_{\varepsilon 1}^2 = \sigma_{\varepsilon 2}^2 = 0$ and $\mu = 0.296^{23}$ we get that the volatility in SA GDP or 'growth' is described by

$$Var(y) = 0.09\left[0.24Var(s) + 2.82Var(y^*)\right].$$

This suggests that the volatility of SA output growth (via the trade balance) is largely driven by international business cycles (0.25), rather than by real exchange rate variability (0.02).

In fact, we find that the international business cycle is more than 12 times as important for SA as the real exchange rate!

However, the implied coefficient on $Var(s)$ at 0.02 is larger than the effects found by Aghion et al (2006).

Based on a sample of 83 countries from 1960-2000 they (we) find that a 50 percent increase in the volatility of the exchange rate leads to a 0.33 (1.05) percent reduction in annual productivity growth (growth, not productivity growth).

9. EXCHANGE RATE TARGETING AND EVALUATION OF SA'S INFLATION TARGETING REGIME

Now we address some of the criticisms of the Harvard Team with respect to the present architecture of SA's inflation targeting regime.

Rodrik (2006) argues that the South African Reserve Bank (SARB) should switch to a modified inflation targeting framework which allows considerations of competitiveness (or the real exchange rate) to affect its decision-making.

On what constitutes the equilibrium real exchange rate, Rodrik says that 'equilibrium' refers to satisfactory outcomes in terms of tradable output and employment- and the SARB should then steer exchange rates accordingly.

Well, in order to build a more specific line of critique regarding Rodrik's suggestion to target 'tradeable output', let's assume tradeable output means exports.[24]

We have estimated the following exports equation:

$$b_t = \alpha_0 + \eta_x s_t + \alpha_2 y_t^* + \varepsilon_{1t} \qquad \textbf{(3)}$$

More specific, for argumment's sake suppose that the SARB has a target level of exports at zero (in natural logs), say, so constant in levels.

Then rewriting equation **(3)** (where I have set $b_t = \alpha_0 = \varepsilon_{1t} = 0$), yields the result that – if the SARB would be targeting tradable output; here exports - any adverse change in overseas demand would have to be compensated for by a real exchange rate movement in the opposite direction:

$$\eta_x s^{TARGET} = -\alpha_2 y^* \qquad \textbf{(14)}$$

Plugging in the estimated elasticities from above we get $0.359 * s^{TARGET} = -1.680 y^{*}$.

This means basically that any 1 percent decline of foreign economic activity ('world trade') would have to be offset by an almost 5 percent real exchange rate depreciation.

Knowing that world trade can be quite volatile, targeting tradable output (here exports) will produce substantial real exchange rate variability.

This doesn't seem to be a very desirable by-product of such a policy as we know from the literature that real exchange rate volatility can have a significant adverse impact on the long-term rate of productivity growth [Aghion et al (2006)].

10. CONCLUSIONS

A weaker exchange rate increases the CPI inflation rate. We show that the degree of exchange rate pass-through (from NEER to CPI) is about 20 percent across the 94-06 sample.

We show that for a weaker real exchange rate to increase growth (in addition to increasing CPI inflation) it should boost net exports (exports minus imports, or the trade balance) as otherwise the export sector gains via implicit subsidization at the expense of other sectors in the economy; possibly the poor (inflation tax).

So, there may be a trade-off between inflation and competiteveness (and then possibly growth).

We show that over the 1994-2006 sample period real depreciations did not improve the trade balance and therefore had no positive effect on growth! One reason is that SA exports are priced to market (PTM instead of PCP).

We also find that the volatility of SA output growth (via the trade balance) is largely driven by international business cycles (0.25), rather than by real exchange rate variability (0.02).

In fact, we find that the international business cycle is more than 12 times as important for SA as the real exchange rate!

Rodrik (2006) argues that the South African Reserve Bank (SARB) should switch to a modified inflation targeting framework which allows considerations of competitiveness (or the real exchange rate) to affect its decision-making.

On what constitutes the equilibrium real exchange rate, Rodrik says that 'equilibrium' refers to satisfactory outcomes in terms of tradable output.

Interpreting tradable output as exports, we find that – if the SARB would be targeting exports - any adverse change in overseas demand would have to be compensated for by a real exchange rate movement in the opposite direction.

More specific, any 1 percent decline of foreign economic activity ('world trade') would have to be offset by an almost 5 percent real exchange rate depreciation.

Knowing that world trade can be quite volatile, targeting tradable output (here exports) will therefore produce substantial real exchange rate variability.

This doesn't seem to be a very desirable by-product of such a policy as we know from the literature that real exchange rate volatility can have a significant adverse impact on the long-term rate of productivity growth [This Presentation (0.02) and Aghion et al (2006) (0.07)].

So, the South African Reserve Bank (SARB) should not switch to a modified inflation targeting framework which allows explicit considerations of the (real) exchange rate.

REFERENCES

Aghion, P. , P. Bacchetta, R. Ranciere and K. Rogoff (2006). 'Exchange Rate Volatility and Productivity Growth: The Role of Financial Development', NBER Working Paper, No. 12117, March.

Aghion, Braun, and Fedderke (2006). 'Competition and Productivity Growth in South Africa', CID Working Paper No. 132, August.

Allard (2006). 'Inflation In Poland: How Much Can Globalization Explain', Mimeo International Monetary Fund, September.

Edwards, L. and R. Lawrence (2006). 'South African Trade Policy Matters: Trade Performance & Trade Policy', CID Working Paper, No 139, March.

Frankel, Smit and Sturzenegger (2006). 'South Africa: Macroeconomic Challenges after a Decade of Success', CID Working Paper, No. 133, September.

Rodrik (2006). 'Understanding South Africa's Economic Puzzles', CID Working Paper, No. 130, August.

Schaling, E. (2007). 'Trade and Poverty in South Africa: The Roles of the Exchange Rate, Tariffs and Import Parity Pricing for CPI Inflation', TIPS Trade and Industry Monitor, Forthcoming.

[1] For example, on 8 May finance minister Trevor Manuel said: 'South Africa wanted to maintain stability in the currency to benefit exports'.As quoted in Business Report, Wednesday 9 May 2007.

[2] Where $0 < \gamma < 1$ is the share of imported final goods in the domestic consumption basket and we have abstracted from non-traded goods. For this case see Appendix A.1.3 of the full Report.

[3] Here $\eta_m = \partial m / \partial s$ is the home import (demand) price elasticity, and $\eta_x = \partial b / \partial s$ is the foreign demand (price) elasticity for the home country's exports. A specification along these lines will be estimated in Section 3.

[4] For a derivation of this condition see Appendix A.2 of the Report. The intuition behind the Marshall-Lerner (hereafter ML) condition is the following. A nominal exchange rate depreciation increases the (domestic currency) price of imports one-for-one (hence the 'one' in the condition). This adverse price effect has to be compensated for by (i) the fact that more expensive imports will induce people to import less (the η_m term), and (ii) higher export volumes driven by the more 'competitive' exchange rate (the η_x term). All the ML condition says is that effect (ii) must be relatively large to the 'one-for-one effect', and that the more price sensitive imports volumes are (the more negative η_m is, and thus the better the 'automatic brake' works), the less need is there for export volumes to be price sensitive. It can be shown that the standard ML conditions are equivalent whether they are formulated with respect to the nominal or the real exchange rate.

[5] A nominal depreciation also improves profits of SA producers that sell in the local market if they set their price according to import parity pricing (IPP).

[6] The model specified by equation **(12)** then allows us to obtain the dynamics of the CPI price level in terms of a standard error correction model, given by:

$\Delta p_{C,t} = h_0 + \sum_{i=1}^{n} h_{1i} \Delta e_{t-i} + \gamma_1 ECM_{t-1} + \varepsilon_t$ **(12')**. Here ECM_{t-1} denotes the deviation of the actual CPI price level from the long-run (equilibrium price level) implied by equation **(13)**, i.e. $ECM_{1-1} = p_{C,t-1} - \alpha_0 - \lambda e_{t-1}$.

[7] Schaling (2007) in a calibrated model finds exchange rate pass-through to be quite a bit higher: 37 percent from imported goods to the CPI. Here 10 percent is accounted for by the imported final goods-CPI channel, and 27 percent by the imported intermediate goods-CPI channel.

[8] SARB - 7032N (2000=100). Monthly series converted to quarterly series.

[9] Nominal effective exchange rate of the rand consistently excl. Zimbabwe: Average for period (5369M). We have transformed the series according to the European definition of the exchange rate (increase means depreciation); that is, minus 1* (BOP5369M) plus 200. Next, we have re-based the series to Jan 1994 (Jan 1994 = 100).

[10] The implicit price is the difference of logs of total exports excluding gold and the log of the export index excluding gold. This gives us the implicit price per unit of total exports.

[11] Nominal effective exchange rate of the rand consistently excl. Zimbabwe: Average for period (5369M). We have transformed the series according to the European definition of the exchange rate (increase means depreciation); that is, minus 1* (BOP5369M) plus 200. Next, we have re-based the series to Jan 1994 (Jan 1994 = 100).

[19] SARB series: KBP5032L.

[13] SARB series: KBP5034L.
[14] Trade balance series was computed as the difference between export index excluding gold (SARB series: KBP5032L) and the import index (SARB series: KBP5034L).
[15] The model specified by equations **(3)** and **(4)** then allows us to obtain the dynamics of exports and imports in terms of a standard error correction model, given by: $\Delta b_t = h_0 + \sum_{i=1}^{n} h_{1i}\Delta s_{t-i} + \sum_{j=1}^{m} h_{2j}\Delta y^*_{t-j} + \gamma_1 ECM_{1,t-1} + \varepsilon_{1t}$ **(3')** and $\Delta m_t = k_0 + \sum_{i=1}^{n} k_{1i}\Delta s_{t-i} + \sum_{j=1}^{m} k_{2j}\Delta y_{t-j} + \gamma_2 ECM_{2t-1} + \varepsilon_{2t}$ **(4')**. Here $ECM_{1,t-1}$ denotes the deviation of actual exports from equilibrium exports implied by equation **(3)**, i.e. $ECM_{1-1} = b_{t-1} - \alpha_0 - \eta_x s_{t-1} - \alpha_2 y^*_{t-1}$ and $ECM_{2,t-1} = m_{t-1} - \beta_0 - \eta_m s_{t-1} - \beta_2 y_{t-1}$ is the deviation of actual imports from equilibrium imports implied by equation **(4)**.
[16] SARB series: KBP5030L: Index 2000 = 100. Seasonally adjusted.
[17] SARB series: KBP5032L (Index 2000 = 100)
[18] SARB series: KBP5369M.
[19] SARB series: KBP7095N.
[20] SARB series: KBP7091N; Index 2000 = 100. Seasonally adjusted monthly series – converted to quarterly.
[21] Although we do not use exactly the same variables as Edwards and Lawrence (2006), there are however some similarities with respect to the values of the estimated coefficients. For instance, in their export equation the 'foreign output' coefficient is more than unity in most estimations. In two instances in Table A.3.6. that coefficient is 0.93 – but overall it is larger than 1. For more details on a comparison between our empirical results and those of EL, see Appendix A.3 of the Report.

[22] This is the log-linearized version of equation **(1)**.
[23] The number for μ is based on a calibrated share γ of imported (final plus intermediate) goods in the SA consumption basket of 0.37 (see Schaling (2007)) and has then been converted to μ using the definition $\gamma = \hat{M}/\hat{C} = \hat{M}/\hat{Y}^*(\hat{Y}/\hat{C})$. For $\hat{Y}/\hat{C}$ we have used 1.25, which assumes a constant consumption share of 80 percent in GDP.
[24] This seems to be a fair interpretation of Rodrik as his whole paper is about the crucial role of the formal manufacturing sector for the SA economy.