Determinants of the equilibrium exchange rate for South Africa's manufacturing sector and implications for competitiveness

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Abstract

Debate frequently rages on the exchange rate and how it impacts on the economy. The focus tends to be on rand volatility, its overall level and how it is affected by economic policy with the principal argument being that the volatility and long-term level constrain exports – particularly manufacturing exports. The South African manufacturing sector has exhibited relatively disappointing export performance in the face of booming world trade. This paper studies the equilibrium exchange rate for the manufacturing sector of South Africa and tries to establish how competitive manufacturing is. It employs a PPP exchange rate measure for the manufacturing sector developed by the Groningen Growth and Development Centre (GGDC) and uses single Engle Granger techniques to determine the drivers of the manufacturing equilibrium exchange rate (MEER). The results indicate that over the period from 1995 to 2006 the MEER and economy wide exchange rate have largely been aligned with each other, although some misalignment was experienced during the early 2000s. Productivity and unit labour cost are found to be important drivers of the manufacturing exchange rate along with openness and government expenditure. In line with the Ricardian framework, this implies that rising productivity and declining unit labour costs, are imperative for improving the competitiveness of the sector.

JEL Classification Numbers: F3, F31

Keywords: Equilibrium Exchange Rates, Manufacturing, South Africa

1. Introduction

Debate frequently rages on the exchange rate and how it impacts on the economy. The focus tends to be on rand volatility, its overall level and how it is affected by economic policy with the principal argument being that the volatility and long-term level constrain exports – particularly manufacturing exports. One cannot ignore the influential role that a competitive export-orientated manufacturing sector can play in facilitating industrial as well as economic development and growth. This has been particularly evident in the past growth miracles of Japan and the East Asian Tigers and current phenomenal economic growth in China. This begs the question; how competitive is South Africa's manufacturing sector?

In South Africa, the manufacturing sector has largely stagnated. Despite manufacturing accounting for almost 1/6th of gross value added, since the 1980s it has been characterised by

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falling employment, a declining relative price (Rodrik 2006) and disappointing export performance given the boom in world trade. It is within this context that debate often turns to the role of the exchange rate and the competitiveness of the manufacturing sector. This is perhaps unsurprising since the real exchange rate has been shown to be an important determinant of both manufacturing exports and the general health of the manufacturing sector (Golub and Ceglowski 2002; Edwards and Golub 2003; Rodrik 2006).

This paper investigates a number of questions at a fairly conceptual level. First and foremost it asks, what is the manufacturing equilibrium exchange rate (MEER)? Furthermore, the paper aims to explore the (potential) drivers of this equilibrium exchange rate and the implications for competitiveness. In conventional analyses of the South African exchange rate, one cannot escape the finding that it is highly influenced by the mining sector and commodities prices. This potentially makes the rand subject to the vagaries of the commodity cycle and the potential exchange rate appreciation associated with Dutch Disease. This paper tries to abstract from this reality by attempting to determine an equilibrium exchange rate for manufacturing sector independent of commodities. In providing a comparison of the MEER with the actual exchange rate, it will be possible to establish the extent to which the manufacturing sector has been subject to exchange rate misalignment.

The MEER essentially represents a manufacturing relative PPP on the basis of the ICOP methodology developed by the Groningen Growth and Development Centre (GGDC). This is the point of departure for our analysis. The paper continues to investigate the determinants of the equilibrium exchange rate within a Ricardian framework where the role of productivity and unit labour costs as determinants of the exchange rate and manufacturing competitiveness are emphasised.

In the next section we develop the ideas that motivate this study focusing on the links between manufacturing, the exchange rate and competitiveness. Section 3 provides a brief discussion of different methodologies used to assess the equilibrium exchange rate with particular focus on the Behavioural Equilibrium Exchange Rate (BEER) approach, which appeals to economic fundamentals to explain the behaviour of the exchange rate. Given this is our chosen methodology, section 4 proceeds to explore in more detail the BEER literature and consider the economic fundamentals deemed determinants of the exchange rate. Section 5 describes the methodology in more depth, and examines the choice of variables and data sources whilst section 6 discusses the trends and patterns observed in the data. Section 7 analyses the results and section 8 concludes.

2. Manufacturing, exchange rates and competitiveness

Export orientated growth is the catch phrase frequently used to explain the economic growth of the Asian Tigers (Hong Kong, Korea, Singapore, Taiwan) during the final four decades of the twentieth century. Exploiting global demand, manufactured exports for the Asian Tigers grew from US$4.6 billion (in 2000 dollars) in 1962 to $715 billion in 2004 (World Bank 2008). Prior to these, export orientated growth was an appropriate description for the Japanese post-WWII growth miracle whilst manufactured exports continue to be important for China's re-emergence as a global economic superpower.[1] South Africa provides a stark contrast. The import substitution policies and drive for self-sufficiency during the apartheid regime contributed

[1] The Commission on Growth and Development identify these countries (China, Hong Kong, Japan, Korea, Singapore, Taiwan) as six of the thirteen examples of "growth miracles", where economic growth averaged at least 7 per cent over 25 years.

significantly to the stagnation of the manufacturing export sector. Import substitution in particular resulted in declining competition which has been reflected in higher mark-ups and rising concentration ratios in the manufacturing sector (Aghion et. al. 2006; Fedderke and Szalontai 2006; Fedderke et. al. 2007). South Africa's re-integration into the world economy post-1994 has re-orientated the economy and attempted to stimulate exports. However, the weakness of the export orientated manufacturing sector has been identified as a principal explanation not only for South Africa's limited growth performance, but also for the lack of job creation amongst the lower-skilled (Rodrik 2006).

The exchange rate provides the fundamental link between a country's internal economy and the international economy (Williamson 2007). Given this, it is perhaps unsurprising that a large body of exchange rate literature investigates the concept of an "equilibrium exchange rate" and attempts to quantify the magnitude of exchange rate misalignment, where overvaluation in particular is considered detrimental to competitiveness. Since the exchange rate is an important determinant of competitiveness and trade, understanding the drivers of the exchange rate are critically important.

In South Africa empirical papers assessing the exchange rate have highlighted the influential role of gold and other commodities (for example Aron et. al 1997; MacDonald and Ricci 2003; Frankel 2007). If South Africa is to establish and foster a diversified export base in manufactured goods, which will be crucial for South Africa's current and future economic development, it will happen within an environment where the exchange rate is subjected to volatile commodity and terms of trade developments. Despite this, it is an interesting exercise not only to estimate the MEER but also to empirically analyse the determinants of the manufacturing exchange rate due to the insights it provides into misalignment and competitiveness.

There has been a considerable body of literatures that has considered the competitiveness of manufacturing in South Africa and the impact competitiveness has on the manufacturing exports. Using relative unit labour costs Edwards and Golub (2002) find that relative to developed countries, South Africa's manufacturing sector experienced an increase in competitiveness in the 1990s relative to the 1970s and 1980s, but that it remained much less competitive relative to developing countries. The authors proceed to indicate that competitiveness has a statistically significant positive impact on domestic export performance. Golub and Ceglowski (2002) produce similar results when employing the real exchange rate to measure competitiveness and demonstrate that manufacturing exports responded positively to an improvement in competitiveness in the 1990s (the substantial exchange rate depreciation of the 1990s). Rodrik (2006) models the decline in the relative price of manufacturing as a function of import competition, the real exchange rate and the terms of trade. Whilst Rodrik finds that manufacturing profitability displays a close link to trade competition and performance, he also asserts that "the level … of the real exchange rate is a significant determinant of the health of manufacturing".

Estimating the equilibrium exchange rate for manufacturing will help provide intuition on a number of interesting concepts. The first relates to the drivers of the manufacturing exchange rate which will be informative for understanding the importance of different economic fundamentals for the exchange rate. Secondly, estimating an equilibrium exchange rate for the manufacturing sector is an abstract concept in that it tries to identify what the exchange rate would be in the absence of commodity price disturbances. In doing so, it will be possible to estimate the extent of the misalignment between the equilibrium manufacturing exchange rate and the observed economy wide actual exchange rate.

3. Estimating the equilibrium exchange rates

The role of exchange rates, especially in an increasingly globalised and integrated world economy, cannot be overstated. A stable, competitive exchange rate has also been identified as an important factor for economic growth (Eichengreen 2007). Exchange rates influence the prices faced by consumers and producers and the impact of exchange rate misalignment can be damaging. Estimating the equilibrium exchange rate is fundamental in for the judgement of exchange rate misalignment.

In this paper, as with most equilibrium exchange rate literature, we try to explain the real exchange rate over the medium term. This reflects the fact that exchange rate models demonstrate poor predictive accuracy over the short run; a finding most succinctly illustrated in the seminal paper of Meese and Rogoff (1983) that shows models of exchange rate behaviour fail to significantly out-predict a random walk at horizons of up to 12 months. To present a more accurate representation of exchange rates that accounts for a country's multiple trading partners, and to model the more economically appealing behaviour of relative prices, most empirical literature model multilateral real exchange rates. For consistency, this paper also estimates an effective exchange rate.

Assessing the equilibrium exchange rate allows policy makers to estimate and better understand misalignment. There have been numerous approaches and methodologies developed and employed in estimating equilibrium real exchange rates. However, most of the empirical literature has tended to concentrate on two – the Macroeconomic Balance (MB) approach and the Equilibrium Real Exchange Rate (ERER) approach (Clark and MacDonald (1998), IMF (2006), Isard (2007)).[2]

Under the MB approach the equilibrium exchange rate is defined as the real effective exchange rate consistent with macroeconomic balance – generally interpreted as when the economy is operating at full employment with low stable inflation (internal balance) and possesses a current account that is sustainable (external balance). In doing so the MB approach effectively calculates the real exchange rate consistent with medium term macroeconomic equilibrium and as such it is particularly useful as a method of determining misalignment of the current real exchange rate.

The ERER approach directly estimates the relationship between economic fundamentals and the equilibrium exchange rate. As such the ERER approach involves econometric estimation of the behaviour of the real effective exchange rate and as such is often called a Behavioural Equilibrium Exchange Rate (BEER) model. The use of the BEER approach in the empirical literature is extensive and has been applied to both industrialised and developing country samples (Bayoumi et. al. (2005), Chudik and Mongardini (2007), Clark and MacDonald (1998; 2000), Ricci et. al. (2008)). In this paper we adopt a BEER estimation model, appealing to economic fundamentals to explain the equilibrium real exchange rate. The question then becomes one of identifying the relevant economic fundamentals for which the vast literature provides a considerable insight and guidance. There is general consensus within the literature in respect of these fundamentals with most empirical studies including variables that account for productivity differentials, terms of trade effects, net foreign assets, fiscal and trade policy. The relationship between real exchange rates and real interest rate is often acknowledged through the inclusion of the real interest rate differential.

[2] A useful description and review of six approaches is provided by Isard (2007), whilst the IMF (2006) provides detailed information on the MB, ERER and External Sustainability (ES) methodologies for exchange rate assessment.

4. Economic fundamentals to explain the exchange rate: A review of literature

The Balassa-Samuelson (BS) hypothesis appeals to productivity differentials as explanation for deviations away from PPP over the longer term (Froot and Rogoff (1994), Rogoff (1996)). The argument posits that relative productivity increases in the tradables sector– i.e. productivity in the tradables sector growing at a faster rate than in the non-tradables sector – places upward pressure on wages in the entire economy, including in the non-tradables sector. Producers in the non-tradable sector will only be able to accommodate this if there is a rise in the relative price of non-tradable goods – a real appreciation in the exchange rate. Positive productivity differentials are therefore expected to have a positive impact on the equilibrium real exchange rate. The BS hypothesis has been subject to repeated empirical investigation and evidence is somewhat mixed (Froot and Rogoff (1994), Rogoff (1996)). Empirical support for the BS effect is strongest for broad samples comprising both very rich and very poor countries where productivity and price levels differ markedly. An interesting recent finding also postulates that the significance of productivity differentials depends on how productivity is measured. Lee and Tang (2003) indicate that the exchange rate impact of the Balassa-Samuelson effect depends on whether labour productivity or total factor productivity is the chosen measure.[3]

Terms of trade gains induce a positive wealth effect that raises domestic demand and subsequently the relative price of non-tradables. In most conceptualisations, the terms of trade effect operates through commodity prices with higher commodity prices representing a terms of trade gain for net commodity exporters.

The role of net foreign assets as a determinant of the equilibrium exchange rate appeals to the interrelationship between the external asset position, the trade balance and the real exchange rate. It follows that a positive, sustainable net external asset position allows persistent trade deficits to be run which are associated with an appreciated exchange rate (Lane and Milesi-Ferrati 2002). A slightly different interpretation of the relationship suggests that given larger net foreign assets, which represent a country's net external position, a higher inflow of capital from abroad implies greater demand for a country's currency and consequently introduces appreciation pressure on the exchange rate. Net foreign assets are therefore expected to display a positive relationship with the exchange rate.

Fiscal policy and government spending have traditionally been introduced as a demand side explanation for deviations from PPP (Froot and Rogoff (1994), Rogoff (1996)). Ex ante, fiscal policy, primarily proxied by the ratio of government consumption to GDP, has an ambiguous effect on the equilibrium real exchange rate and will depend on whether fiscal support is towards the tradables or non-tradables sector. The IMF (2006), and indeed many theoretical and empirical exchange rate papers assert that the exchange rate will tend to appreciate in response to increasing government consumption to the extent that such consumption is primarily directed to the non-tradables sector, whose prices would subsequently rise.

Greater openness (conventionally measured by the sum of imports and exports as a share of GDP) is associated with a more depreciated exchange rate since protection of domestically produced

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[3] Lee and Tang (2003) find that empirical support for the Balassa-Samuelson hypothesis depends on the measure of productivity used. In particular, whilst the authors find a positive relationship when labour productivity is used as the measure productivity, when TFP is used the correlation between productivity differential and the real exchange rate is no longer statistically significant and in some instances becomes negative.

goods through the imposition of cross-border restrictions results in higher domestic prices. The reduction and removal of trade restrictions – using the conventional openness proxy, or alternatively some other measure of trade restrictiveness – should therefore cause the equilibrium real exchange rate to depreciate as the relative price of non-tradables declines.

The ratio of investment to GDP relative to trading partners is also likely to impinge on the equilibrium exchange rate. Investments in low- and middle-income economies tend to have high import content and as such have a deleterious impact on trade balances. However, the impact may be ambiguous since there is a positive boost to productivity if this investment engenders or encapsulates technological progress.

Some estimations include the risk premium as a determinant of the equilibrium exchange rate arguing that a rise in the risk premium requires depreciation of the real exchange rate (Clark and MacDonald (1998)). In this instance the evolution of the risk premium over time is a function of the relative supply of domestic and foreign debt. The influence of debt, and in particular increasing debt service, manifests itself through deteriorating the external balance and increasing the risk premium which requires a more depreciated exchange rate to facilitate the debt service.

The relationship between the real interest rate and the real exchange rate can be derived by combining the Fisher parity condition, a real exchange rate identity and the uncovered interest parity condition (UIP). It is argued that the real interest differential potentially reflects several factors – aggregate demand, productivity, and persistent monetary policy – that all suggest a positive relationship with the real exchange rate. As such a positive real interest rate differential is consistent with an appreciated real exchange rate. Investigations of the real exchange rate-real interest rate (RERI) model (MacDonald and Nagayasu (1998)) and the inclusion of the real interest differential into a BEER estimation framework (MacDonald (1997)) have all found a statistically significant positive relationship.

Chudik and Mongardini (2007) in their study of estimating equilibrium exchange rates in Sub-Saharan African countries include three additional determinants – aid flows, controls over capital flows, and fiscal and monetary. In some developing countries aid flows represent a significant fraction of GDP and an increase can improve the external balance and appreciate the equilibrium exchange rate. Easing capital controls may also impact the equilibrium exchange rate. The direction of this impact will, however, depend on the real interest rate differential and the country's risk profile. Finally fiscal and monetary policy has been shown to affect the real exchange rate; however the impact over the long run is unclear.

5. An equilibrium exchange rate for South Africa

The exchange rate has been a popular topic within the economic literature concerning South Africa and often concentrates on both the volatility and the level of the rand. There have been a number of studies in recent years estimating the equilibrium value of the rand and investigating the determinants of the exchange rate (Aron et. al. (1997), MacDonald and Ricci (2003), Frankel (2007)). These studies have incorporated many of the explanatory variables identified in the previous section as economic fundamentals determining the equilibrium real exchange rate over the longer term, including terms of trade (commodity prices), trade measures, and the real interest rate differential. In all cases commodity prices, either separately or through the terms of trade, have been identified as very influential drivers of the exchange rate. This is unsurprising given the importance commodities in GDP. Selected significant explanatory variables are summarised in the table below with the coefficient sign included in parentheses. In most cases explanatory variables possess the expected sign. The only variable that does not have the expected sign is the income per capita variable from Frankel's equation, which is interpreted as a rejection of the importance of Balassa-Samuelson effects.

Table 1: Summary of previous literature on the SA exchange rate

Authors	Sample period	Selected determinants (sign of coefficient)
Aron, Elbadawi and Khan (1997)	[1970q3:1995q1]	Trade policy (tariff reduction (-), openness (-)) Terms of trade shocks (Gold price (+), Non-gold terms of trade (+)) Government expenditure (+) Capital flows (+) Reserves (+)
MacDonald and Ricci (2003)	[1970q1:2002q1]	Terms of trade (Commodity prices (+)) GDP per capita (+) Net foreign assets (+) Real interest rate differential (+) Openness (-) Fiscal balance (-)
Frankel (2007)	[1984q2:2006q2]	Lagged real exchange rate (+) Terms of trade (Real minerals prices (+)) Real interest rate differential (+) Risk premium (-) Capital account liberalisation (-) Income per capita (-)

Notes:
The dependent variable in the literature is expressed as units of foreign currency per unit of domestic currency, therefore a positive sign (+) indicates appreciation in the domestic currency and a negative sign (-) indicates depreciation.

6. Methodology and data

The study employs the dynamic single Engle-Granger co-integration approach. It involves simultaneous estimation of the long and short term parameters and is based on an unrestricted error correction autoregressive distributed lag model, or ARDL (p,q) (Wickens and Breusch 1988). The model is represented as:

$$\Delta y_t = \varphi\eta_{t-1} + \sum_{j=1}^{p-1}\lambda_j \Delta y_{t-j} + \sum_{j=0}^{q-1}\boldsymbol{\delta}_j' \Delta \boldsymbol{x}_{t-j} + \mu_0 + \varepsilon_t \qquad (1)$$

where $\eta_t = y_t - \theta' \mathbf{x}_t$

t denotes time periods, y_t is a scalar dependent variable, x_t is the $k \times 1$ vector of (weakly exogenous) regressors, μ_0 represents a constant, η_t is the error-correction term and φ is a scalar coefficient that measures the speed of adjustment towards long term equilibrium, β is the $k \times 1$ vector of coefficients on explanatory variables, $\theta = -\beta / \varphi$ is a $k \times 1$ vector of the long-run coefficients, λ_j's are scalar coefficients on lagged first-differences of dependent variables, and δ_j's are $k \times 1$ coefficient vectors on first-difference of explanatory variables, and their lagged values.[4] We assume that the disturbance term ε_t is independently distributed, with zero means and constant variance $\sigma^2 > 0$.

[4] The error-correction term implies that there is a long-run relationship between y_t and x_t

The dependent variable is the trade-weighted ICOP relative PPP value for the manufacturing sector of South Africa. It is constructed using unit value ratios (UVRs) for the manufacturing sector, which are calculated as the ratio of output value to quantity of goods produced in South Africa over the same ratio in its trade partners. This is essentially the prices of manufactured goods in South Africa relative to its trading partners. The value is calculated using data from the International Comparison of Output and Productivity (ICOP) project carried out at the universities of Groningen and Eindhoven as well the ICOP PPP value calculated for the rand against the dollar by van Dijk (2002).[5] The data is extrapolated both backward and forward using the ratio of the manufacturing deflator of South Africa to the manufacturing deflators of the country's major trade partners (van Dijk 2002). The countries included in the calculation are France, Germany, Italy, Spain, the Netherlands, the United Kingdom and the United States. Together, they account for approximately one-third of South Africa's trade.[6] The importance of each trade partner in the trade-weighted ICOP relative PPP is calculated by applying the average trade weight for the sample period.

The choice of the ICOP relative PPP as the MEER is guided by the limitations of the normal exchange rate. Exchange rates are not only determined by relative prices, but also other factors such as political factors, capital movements and speculation. In addition, it reflects the price levels of all goods produced in a country and is thus less suitable for this study of the manufacturing sector (van Dijk 2002).

The ICOP PPP is explained in terms of a number of factors identified in the exchange rate literature. These include measures for productivity, unit labour cost, investment, government consumption, openness, and interest rate and growth differentials.

Consistent with the Ricardian framework, two measures of **productivity** are included in the analysis. The first measure captures the productivity of South Africa's manufacturing sector compared to her non-tradable sector and relative to the selected trading partners (Froot and Rogoff 1994; Rogoff 1996; IMF 2006; Delechat and Gaertner 2008). This refers to the Balassa-Samuleson effect:

$$R\_PROD1 = \left[\frac{\left(\dfrac{GVA_{SA-m} / L_{SA-m}}{GVA_{SA-nt} / L_{SA-nt}} \right)}{\sum \beta_i \left(\dfrac{GVA_{i-m} / L_{i-m}}{GVA_{i-nt} / L_{i-nt}} \right)} \right]$$

where GVA is gross value added by the manufacturing sector converted into US dollars, using the ICOP PPPs. The coefficient β represents the trade weight of a country within the selected sample of South Africa's trade partners, where i=7, reflecting the chosen set of South Africa's major trade partners. [7] A negative coefficient implies that a Balassa-Samuelson effect is present.

[5] For more detail please refer to the ICOP industry Database, 2000 at www.eco.rug.nl/GGDC/icop.html

[6] Given the methodology for constructing the dependent variable, selection of trade partners to include is determined by the countries available in the ICOP database.

[7] Our measure is similar to Edwards, L. and S. Golub (2002) South Africa's International Cost Competitiveness and Productivity: A Sectoral Analysis", Report Prepared for the National Treasury

The second measure explores the productivity of the manufacturing sector in South Africa relative to the trade weighted productivity of the selected trading partners and is calculated using the formula below[8]:

$$R\_PROD2 = \frac{(GVA_{SA} / L_{sa})}{\sum \beta_i (GVA_i / L_i)}$$

The expectation is that relatively higher productivity in South Africa will cause the manufacturing exchange rate to appreciate

The unit labour cost variable measures the **relative unit labour cost** of the South African manufacturing sector to its trade partners. It is calculated by dividing the total labour cost by the gross value added. Higher values of the measure imply that the exchange rate needs to be weaker to make local exports competitive on foreign markets. This links to the Ricardian theory of comparative advantage (Golub and Hsieh 2000).

Investment is proxied by gross fixed capital formation to gross value added in the manufacturing sector, while **government consumption** is calculated as the ratio of government consumption to GDP. As discussed in the literature review, government consumption can have either positive or negative effect on equilibrium exchange rate depending on how it affects the tradable and non-tradable sectors.

The measure of **openness** employed in the estimation is the ratio of the sum of manufacturing exports and imports to GDP and is included to capture the impact of trade policy on the exchange rate. This differs to some examples in the empirical literature and in particular the IMF's CGER methodology, which rather chooses to use a trade restrictiveness index (IMF 2006). In principle this is consistent with other studies into the equilibrium exchange rate (Chudik and Mongardini 2007; Delechat and Gaertner 2008). Generally, openness is associated with a weaker real exchange rate as the price of trade liberalisation reduces the relative price of non-tradables.

Two measures of **interest rate differentials** are employed. The first measure is the long run interest rate differential measured by the difference between the South African and US yields on government stocks longer than 10 years. The second measure is more short-run and is based on the difference between the South African repo rate and the US fed rate. All values are real. Consistent with the principle of uncovered interest rate parity – UIP – (MacDonald and Nagayasu 1999; Patterson 2000), a higher interest rate differential should appreciate the exchange rate.

The **growth differential** between South Africa and its trading partners, proxied by G7 growth, is also included to test whether wealth effects have a role in determining the equilibrium exchange rate for the manufacturing sector. Finally, and consistent with Frankel (2007), the estimation introduces a term to capture the influence of **momentum effects** or the observed persistence in the exchange rate. [9] This is what Frankel terms a "dragging anchor" and is represented by a seasonal autoregressive lag of 4. The stationarity of all variables, including the residual term in

[8] The productivity measures are trade weighted consistent with the dependent variable with trade weights representing the average trade share over the sample period.
[9] Mark (1995) finds empirically that an equation that includes the lagged exchange rate together with current fundamentals performs better than either fundamentals alone or the lagged rate alone (random walk)

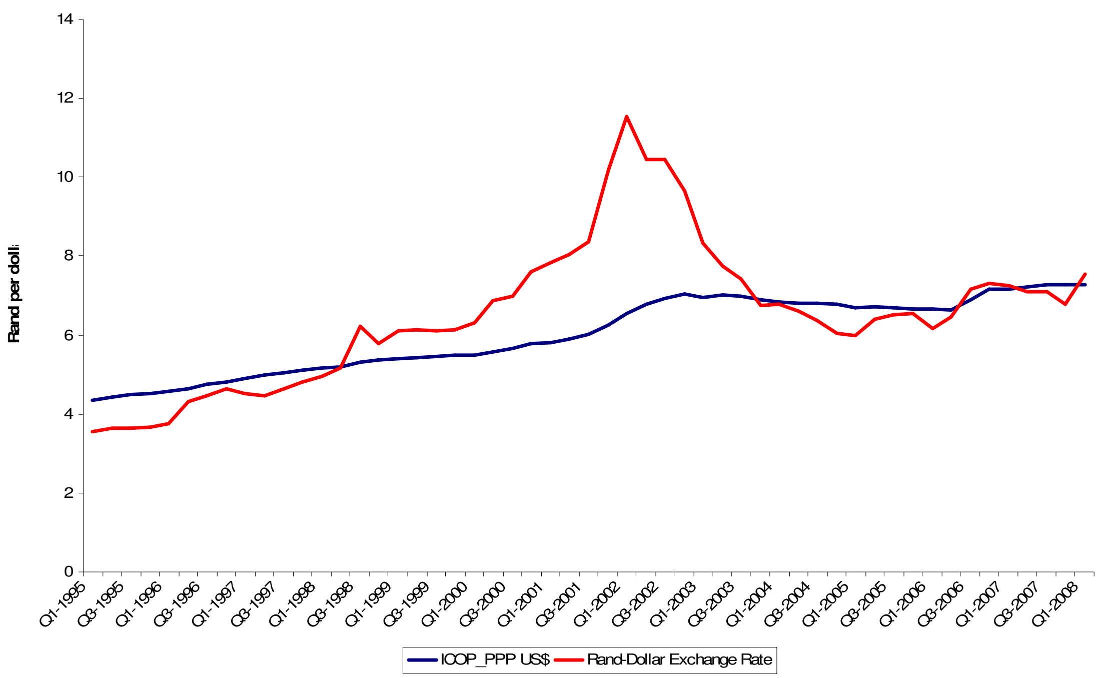
the single Engle-Granger model is tested using the Augmented Dickey-Fuller Test and the Phillips-Perron test (Patterson 2000).

The analysis employs quarterly data over the period 1995q1 to 2006q3. Unfortunately, due to paucity of quarterly data for some countries in the selected sample, the sample period could not be extended. Most of the data for South Africa's trade partners is sourced from the OECD statistical database, while South Africa's data is sourced from Statistics South Africa and the South African Reserve Bank. Annex 1 provides a summary of the different variables and their sources.

7. Data analysis

Figure 1 compares the ICOP PPP (rand-dollar) against the nominal rand-dollar exchange rate. Over the period 1995 to 2007, the PPP measure shows considerably less volatility than the nominal exchange rate, which exceeds the PPP measure significantly over the 1998 to 2004 period. This is mainly driven by the large depreciation of the rand in nominal terms in 2001/02 when it reached average quarterly values of close to R12 to the dollar.

Figure 1: Rand-US dollar economy-wide and ICOP PPP manufacturing exchange rates



As indicated earlier, the comparison of the rand-dollar MEER with the actual rand-dollar exchange rate can provide inferences into the extent of exchange rate misalignment. During the late 1990s it is evident that the economy wide exchange rate trended below the MEER to the detriment of South African manufacturing competitiveness and exports. This was subsequently followed by a strong and rapid depreciation in 2001. From a theoretical perspective, the depreciated exchange rate should have made South Africa's manufacturing exports cheaper in and more competitive on world markets. Despite this, the empirics show little improvement in export performance. The inability to respond may to some extent reflect manufacturing concerns regarding the sustainability of the large nominal depreciation, and perhaps that the real competitiveness gains might soon have been eroded by higher cost and wage pressures. Over the most recent period, the nominal exchange rate appears to trace the ICOP PPP more closely, indicating that the degree of misalignment has narrowed considerably. At the end of 2007 there was been some misalignment on the downside, indicating some loss in competitiveness. Table 2 indicates that manufacturing inflation has been significantly higher in South Africa reaching approximately 8 per cent in 2006-2007 having averaged just over 6 per cent in the previous decade.

Table 2: Average manufacturing inflation (%) in South Africa and trading partners

	1996-2000	2001-2005	2006-2007
France	-0.74%	0.85%	2.36%
Germany	0.68%	0.85%	2.36%
Italy	1.82%	2.10%	4.52%
Netherlands	2.54%	2.03%	4.42%
Spain	1.64%	2.42%	4.32%
UK	1.08%	1.30%	2.76%
US	1.47%	2.49%	3.93%
South Africa	**6.38%**	**6.16%**	**8.08%**

The productivity of the South African manufacturing sector compared to the non-tradable sector is significantly above the country's trade partners as depicted in figure 2. This gap in relative productivity widened during 2002 but has narrowed slightly since. It does however remain approximately 20 per cent higher in South Africa. This largely reflects improvements in South African manufacturing productivity, which has increased levels similar to those observed in the major trade partners (figure 3)

Figure 2: Ratio of manufacturing to non-tradable sector productivity

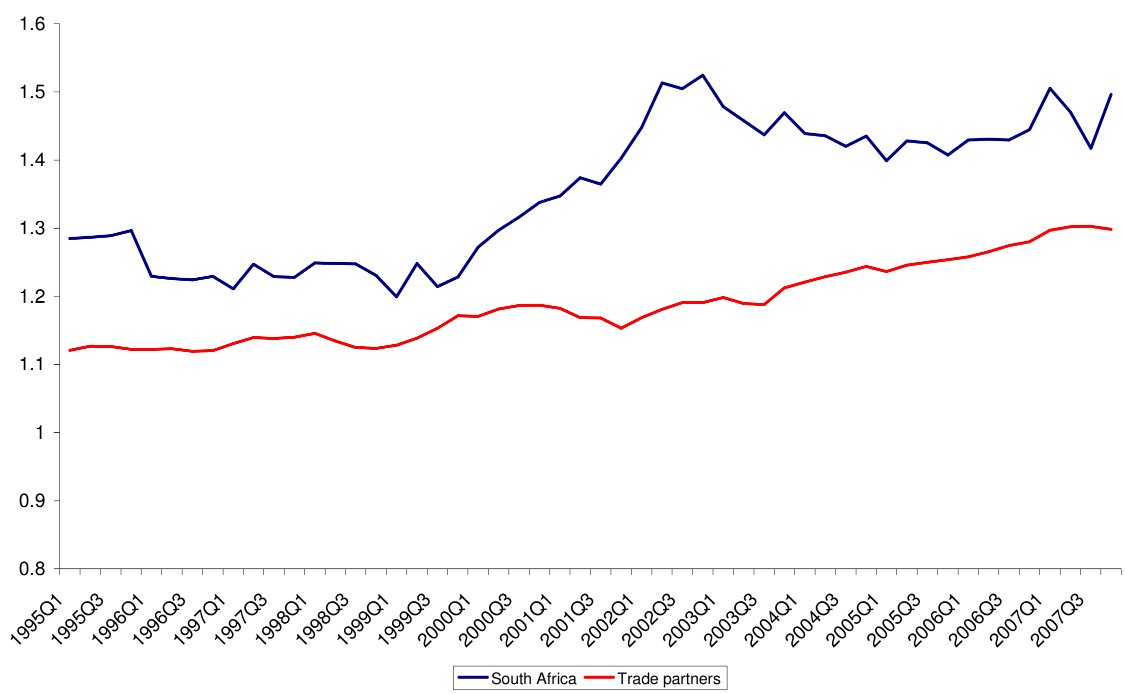
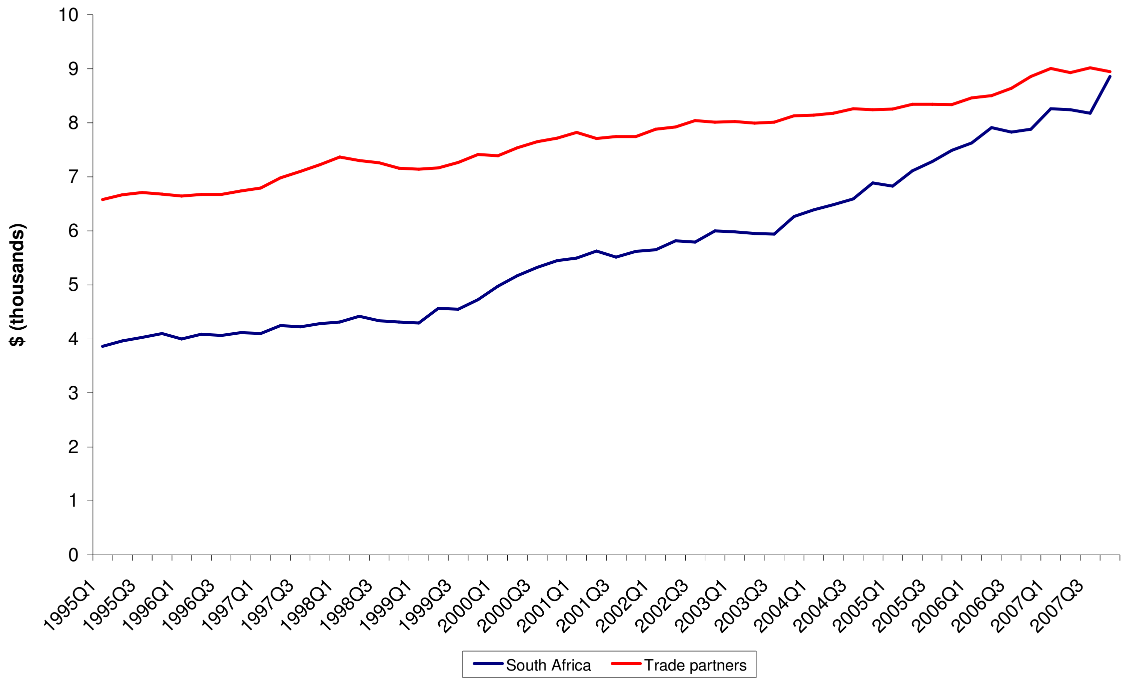


Figure 3: Productivity of the manufacturing sector ($)



The improvements in manufacturing productivity has led to a slow down in the growth of unit labour costs, which have declined from around 5.3 per cent over the 1996-2000 period to levels roughly in line with trade partners. Given this slowdown, relative unit labour costs have declined. This finding is consistent with extending the trend shown in Edwards and Golub (2003).

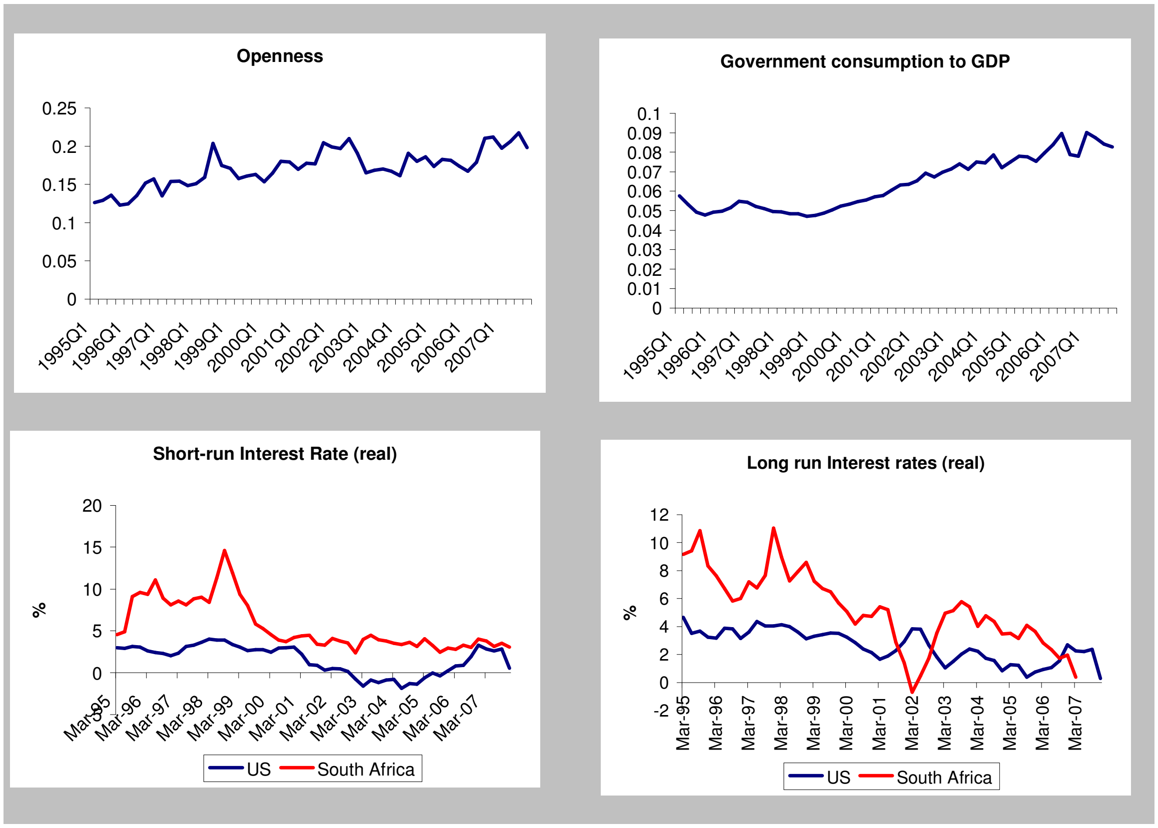
Table 3: Average percentage change in Unit Labour Cost

	1996-2000	2001-2005	2006-2007
South Africa	5.3	4.3	4.5
Trade Partners	3.6	4.2	4.2
Relative measure*	0.70	0.65	0.66

* a value below 1 indicates relative competitiveness.

Figure 4 below indicates the movements of the other explanatory variables. The level of openness in the manufacturing sector has risen at a very slow rate. The proxy for government expenditure has a similar trend to the ICOP PPP measure, displaying a rise in government consumption relative to GDP since 1999. The long-run and short-run real interest rate differentials have remained roughly unchanged over the period with two exceptions. The interest rate differential narrowed in 2002, largely driven by high inflation in South Africa, and more recently during 2007 reflecting both higher inflation in South Africa and the sharp reversal in the US interest rate cycle.

Figure 4: Movements in other explanatory variables



8. Empirical results

The preliminary analysis indicates that all the variables are integrated of first order (Table 4)

Table 4: Order of integration

Order of integration	
ICOP_PPP	I(1)*
GCOTH/Y	I(1)
OPENNESS	I(1)
R_PROD1	I(1)
R_PROD2	I(1)
R_ULC1	I(1)**
R_ULC2	I(1)
(FREPO-FFED)	I(1)
(FGOVL-FGOVLUS)	I(1)
I_MANSHARE	I(1)
GY1-GG7Y1	I(1)

* at the 10% level; ** Phillips-Perron Test

where ICOP_PPP is our dependent variable, GCOTH/Y is a proxy for government consumption, OPENNESS is a measure of trade openness for the manufacturing sector, R_PROD1 represents the ratio of the South African manufacturing sector to the non-tradable sector relative to the same ratio in the trade partner countries, R_PROD2 is the relative productivity of the South African manufacturing sector to the country's trade partners, R_ULC1 is unit labour cost calculated per unit of gross value added, the second measure is a proxy of the cost per worker, (FREPO-FFED) is the short-run interest rate differential in real terms, (FGOVL-FGOVLUS) is the long-run interest rate differential, I_MANSHARE is the share of manufacturing investment and (GY1-GG7Y1) is the growth differential.

Table 5 below depicts the results from the econometric analysis. Four equations are presented including the different productivity and labour cost measures outlined earlier. We choose not to use all the variables in the same equations to avoid multicollinearity. The residuals from the equations are stationary indicating the presence of a cointegrating relationship and thus the presence of an Error Correction Mechanism (Patterson 2000).

The equations indicate that government consumption, openness, productivity and unit labour cost have a significant effect on the manufacturing exchange rate in the long run, while long run real interest rate differentials as well as the seasonally adjusted momentum effect have an impact in the short run. The sign of the coefficients indicates the direction of the response of the ICOP PPP to maintain equilibrium between South African manufacturing prices and those in trade partners.[10]

The exchange rate actually facing the manufacturing sector, however, is the economy wide exchange rate, which takes into consideration the fundamentals of the entire economy, including the influential commodities sector in South Africa's case, to ensure equilibrium between the internal and external economy. The dynamics governing the interaction between the MEER and the economy wide exchange rate provides inferences about competitiveness. If, for example, the economy wide exchange rate is exceeds the ICOP PPP exchange rate, it implies that foreigners can source manufacturing products relatively cheaper from South Africa than at home and thus suggests higher manufacturing exports from South Africa. Therefore, appreciation in the ICOP PPP at a given economy wide exchange rate, indicates an improvement in the competitiveness of the manufacturing sector whereas a depreciation implies a loss in competitiveness. If the ICOP PPP and the economy wide exchange rate both change by the same magnitude, the relative competitiveness of the manufacturing sector to the overall economy is unchanged. Given these interactions and dynamics, lasting gains in the competitiveness of South African manufacturing will only occur if there is a sustained real depreciation in the economy wide exchange rate.

[10] In contrast to much of the empirical literature, the exchange rate is defined as domestic currency per unit of foreign currency. As such, positive sign implies depreciation and a negative sign implies appreciation.

Table 5: Results

$\Delta ICOP\_PPP_t$	eq1	eq2	eq3	eq4
$ICOP\_PPP_{t-1}$	-0.086	-0.187	-0.130	-0.138
	(-3.431)*	(-5.121)*	(-4.705)*	(-4.710)*
$GCOTH_{t-1}/Y_{t-1}$	0.062	0.121	0.060	0.051
	(-4.436)*	(-4.394)*	(-3.868)*	(-3.135)*
$OPENNESS_{t-3}$	0.140	0.605	0.354	0.242
	(-1.414)	(-4.593)*	(-3.501)*	(-2.417)*
R_PROD1_{t-8}	-0.131			
	(-6.012)*			
R_PROD2_{t-8}		-0.087		
		(-4.414)*		
R_ULC1_{t-8}			0.065	
			(-4.835)*	
R_ULC2_{t-8}				0.087
				(-4.414)*
C	0.342	0.566	0.392	0.373
	(-4.703)*	(-4.749)*	(-4.664)*	(-4.122)*
DUM02	0.016	0.020	0.018	0.018
	(8.205)*	(9.19)*	(-8.613)*	(4.122)*
$\Delta(FGOVL_{t-1}-FGOVLUS_{t-1})$	0.021	-0.108	-0.123	-0.339
	(-0.175)	(-0.77)	(-1.027)	(9.167)*
SAR(4)	-0.842	-0.706	-0.703	-0.563
	(-6.35)*	(-6.842)*	(-5.844)*	(-4.688)*
R-squared	0.95	0.94	0.94	0.94

* significance at 5%, ** significance at 10 per cent
t-statistics in parentheses

Both equation 1 and equation 2 indicate that higher levels of productivity in the South African manufacturing sector, which improves competitiveness, and leads to appreciation in the exchange rate. In equation 1, this effect is stronger, reflecting the large discrepancy between productivity in manufacturing compared to non-tradables in South Africa. The long-run elasticities with respect to productivity are 1.5 per cent and 0.5 per cent respectively. The speed of adjustment indicates that the adjustment to the new long run equilibrium value due to a shock in one of the explanatory variables will take a long time. The result indicates the presence of a Balassa-Samuelson effect consistent with the findings from much of the literature surveyed (for example Aron et. al. 1997; Clark and MacDonald 1998; Choudhri and Khan 2004; Chudik and Mongardini 2007).

The two relative unit labour cost specifications in equations 3 and 4 have the expected signs. A relatively larger rise in South African unit labour cost than in its trade partners makes South African manufacturing production more expensive and thus less competitive. This causes the ICOP PPP exchange rate to depreciate to maintain equilibrium between South African manufacturing prices and those in trade partners. In the long run a shock of 1 per cent to unit labour cost will lead to a depreciation of 0.5 and 0.63 per cent in the ICOP PPP. The long lag of the unit labour cost variable indicates that it may take up to two years before relative changes in the unit labour cost affect the exchange rate.

In all the estimated equations there is a significant positive impact associated with increased government non-wage consumption expenditure on the manufacturing exchange rate. The long-run elasticity ranges from 0.37 per cent to 0.73 per cent. Our findings differ from IMF (2006).

The results illustrate that increasing the openness of the economy depreciates the exchange rate, consistent with the argument that removing trade restrictions reduces the relative price of non-tradables through import competition. The effect is highly significant in all equations except equation 1, reconfirming the findings in the South African literature on the importance of openness to the exchange rate (Aron et. al 1997; MacDonald and Ricci 2003; Frankel 2007). Increasing our measure of openness by 1 unit will depreciate the MEER between 1.63 and 3.24 units depending on the specification.

In the short-run, the results indicate that the manufacturing exchange rate is mainly driven by the variable included to proxy for the dragging anchor or momentum element, rather than the long-run interest rate differential. The momentum component is significant in all four equations and has a strong effect on the exchange rate. The significance of this variable could be driven by the presence of serial correlation; however this is rejected by the Q-statistic. The interest rate differential, measured by the difference of the long-run interest rates between South Africa and the US, has the expected negative sign in all equations except equation 1. [11] The inclusion of the long-run interest rates differential rather than the short-run is driven by the notion that in emerging markets short-run interest rates may be more associated with changes in inflation rather than changes in rates of return. This sign of the coefficient is consistent with the findings of MacDonald (1997) but is only significant in equation 4 where it is estimated that a rise in the interest rate differential by 1 percentage point will appreciate the equilibrium manufacturing exchange rate by approximately 2.4 per cent in the short run

9. Conclusion

This paper considers the competitiveness of South Africa's manufacturing sector by estimating a manufacturing equilibrium exchange rate (MEER) and identifying the economic fundamentals that drive it using single equation Engle Granger co-integration techniques. The results indicate that the higher relative productivity and lower relative unit labour costs improve the competitiveness of the manufacturing sector. Other explanatory factors that are important determinants include openness and government expenditure. The short-run dynamics seems to be largely driven by momentum elements.

The MEER, calculated as an ICOP PPP measure for the manufacturing sector, has experienced misalignment with the actual exchange rate over the sample period. This was most evident during 2002 when it was approximately 50 per cent undervalued. Over the past two years the results indicate that the MEER has been broadly in line with the current nominal exchange rate. The movements in the MEER are largely driven by consistently higher inflation in the South African manufacturing sector compared to its trade partners. This has eroded some of the competitiveness of the sector. However, it appears that the current level of the rand is at a competitive level as far as the manufacturing sector is concerned. While this may be the case, it is worth mentioning some limitations of the ICOP PPP measure, which may drive this result. Firstly, the measure has limited coverage as some goods are not produced in some trading partners, which creates discrepancies in the calculation of the measure. Secondly, the measure does not fully address differences in quality, which may exist in similar products across countries, and thirdly the

[11] However the coefficient is insignificant in equation 1

measure suffers from common shortfalls involved in employing PPP measures (Patterson 2000). These shortfalls should be addressed in future studies.

Data limitations were important in determining the direction of analysis as evidenced in the study looking only at South Africa's developed trade partners over the period between 1995q1 and 2006q4. This in itself generates issues since the period is influenced by a strong depreciation in the value of the rand.

Further improvements in the study require that the sample of countries as well as the sample period be extended. Additional factors such as net foreign assets and the terms of trade should also be included as explanatory variables. Finally, a sanity check of the findings could be made by adopting a top-down approach that looks to remove the influence of commodities rather than isolate the manufacturing sector.

The study indicates that to address the misalignment between the manufacturing equilibrium exchange rate and the economy wide exchange rate, productivity must rise, whilst unit labour costs must fall, relative to trade partners. This does not necessarily advocate a fall in nominal or even real wages; rather, it argues that unit labour costs (wages adjusted for labour productivity) must grow at a slower pace than in SA's trading partners.

To conclude, the paper re-emphasised the importance of lower unit labour cost and improved productivity in raising domestic competitiveness. Not only does this boost economy wide competitiveness, but it also prevents an over reliance on nominal exchange rate depreciation. The latter is not only difficult and potentially costly to manage, but it often results in a depreciation-inflation-wage spiral that negates the initial real depreciation.

Annex 1:

Variable choice and data sources

Factor	Variable	Source
Growth differential	SA growth	Stats SA
	G7 growth	International Financial Statistics (IMF)
Productivity	Gross Value Added (manufacturing and total for South Africa)	Stats SA
	Gross Value Added (manufacturing and total for trade partners)	OECD
	Employment (manufacturing and total for South Africa)	Stats SA
	Employment (manufacturing and total for trade partners)	OECD
Government consumption	Government Consumption	South African Reserve Bank (SARB)
	Nominal GDP	Stats SA
Interest Rate Differential	Interest rate on government bills>10years (South Africa)	SARB
	Interest rate on government bills>10years (US)	Bloomberg
	South African Repo Rate	SARB
	US Fed Rate	Bloomberg
The share of manufacturing in the economy	Gross value of the manufacturing sector to total gross value added	Stats SA
Relative unit labour cost	Total labour cost for the manufacturing sector (SA)	Stats SA
Relative unit labour cost	Total labour cost for the manufacturing sector (trade partners)	OECD
	GVA (SA manufacturing)	Stats SA
	GVA (trade partners manufacturing)	OECD
Manufacturing Exchange Rate	ICOP PPP	ICOP industry Database, 2000 at www.eco.rug.nl/GGDC/icop.html and van Dijk (2002).
	Manufacturing Deflator (SA)	Stats SA
	Manufacturing Deflator (Trade Partners)	OECD
Openness	trade data on manufacturing export, imports, total exports	Quantec

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