THE EXCHANGE RATE, DUTCH DISEASE AND MANUFACTURING IN SOUTH AFRICA: WHAT DO THE DATA SAY?

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The Dutch disease argument suggests that "overvaluation" of the exchange rate due to large sustained increases in commodity prices harms manufacturing, even though domestic growth as a whole benefits led by the booming natural resources sector of the economy. The relationship between the real exchange and manufacturing is studied here with regard to South Africa as a commodity export-led economy. Rather than try to determine whether the exchange rate is "overvalued" or "undervalued" against some theoretical benchmark or criteria, this study uses an Engel-Granger cointegration approach to "let the data speak". Using annual data for the sample period 1980–2010 the main findings are: changes in the real exchange rate have no significant effect on manufacturing in South Africa; world growth drives the exchange rate, the commodity cycle and domestic manufacturing strongly in the same direction; there is no evidence of a Dutch disease effect, on the contrary upswings in commodity prices are associated with increases in domestic manufacturing; the large increases in unit labour costs since the early 1980s have dragged down manufacturing in South Africa over the long run.

JEL: E20, E31, F43, O55

1. INTRODUCTION

Various economists have argued that periodic episodes of "overvaluation" of the currency of a commodity exporting country during upswings in the commodity cycle harm domestic manufacturing such that it lags the booming natural resources sector of the economy. This is the familiar Dutch disease effect on domestic manufacturing (see Corden 1984 and Corden and Neary 1982 for early studies thereof).

The main mechanism hypothesized in this regard is the relative price effect. The increase in the relative price of domestic compared to foreign manufactured goods following an increase in the real exchange rate implies an erosion of the competitiveness and profitability of domestic manufacturing. Foreign demand for manufactured exports declines whereas domestic demand for foreign manufactured goods increases resulting in greater import penetration. Hence sustained increases (appreciation) in the real exchange rate are argued to drag down domestic manufacturing output. Such periods of "overvaluation" of the currency are often also argued to be an avoidable constraint on manufacturing

with various forms of intervention by the authorities to lower the value of the currency being suggested accordingly (for example, a Tobin tax on speculative capital inflows). As a significant producer and exporter of metals and minerals related commodities, it has been argued that South Africa is periodically afflicted by an "overvalued" currency and shows signs of the Dutch disease syndrome with regard to domestic manufacturing. Various recommendations have been made to try to deal with what is seen as an avoidable constraint on the economy (see, for example, Rodrik 2008; 2009).

This study takes a somewhat different approach in examining the relationship between the exchange rate, commodity prices and manufacturing in South Africa without trying to determine whether or not the currency is theoretically "overvalued" or "undervalued" over time. Instead, standard Engel-Granger cointegration and estimation techniques are used to "let the data speak". The econometric analysis examines the relationship between manufacturing in South Africa and the real exchange rate, world growth, unit labour costs, real money supply and a metals commodity price index using annual data for the sample period 1980-2010. The main finding is that world growth and unit labour costs determine the level of manufacturing over the long run, with the metals' price and world growth also significant in the short-run error correction model. The real exchange rate did not add any significant explanatory value to the model. This is because world growth tends to drive domestic growth (including manufacturing), commodity prices and the exchange rate in the same direction. Hence any negative relative price effect on manufacturing in South Africa via increases in the real exchange rate tends to be offset by the positive world growth effect.

The paper is organized as follows. Section 2 motivates the selection of the main variables and data for further investigation and describes some of their basic time series trends and relationships. Section 3 sets out the more formal Engel-Granger cointegration model and estimation results. Section 4 interprets and explains the possible limitations of the findings. Section 5 concludes.

2. SELECTION OF VARIABLES AND DESCRIPTION OF THE DATA

The main item of interest in this study is the empirical relationship between domestic manufacturing and the South African rand exchange rate over the annual sample period 1980 – 2010. Before examining this relationship in the context of a better specified cointegration model including additional explanatory variables, it is helpful to look briefly at the simple bivariate relationship between them. The data for the manufacturing variable (MAN) is manufacturing gross value added (R millions, constant 2005 prices). The exchange rate variable is the real effective exchange rate (REER) index (2000=100).

Changes in the nominal exchange rate affect relative prices and thus the competitiveness of manufacturing only if they are not offset by corresponding changes in inflation rates: thus depreciation of the currency should have no effect on the competitiveness of domestic manufacturing if prices rise over the period by the same amount as the depreciation. Hence, the best exchange rate indicator for the competitiveness of manufactured goods is the real effective exchange rate: an increase or real appreciation indicating a decline in competitiveness and a decrease or real depreciation indicating greater competitiveness of manufactured goods accordingly. Both the MAN and REER time series data were sourced from the South African Reserve Bank (SARB) Quarterly Bulletins using the Time-Series Explorer package.

The manufacturing sector in South Africa has tended to decline steadily relative to the economy as a whole since the early 1980s while the volatile real exchange rate has also declined erratically over the same period, as shown in the diagram below:

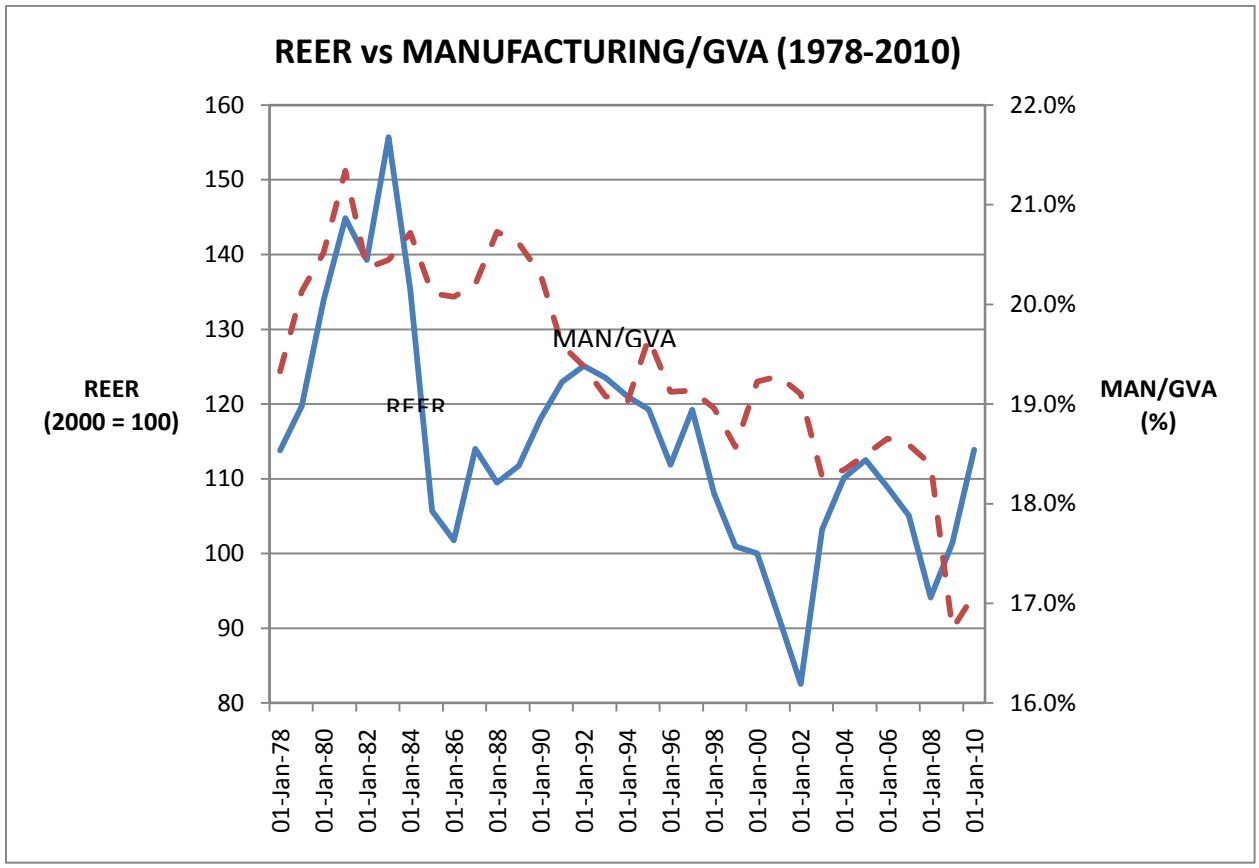

Figure 1: The real effective exchange rate of the rand (2000=100) and manufacturing as a proportion of gross value added, annual data (1978-2010)

The diagram shows that manufacturing as a proportion of gross value added (MAN/GVA) has declined from a peak of 21.3 percent in 1981, to 17.1 percent in 2010. Over the same period, the real effective exchange rate of the rand (REER) has also declined, from an index value of 144.9 to 113.9 respectively, a decrease of 21.4 percent. These broad trends do not support the idea that a weaker currency has provided any sustainable boost to manufacturing over the longer term. If anything, the trend of a weaker currency in real terms has been associated with a declining contribution of manufacturing to the economy over this period.

However, closer inspection of the diagram shows that the trend declines in both MAN/GVA and REER have been interrupted by periodic increases. Thus certain sub-periods show that sharp declines in REER are associated with increases in MAN/GVA and vice versa. For example, between 1999 and 2002, REER declined by 18.2 percent whereas MAN/GVA increased by 0.5 of a percentage point (from 18.6 to 19.1 percent). More recently, from 2008 to 2010, REER rose by 21 percent whereas MAN/GVA fell by 1.3 percentage points (from 18.4 to 17.1 percent). These counter-examples to the general longer-term trend provide some support for the idea that in the short run, a weakening currency (in real terms) may help boost the manufacturing sector at least temporarily whereas a strengthening currency has the opposite effect. This is investigated further below by focusing on the short run relationship between manufacturing and the real exchange rate. Taking first differences of the logs of the variables (denoted by D(LMAN) and D(LREER) respectively) and running a simple bivariate regression with D(LMAN) set as the dependent variable yields the following estimation results and graph of the actual and fitted values (all estimations and outputs were calculated using the EViews 7 econometrics package):

Dependent Variable: D(LMAN)
Method: Least Squares
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.015953	0.008304	1.921244	0.0649
D(LREER)	-0.039746	0.090533	-0.439018	0.6640

R-squared	0.006836	Mean dependent var	0.016168
Adjusted R-squared	-0.028634	S.D. dependent var	0.044766
S.E. of regression	0.045402	Akaike info criterion	-3.282186
Sum squared resid	0.057717	Schwarz criterion	-3.188772
Log likelihood	51.23278	Hannan-Quinn criter.	-3.252302
F-statistic	0.192737	Durbin-Watson stat	1.892729
Prob(F-statistic)	0.664018		

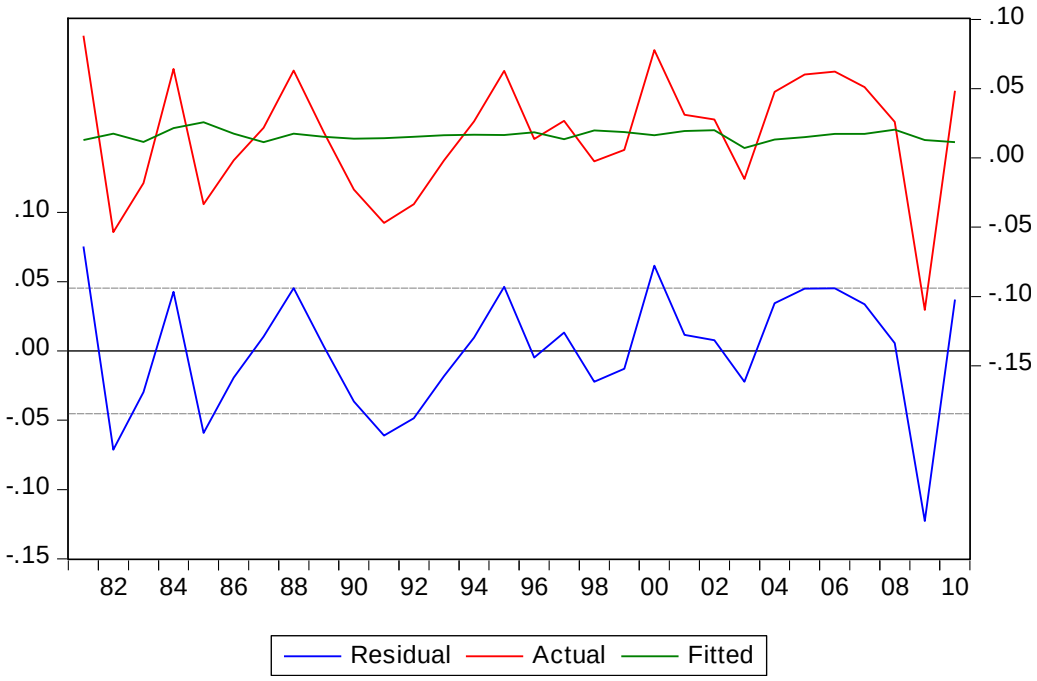

Figure 2: Graph of the actual and fitted values and residuals of the regression estimates of DLREER on DLMAN, 1980-2010.

Figure 2 suggests that changes in the real exchange rate D(LREER) have very little explanatory value as regards changes in domestic manufacturing D(LMAN). This is confirmed by the estimation results of the regression above. The negative coefficient on D(LREER) is correctly signed but statistically completely insignificant, with both the coefficient and the R-squared values very close to zero. Clearly there is little evidence here that a lower exchange rate helps manufacturing or that a higher exchange rate harms it in the short run, if we take annual data as indicative of short run adjustments.

However, a common problem with taking first differences of the variables is that one loses any potential long-run relationship between them. The change in the *level* of the exchange rate over the long run is perhaps a better indicator of more enduring currency strength or weakness. The adjustment of manufacturing may thus be more responsive to changes in the level of the exchange rate over the long run than in the short run. A better specified model with additional explanatory variables may reveal an underlying relationship between the exchange rate and manufacturing that the simple bivariate

regression in first differences fails to uncover. For the purposes of this study, an Engel-Granger cointegration model seems appropriate. The model is developed further in section 3. Before doing so, however, the theoretical motivation for the inclusion of additional explanatory variables is explained and the relevant data described.

South Africa is a small, open, export led economy being a significant producer and exporter of primary commodities, mainly minerals and metals. As such, domestic growth is heavily dependent on world growth. When world growth increases, the foreign demand for exports (including manufactured goods) increases. Moreover, expansion in world growth generally also leads to, or coincides with, an upswing in the commodity cycle (in both price and volume terms). Thus during expansionary phases in world growth, net exports increase sharply thereby directly injecting large inflows of spending into the domestic economy. The foreign trade multiplier further increases domestic demand, spending and income leading to increases in national output which are a multiple of the initial injection of the increase in net exports. Thus increases in world growth increase the demand for domestic manufactured goods both directly (from increased exports thereof) and indirectly (via the multiplier effect on domestic growth). Again taking first differences of the logs of the two variables, the significance of world growth D(LWGDP) for domestic manufacturing D(LMAN) is clearly evident in the bivariate regression results and graph of the actual, fitted and residual values in Figure 3 below:

Dependent Variable: D(LMAN)
Method: Least Squares
Sample (adjusted): 1981 2010
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.047332	0.014293	-3.311582	0.0026
D(LWGDP)	2.250656	0.458202	4.911932	0.0000

R-squared	0.462851	Mean dependent var	0.016168
Adjusted R-squared	0.443667	S.D. dependent var	0.044766
S.E. of regression	0.033390	Akaike info criterion	-3.896806
Sum squared resid	0.031216	Schwarz criterion	-3.803393
Log likelihood	60.45209	Hannan-Quinn criter.	-3.866922
F-statistic	24.12707	Durbin-Watson stat	1.381512
Prob(F-statistic)	0.000035		

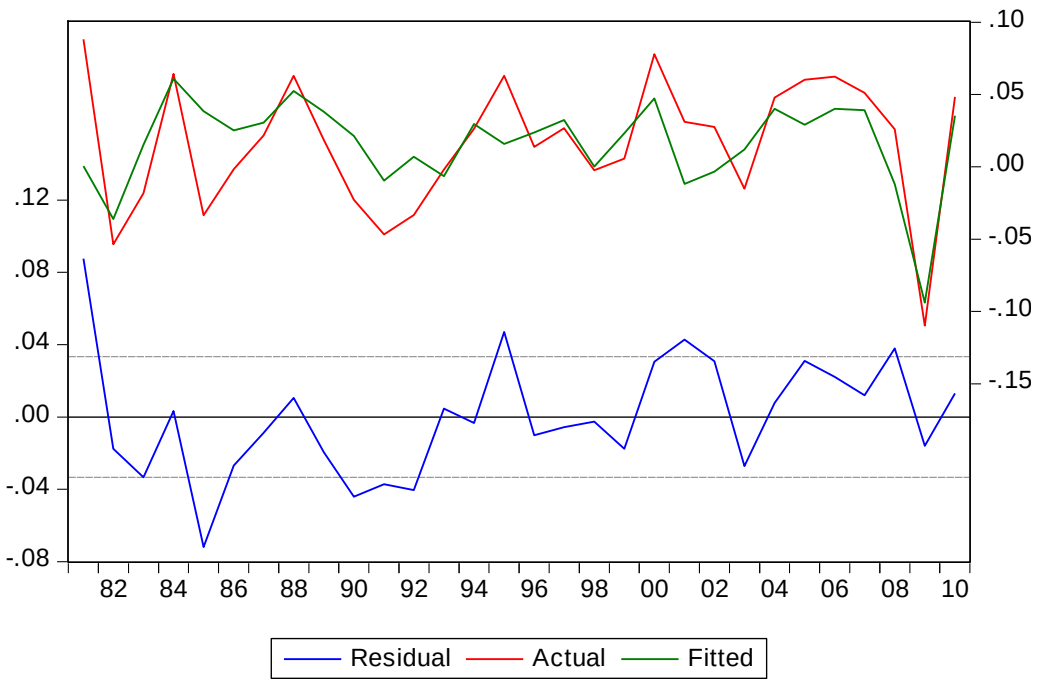

Figure 3: Residuals plot of the world growth D(LWGDP) on manufacturing D(LMAN) regression

Unlike the results of the previous regression of the real exchange rate, the world growth term is highly significant and by itself explains a large proportion of the variance in domestic manufacturing as suggested by the adjusted R-squared of 0.44 and the much better visual goodness-of-fit of the model's predicted values with the actual manufacturing values.

These results strongly suggest the inclusion of a world growth term and possibly also a relevant indicator of commodity prices in the more comprehensive cointegration model to be explained further in Section 3. An index (1980=100) of world real gross domestic product (WGDP) was constructed from annual world growth data (at market exchange rates) provided by the IMF World Economic Outlook tables. The (2005=100) world commodity metals price index (CPIMET) was selected as the best proxy for South Africa as a primarily metals and minerals exporter, also sourced from the IMF World Economic Outlook tables.

Both world growth and the metals' price index may be viewed as exogenous foreign determinants of domestic manufacturing. Two potential candidates stand out as important internal determinants thereof. A broad measure of the real money supply captures the effect of both domestic credit extension and a possible wealth effect on aggregate demand via increases in financial asset prices. The M3 monetary aggregate deflated by the headline consumer price index was selected as the best proxy in

this regard. The nominal M3 data was sourced from the SARB Quarterly Bulletin while the long run consumer price index (2000=100) series was sourced from Statistics South Africa. On the supply side, changes in unit labour costs have a significant effect on the competitiveness and profitability of the industry and thus on manufacturing production over the longer term. Increases in unit labour costs tend to lower the profitability of manufacturing and thus lead to lower growth in this sector than would otherwise be the case. While real wages could also be used as an indicator of changes in the competitiveness of manufacturing, unit labour cost is a better measure thereof since it adjusts earnings per worker for changes in productivity: changes in earnings per worker leave the competitiveness of manufacturing unaffected if they are matched by equivalent changes in labour productivity (output per worker). Manufacturing unit labour costs rose almost uninterruptedly in South Africa over the 1980–2010 sample period. The manufacturing unit labour cost index (2000=100) was also sourced from the SARB Quarterly Bulletin.

3. ENGEL-GRANGER COINTEGRATION AND ERROR CORRECTION MODEL

The list of variables from the motivation given in Section 2 is:

DEPENDENT VARIABLE

MAN	Manufacturing (R millions, constant 2005 prices)

INDEPENDENT VARIABLES

REER	Real effective exchange rate index (2000=100)
WGDP	World GDP (at market exchange rates) index (1980=100)
CPIMET	World commodities metals price index (2005=100)
M3REAL	Nominal M3 monetary aggregate deflated by headline consumer price index (2000=100)

After log transformations (to allow for an elasticity interpretation of the coefficient estimates), all the variables were first tested for unit roots using the Augmented Dickey-Fuller (ADF) test. All the variables were found to be I(1) and thus stationary in first differences at the 5% level of significance or better.

3.1. Long-run equilibrium equation (LRE)

The choice of variables from the above list to include in the LRE was a matter of both theoretical and empirical considerations. First, there are good reasons for regarding world growth as a truly exogenous

independent variable: there is no basis in economic theory to think that manufacturing in a small, open, export led economy like South Africa would have any significant influence on world growth or that domestic growth would tend to precede world growth. The choice of LWGDP as the primary explanatory variable in the LRE then conditions the choice of the other variables to some extent. In particular, there is a high degree of co-linearity between world growth and domestic real money supply (a regression of LWGDP on LM3REAL yields a significant coefficient estimate of 1.53 and an adjusted R-squared of 0.82). Although some degree of co-linearity between the explanatory variables is not necessarily problematic (for example, if the main aim of the model is to make forecasts rather than to give a good economic explanation of the dependent variable) it is preferable to limit this if at all possible. The case against including LM3REAL in the LRE is further supported by the results of a simple Granger causality test on the two variables: for a one period lag, the null hypothesis that LWGDP does not cause LM3REAL can be rejected at the 10% level of significance whereas the null hypothesis that LM3REAL does not cause LWGDP cannot be rejected. With these considerations in mind it was decided not to include LM3REAL in the LRE but rather to give it a chance to "prove itself" in the short run error correction model.

There are good reasons for including manufacturing unit labour costs (LMANULC) as a longer-term determinant of manufacturing. Increases in unit labour costs erode the competitiveness and profitability of manufacturing which thus tends to drag down manufacturing growth over the longer term. As noted in Section 2, unit labour costs in South African manufacturing have increased steadily, rising nearly fifteen-fold over the sample period. Changes in demand may obscure the drag effect of increasing unit labour costs in the short run, but over the long run it would be surprising if manufacturing output remained unaffected by such large increases in unit labour costs. A further consideration is that, unlike the case with LM3REAL, the Granger causality test was unable to reject the null hypothesis that LWGDP does not cause LMANULC.

Both the real exchange rate and the metals' price index are considerably more volatile than either the world growth or unit labour cost terms. The standard deviations of their first differences (in parentheses) are: D(LREER) [0.093]; D(LCPIMET) [0.201]; D(LWGDP) [0.014]; and D(LMANULC) [0.070]. For this reason it makes sense to include the real exchange rate and the metals' price index in the short-run ECM rather than the LRE.

Thus from the above list of variables, the best fit long-run equilibrium equation resulting in the desired stationarity of the residuals was found to be:

LMAN = c + aLWGDP + bLMANULC + e

The remaining variables (LREER, LM3REAL AND LCPIMET) were included in the error correction model for their possible short run dynamics in Section 3.2. The estimation results for the LRE are set out below:

Dependent Variable: LMAN
Method: Ordinary Least Squares
Sample (adjusted): 1980 2010
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.073309	0.345338	17.58657	0.0000
LWGDP	1.489462	0.093039	16.00908	0.0000
LMANULC	-0.322659	0.031385	-10.28058	0.0000

R-squared	0.963112	Mean dependent var	12.25803
Adjusted R-squared	0.960477	S.D. dependent var	0.165681
S.E. of regression	0.032938	Akaike info criterion	-3.896619
Sum squared resid	0.030377	Schwarz criterion	-3.757846
Log likelihood	63.39759	Hannan-Quinn criter.	-3.851382
F-statistic	365.5263	Durbin-Watson stat	1.176864
Prob(F-statistic)	0.000000		

The positive sign on LWGDP and the negative sign on LMANULC are as expected and the sizes of the coefficients appear justifiable economically. The Engel-Granger cointegration test using the McKinnon critical values for n=3 and T=31 suggested that the null hypothesis of non-stationarity could be rejected at the 5% level of significance for both the constant, no trend model (ADF t-stat -4.5142 < -4.0263 critical value) and the constant, plus trend model (ADF t-stat -4.5354 < -4.5209 critical value). It can thus be concluded that the variables in the LRE are cointegrated.

3.2 The short-run error correction model (ECM)

All the variables plus their one-period lags (deemed sufficient for annual data) were included in the initial ECM set-up in first difference form to prove themselves after stepwise regressions to eliminate insignificant estimates. The starting ECM, including the one-period lag on the residuals RES_MAN(-1) generated by the LRE was as follows:

Dependent Variable: D(LMAN)
Method: Least Squares
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008445	0.016508	0.511568	0.6155
D(LREER)	-0.064048	0.042985	-1.490001	0.1545
D(LWGDP)	1.156103	0.331971	3.482545	0.0028
D(LM3REAL)	-0.043498	0.118903	-0.365828	0.7190
D(LMANULC)	-0.053101	0.060413	-0.878971	0.3917
D(LCPIMET)	0.048910	0.029356	1.666083	0.1140
D(LREER(-1))	0.059087	0.045518	1.298089	0.2116
D(LWGDP(-1))	-0.713338	0.413174	-1.726481	0.1024
D(LM3REAL(-1))	0.047326	0.093067	0.508517	0.6176
D(LMANULC(-1))	-0.054413	0.077980	-0.697787	0.4947
D(LCPIMET(-1))	0.078794	0.030243	2.605328	0.0185
RES_MAN(-1)	-0.546605	0.187990	-2.907624	0.0098

R-squared	0.911495	Mean dependent var	0.013685
Adjusted R-squared	0.854228	S.D. dependent var	0.043405
S.E. of regression	0.016572	Akaike info criterion	-5.068703
Sum squared resid	0.004669	Schwarz criterion	-4.502925
Log likelihood	85.49619	Hannan-Quinn criter.	-4.891508
F-statistic	15.91641	Durbin-Watson stat	2.165162
Prob(F-statistic)	0.000001		

After eliminating insignificant variables via stepwise regressions, the end result ECM was:

Dependent Variable: D(LMAN)
Method: Least Squares
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.020727	0.009835	-2.107545	0.0457
D(LWGDP)	1.145114	0.340034	3.367649	0.0026*
D(LCPIMET)	0.058208	0.022750	2.558661	0.0172**
D(LCPIMET(-1))	0.066133	0.018722	3.532344	0.0017*
RES_MAN(-1)	-0.584522	0.130539	-4.477755	0.0002*

R-squared	0.845502	Mean dependent var	0.013685
Adjusted R-squared	0.819752	S.D. dependent var	0.043405
S.E. of regression	0.018428	Akaike info criterion	-4.994335

Sum squared resid	0.008150	Schwarz criterion	-4.758594
Log likelihood	77.41785	Hannan-Quinn criter.	-4.920504
F-statistic	32.83545	Durbin-Watson stat	1.869812
Prob(F-statistic)	0.000000		

*1% **5% ***10% (level of significance)

The real money supply variable D(LM3REAL) and its one period lag D(LM3REAL(-1)) were the first to be eliminated as insignificant at step 1 and step 2 of the stepwise regression process respectively. This was followed by the successive eliminations of D(LMANULC), D(LREER(-1)), D(LMANULC(-1)), D(LWGDP(-1)) and finally D(REER). (The elimination of D(LWGDP(-1)) at was decided on theoretical grounds. Although the coefficient estimate was significant at step 6 of the regression, it had a negative sign which did not make sense economically and was thus regarded as a statistical artifact rather than indicating a genuine economic relationship). The negative coefficient on the lagged residual term RES_MAN(-1) is significant at the 1 percent level and the -0.58 estimate suggests a fairly rapid re-adjustment following any shock or deviation from the long run equilibrium.

The graph of the residuals shows a tight fit of the ECM predicted values to the actual values of the dependent variable D(LMAN), in keeping with the high adjusted R-squared of 0.82. The explanatory value (as against the pure forecasting value) of the model is strengthened by the fact that no lagged terms of the dependent variable were included in the ECM.

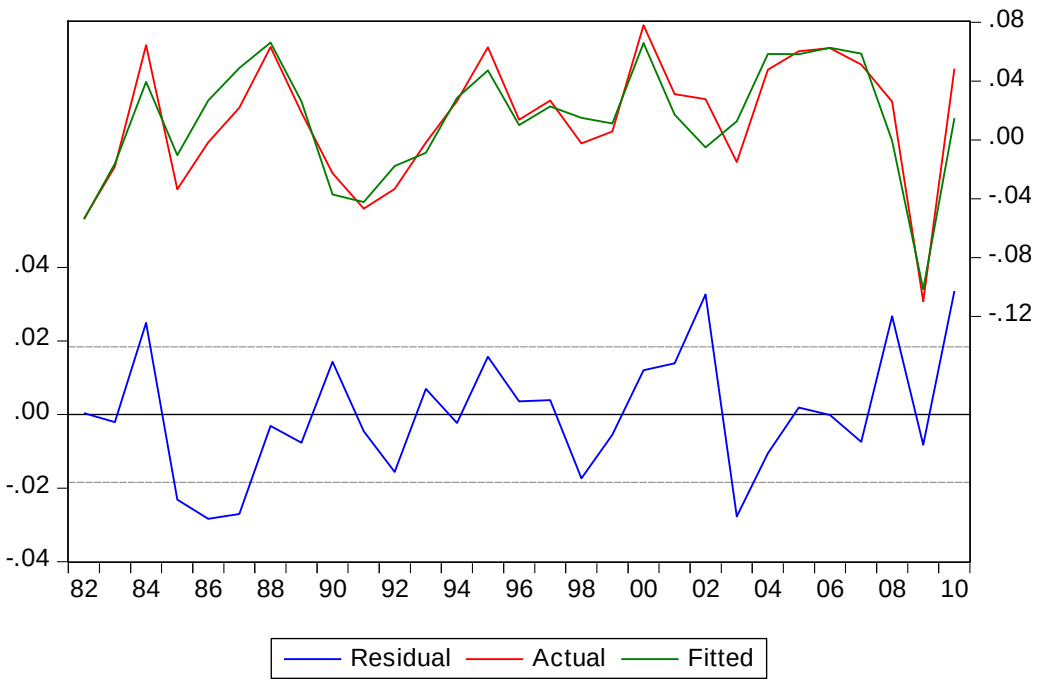

Figure 4: Residuals plot of the error correction model

The visual goodness-of-fit of the ECM is further supported by the various diagnostic tests for the normality of the residuals, the presence of autocorrelation, heteroscedasticity and parameter instability as set out in the table below:

TEST	**Ho**	**TEST STATISTIC**	**p-value**	**CONCLUSION**
Jarque-Bera	Normality of Residuals	JB = 0.557	0.7567	Accept Ho
Ljung-Box Q	No autocorrelation	$LB_Q = 4.50$	0.609	Accept Ho
Breusch-Godfrey LM	No autocorrelation	$nR^2 = 0.099$	0.9517	Accept Ho
ARCH-LM	No heteroscedasticity	$nR^2 = 1.454$	0.2279	Accept Ho
White	No heteroscedasticity	$nR^2 = 11.899$	0.6144	Accept Ho
Ramsey RESET	No parameter Instability	LR = 0.488	0.4850	Accept Ho
				Reject Ho if p-value < 0.05

3.3 The combined model

Combining both the LRE and the ECM and providing the anti-log solutions to the model yields the in-sample baseline values for manufacturing (MAN, R millions, constant 2005 prices) for the period 1982–2010 as shown in the graph below:

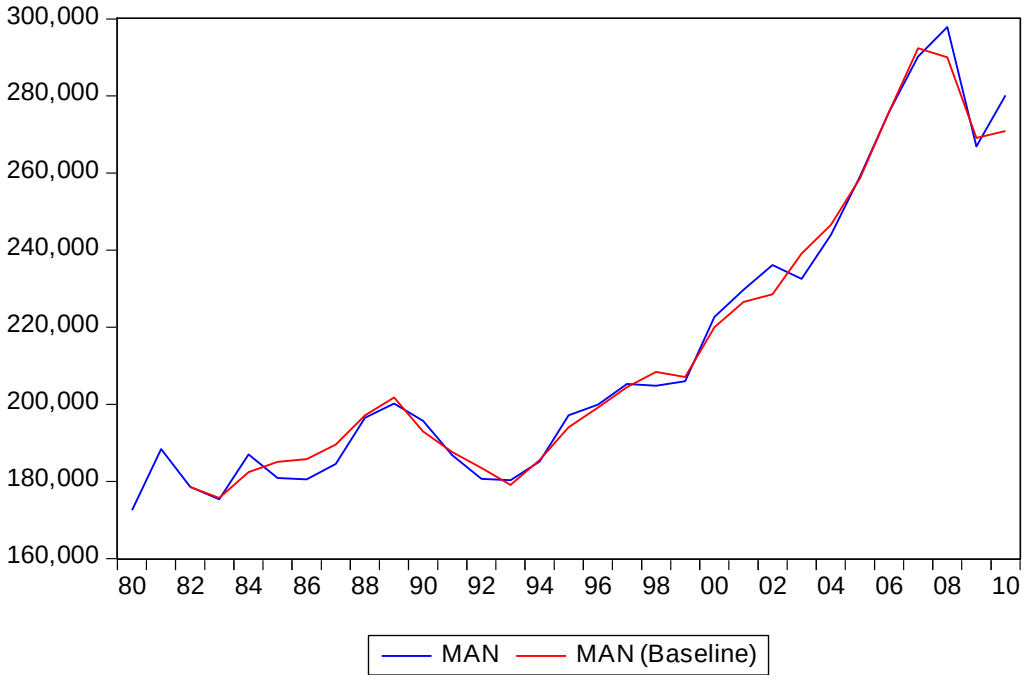

Figure 5: Combined model actual and fitted values for manufacturing (R millions, constant 2005 prices)

For the period as a whole there is a very good fit between the actual manufacturing data and the model predicted values – which is to be expected given the sizes of the coefficients in the LRE, the high adjusted R-squared of the ECM as well as the size of the speed of adjustment coefficient on the lagged residuals term in the ECM. The main anomalies are the mid-1980s (where the model overestimates manufacturing output) and the early 2000s (where the model underestimates manufacturing output). A gap also appears to be opening up over the last couple of years of the sample where the model again underestimates manufacturing. All three periods were marked by financial crises in South Africa as explained further in Section 4 below.

4. ECONOMIC INTERPRETATION AND LIMITATIONS OF THE MODEL

World growth was found to be the single most important factor influencing manufacturing in South Africa, in both the long-run equilibrium and short-run error correction model with a positive coefficient estimate of 1.49 and 1.15 respectively. The estimation results of the model thus provide strong support for the hypothesis that it is world growth rather than changes in the real exchange rate that determines domestic manufacturing. In other words, the growth effect completely dominates any measurable relative price effect on domestic manufacturing. The negative coefficient of -0.32 on the unit labour cost variable in the long-run equilibrium model suggests that increases in such costs drag manufacturing down over the longer term. The continual rise in unit labour costs in South Africa since the early 1980s was the net result both of declines in labour productivity and increases in earnings per worker over the sample period. With reforms to apartheid labour legislation in the late 1970s and 1980s, the unions were able to engage more effectively in strike action and to negotiate higher real wages for their members. The size and power of the unions grew further after the historic democratic election of the ANC government in 1994. While workers may have benefitted in this regard, the accompanying increases in real wages without matching increases in productivity resulted in higher unit labour costs and declining competitiveness of manufacturing in South Africa over the period.

The sum of the positive coefficients on the metals' price index and its lag of 0.12, although small compared to the 1.14 coefficient on the world growth index, suggests that there is little evidence of a Dutch disease effect on South African manufacturing. As noted in the introduction, Dutch disease indicates the presence of booming and lagging sectors in the economy. In the context of South Africa as primarily a metals and minerals export led economy, this implies that upswings in the commodity cycle are associated with expansion in the mining sector at the expense of appreciation in the real exchange rate and contraction in the manufacturing sector. The contraction in manufacturing may either be temporary or prolonged depending on the extent and duration of the commodity upswings and the discovery or development of new natural resources. Many studies suggest that the beneficial effects of upswings in the commodity cycle on the domestic economy more than compensate for the contraction experienced in the manufacturing sector. The results of this study, however, suggest an even stronger conclusion: far from contracting, growth in the manufacturing sector in South Africa is positively correlated with the commodity cycle (thus upswings in the cycle are associated with expansion in manufacturing and downswings with contractions). This suggests that the meaning of "booming" and "lagging" sectors, at least in the South African context, may need to be refined in terms of *relative*

growth: upswings in the commodity cycle are associated with some sectors (manufacturing) *growing more slowly* than others (mining). This revised relationship is consistent with the declining contribution of manufacturing to national output (measured as gross value added) portrayed earlier in Figure 1.

Two limitations of the present study arise at this point. These concern the level of aggregation of manufacturing and the dynamics of the interactions between the variables. First, although changes in the real exchange rate were not found to have any significant effect on domestic manufacturing in aggregate, there may be important effects at a more disaggregated level of analysis which are ignored by the model. For example, manufacturing may be divided into goods that are exported and those that are consumed domestically. It may be the case that manufactured exports are more sensitive to changes in the real exchange rate than are such goods consumed domestically. Thus increases in world growth and currency appreciation may affect manufacturing exports negatively even though the model predicts that manufacturing as a whole will increase (implying that the net positive growth effect on manufacturing for domestic consumption outweighs the net negative relative price effect on manufactured exports). This is more likely to be the case the greater are any tariff and non-tariff barriers to imports. At a finer level of disaggregation, it may also be the case that certain manufacturing industries are more sensitive to changes in the real exchange rate than others. For example, the clothing industry may be more sensitive than the steel industry. These more disaggregated effects are beyond the scope of this study and could thus be an issue for further research in this area.

Second, some interesting dynamics may have been obscured by the use of annual time series data rather than, say, quarterly data. Quarterly data are readily available for all the variables except the world growth index. For this reason it was decided to stick with the annual data. Using the models to estimate the same variables using quarterly data with many lags may reveal the presence of a significant negative relationship between the real exchange rate and manufacturing within these shorter time intervals. Again, this could be the subject of further research in this area.

As noted in Section 3.3, in the combined model there are three periods where the actual and fitted values deviate from each other to a greater degree than the average for the sample period as a whole. It is helpful to try to explain these anomalies in terms of the different kinds of financial crises that the South African economy experienced at these times.

In the mid-1980s, the turbulent political situation in South Africa intensified and helped precipitate the country's foreign debt crisis. Then President PW Botha's defiant "Rubicon" speech in July 1985 unnerved

foreign investors who had been expecting a more conciliatory speech promising further reforms to the apartheid regime. It served as a trigger for some of the major foreign banks who refused to rollover the country's maturing debt obligations. The ensuing liquidity crunch in the foreign exchange markets led to an unprecedented massive depreciation of the domestic currency, followed by sharp hikes in interest rates by the central bank to contain the inflationary consequences thereof. Domestic economic growth, including manufacturing, stalled as a result (notwithstanding the substantial real depreciation of the currency). At the same time, world growth was still chugging ahead while metals prices remained subdued with inflation well under control in the major industrialized countries. These events thus help to explain the overestimation of manufacturing by the model over this period.

The early 2000s presented a somewhat different sequence of events and outcome. In 2001 and 2002 world growth slowed significantly below its trend following the bursting of the technology bubble and the sharp decline in equity prices as investors re-priced riskier financial assets. Metals prices also declined over this period. South Africa was not unaffected by the slowdown in world growth and the decline in metals prices. However domestic growth, including manufacturing, performed relatively well by comparison. In this case the main reason for manufacturing exceeding the model estimates was probably the temporary protection afforded by the sharp depreciation of the currency that peaked dramatically with the well-documented speculative pressure against the Rand in December 2001 (on average, the REER declined by 17 percent over the two year period). This illustrates one of the rare times that a depreciating Rand may have helped South African manufacturing by shielding it from adverse foreign shocks.

Over the most recent 2009–2010 period, the model also underestimates domestic manufacturing. Again, while South Africa was seriously affected by the preceding global financial crisis, it has fared relatively well compared to the major industrialized economies. Although South Africa had its own problems with excessive credit extension by local banks during the boom years preceding the financial crisis, these excesses were a far cry from the rampant debt creation and mispricing of risk by many of the foreign banks and other foreign lending institutions. Domestic economic growth, including manufacturing, has rebounded relatively strongly from the recession compared to the major industrialized economies. It remains to be seen whether the relative outperformance of the South African manufacturing will continue and the gap with the model's in-sample predictions widens or narrows.

5. CONCLUSIONS

As explained in the introduction, this study takes a different approach to examining the relationship between the exchange rate and manufacturing in South Africa. Instead of deciding whether the exchange rate is "overvalued" or "undervalued" relative to some theoretical or preconceived benchmark, an Engel-Granger cointegration technique was used to "let the data speak" in estimating the empirical relationships between the variables in a defensible model thereof. Using annual data for the sample period 1980-20101, the main findings and implications of this analysis are:

i) There is no empirically significant relationship between the real exchange rate and manufacturing in South Africa.

ii) World growth is the single most important determinant of domestic manufacturing. Changes in world growth drive South Africa's real exchange rate, commodity prices and domestic manufacturing strongly in the same direction.

iii) There is no evidence of a negative Dutch disease effect on manufacturing in South Africa. Upswings in the commodity cycle are associated with increases, not decreases, in domestic manufacturing. Thus, the positive world growth effect more than compensates for any negative relative price effect on manufacturing resulting from currency appreciation during these episodes.

iv) Large increases in manufacturing unit labour costs in South Africa have dragged down manufacturing over the long run. The large increases in unit labour costs are argued to be the result of the increased size and power of the trade unions since the early 1980s and their success in negotiating higher real wages for workers without any commensurate increase in labour productivity.

Two basic limitations of the model are the level of aggregation of manufacturing and the possible dynamics imposed by annual data. Disaggregating manufacturing into exports and domestic consumption or an even finer industrial classification may reveal a negative relationship with the real exchange rate at these levels. Also, a shorter time interval and a richer lag structure using, say, quarterly data may reveal a negative relationship between the real exchange rate and manufacturing which is obscured by the annual data used in this study. These may be useful avenues for further research in this area.

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