Exchange Rate Undervaluation and Sectoral Performance of the South African Economy

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Abstract

The paper uncovers the channels through which real exchange rate undervaluation influences the performance of the South African economy. We decompose the South African economy into three sectors, namely: agriculture, industry, and service. Using the OLS (with Newey-West and robust standard errors), and GMM estimation techniques; an annual time series data covering the period 1962-2014; and a standard regression model for each sector, we find: (i) real exchange rate undervaluation to exert positive impact on economic performance by enhancing agricultural sector, and industrial sector performance; (ii) real exchange rate undervaluation to exert a negative impact on economic performance by reducing the performance of the service sector.

JEL Classification: C10, F21, F31

Keywords: Exchange Rate Undervaluation, Sectoral Performance, South Africa

1. Introduction

The exchange rate has remained one of the most widely discussed macroeconomic variables throughout the world. The main concern is clear, as most theoretical and empirical studies show – a poorly managed exchange rate could prove disastrous for the growth prospects of an economy. To this end, some cross-country studies have emphasized the need to avoid overvalued currencies (see, for instance, Razin and Collins 1997; Johnson *et al.* 2007; Rajan and Subramanian 2007). The main argument advanced by these studies is that an overvalued currency could destabilize an economy through shortages of foreign currency, unsustainably current account deficits, balance-of-payment crises, corruption, rent-seeking activities, among others (see Fischer 1993; Rodrik 2008).

Overvaluation is the aspect of exchange rate misalignment that has been found undesirable for economic growth in most empirical studies. Real misalignment of exchange rates in the form of undervaluation (albeit moderate undervaluation), however, has been found to be desirable for economic growth. Indeed, some empirical studies have found undervaluation to stimulate growth (see Bhalla 2007; Gala 2008; Gluzmann *et al.* 2007; Rodrik 2008). There is even empirical evidence which shows that most Eastern Asian countries, notably, Japan, South Korea, Taiwan, Hong Kong, Singapore, and China have used undervalued currencies to their advantage (see Dollar 1992).

While the growth-effect of real exchange rate undervaluation has been well-established in the literature, the channel through which this occurs is actively being explored (see Wang and Barret 2007; Rodrik 2008). Our objective, in this paper, is to account for the channels through which real exchange rate undervaluation affects the performance of the South African economy. This is important because exchange rate policies aimed at stimulating sectoral performance will be better implemented if the policymaker has a clear knowledge of how each sector reacts to such policies. More so, the South African rand has depreciated rapidly in recent years. Hence, this paper serves to uncover the sectors which responded favourably (unfavourably) to this depreciation. We consider three main sectors of the South African economy, namely: agriculture, industry, and services. Then, we estimate the impact of real exchange rate undervaluation on each of these sectors. To the best of our knowledge, this paper is the first to explore the impact of real exchange rate undervaluation on the performance of the South African economy.

Following standard approaches in the literature, we fit a standard regression model for each sector. To estimate these regression models, we use the Ordinary Least Squares (OLS), and the Generalized Method of Moments (GMM) estimators. We define real exchange rate undervaluation in a fashion similar to Rodrik (2008), so that a positive coefficient of this term implies overvaluation mars sectoral performance, and vice versa. Our measure of real exchange rate undervaluation differs from Rodrik's (2008) measure in that we construct this measure using a quantile regression estimator whereas Rodrik (2008) uses the within-effects estimator. We also construct an alternative measure of real exchange rate undervaluation by extracting the cyclical component of the real exchange rate index to analyze the sensitivity of the results to our measure of undervaluation. This new measure is constructed using the Hodrick-Prescott filter. Our interpretation of this alternative measure of real exchange rate undervaluation is the same as the first. This is another direction in which our paper varies from previous studies.

We establish two important results in this paper. First, real exchange rate undervaluation exerts positive impact on the performance of the South African economy by enhancing agricultural, and industrial sector performance. Second, real exchange rate undervaluation exerts a negative impact on the performance of the South African economy by reducing the performance of the service sector. We emphasize, here, that our results remain robust to serial correlation of the errors, heteroskedasticity of the variance, endogeneity, variable omission, and the measure of real exchange undervaluation used in this paper.

In the next section, we present our methodology and the data. In Section 3, we present and discuss our results. We provide our concluding remarks in the last section.

2. Methodology

2.1 Baseline Regression

The core objective of this paper is to investigate the channels through which real exchange rate undervaluation affects the performance of the South African economy. Defining a standard measure of real exchange rate undervaluation is, therefore, central to achieving this objective. Different measures could be found in the exchange rate literature. In this paper, however, we construct a measure of real exchange rate undervaluation which is very similar in meaning and procedure as the one presented in Rodrik (2008). Essentially, we construct this index by extracting the rand-dollar exchange rate (e_t), and the consumer price indexes for South Africa

(P_t) and the U.S. (P_t^*) from the World Bank's World Development Indicators (WDI) database.[2] Once we extract these variables, we set up the following equation:

$$lnRER_t = \ln\left(e_t \frac{P_t^*}{P_t}\right), \quad (1)$$

where t is the time window and $lnRER_t$ is the natural logarithm of real exchange rate. By interpretation, when RER is increasing, it implies that the Rand is depreciating relative to the dollar in real terms. Eichengreen and Gupta (2013) have also utilized this measure in their paper.

Nontraded goods are known to be cheaper in developing countries than in developed countries. This is the main implication of the Balassa-Samuelson-Bhagwati effect (see Balassa, 1964; Samuelson, 1964; and Bhagwati, 1984). For this reason, Rodrik (2008), Gala (2008), and Gluzmann *et al.* (2012) propose that we account for the Balassa-Samuelson-Bhagwati effect in the final measure of real exchange rate undervaluation. Hence, we proceed to fit a model which accounts for the Balassa-Samuelson-Bhagwati effect in the following fashion:

$$lnRER_t = \eta + \phi lnGDP_t + \varepsilon_t, \quad (2)$$

where η and ϕ are parameters of the model, GDP_t is real per capita GDP of South Africa divided by real per capita GDP of the U.S. at time period t, ln is the natural logarithm, and ε_t is the error term at time t.[3] The *a priori* assumption made on ϕ is that it is negative and significant. In practice, various studies have found ϕ to be negative and significant (see Gala, 2008; Rodrik, 2008; Gluzmann *et al.*, 2012; Vieira and MacDonald, 2012, for example). The main departure of our study from other studies, in the construction of this index, is the estimation technique employed to estimate (2). Gala (2008), Rodrik (2008), and Gluzmann *et al.* (2012), for instance, estimate (2) using the within-effects technique. In our case, we estimate (2) using the quantile regression technique. Our main motivation for using the quantile regression technique is to moderate the impact of outliers on the final value of ϕ. As a final step for constructing the real

[2] We compared this index to the one based on relative GDP deflators of the U.S. and South Africa but there is no significant statistical gain. Data on this other measure of real exchange rate undervaluation is available upon request.
[3] Officer (1976) argued against using absolute productivity. Hence, a measure of relative productivity is in order to resolve this issue.

exchange rate undervaluation index, we find the difference between the actual real exchange in (1) and the adjusted Balassa-Samuelson-Bhagwati rate as:

$$lnQRER_t = lnRER_t - ln\widehat{RER}_t, \tag{3}$$

where $ln\widehat{RER}_t$ denotes the predicted values of the natural logarithm of the real exchange rate in (2); and $lnQRER_t$ is the real exchange rate undervaluation index.

The alternative measure of real exchange undervaluation we use is based on filtering techniques. We decompose the real exchange rate index in (1) into trend and cyclical components and use the cyclical component as the measure of real exchange rate undervaluation. To provide a theoretically defensible cyclical component of the real exchange rate, we employ the most used filter in empirical macroeconomics, the Hodrick-Prescott (HP) filter proposed by Hodrick and Prescott (1997).[4] The cyclical component of the real exchange rate, which we derive from the HP filter, is named HPRER.

Having constructed the measure of real exchange rate undervaluation; we fit a standard regression model for each of the sectors. To conserve space, we only show the relationship between our main measure of real exchange rate undervaluation and the three sectors of the South African economy as follows:

$$SEC_{it} = \tau_0 + \tau_1 lnQRER_t + \Omega CONT_{it} + \omega_{it}, \tag{4}$$

where SEC_{it} is sector i's contribution to GDP at time t. τ and Ω are the parameters of the model; ω_{it} is the error term for sector i at time t. $CONT_{it}$ is a vector of *1xq* control variables denoting the factors that determine sectoral performance, apart from real exchange rate undervaluation. For simplicity, we assume that all sectors are influence by the same kind of factors. This assumption is necessary to keep our estimates tractable. Ω is a vector of *qx1* parameters to be estimated. Our objective parameter is τ_1, the parametric measure of the impact of changes in real

[4] This is an already known filter in the discipline. However, we present a simple description of the filter in the Technical Appendix for the interested reader. A more rigorous description could be found in the main paper, Hodrick and Prescott (1997).

exchange rate undervaluation on sectoral performance. Notice that (4) resembles the standard neoclassical regressions used in various empirical studies. The clear variation is the absence of the initial level of sectoral performance term. As control variables, we include physical capital, human capital, population growth, inflation rate, real interest rate, terms of trade, trade openness, and the size of credit from the banking sector to private sector.

2.2 Testing for Stationarity

In this paper, we examine the stationary status of the variables employed. The reason for examining the stationary properties of these variables is a stylized fact. Time series variables are known to exhibit non-mean reverting features. Such features, if uncontrolled for, result in estimates that are spurious. The standard tests for stationarity that we use are the Phillips-Perron (PP) test due to Phillips and Perron (1988), and the Dickey-Fuller Generalized Least Squares (DF-GLS) test due to Elliot *et al.* (1996).[5] These two tests are chosen because they are able to control for serial correlation when testing for unit roots.

2.3 Data and Estimation Techniques

Our data on the variables used in this paper are obtained from three sources.[6] The dataset is annual and covers the period 1962-2014. The data on human capital (HC)[7], and terms of trade (TOT) are taken from the Penn World Tables, version 7.1 compiled by Heston *et al.* (2012). TOT is calculated as the price of export divided by the price of import.[8] The data on private credit by deposit money banks and other financial institutions as a percentage of GDP (PRIVY) comes from the World Bank's Global Financial Development. The remaining variables, namely: physical capital (K) measured as gross capital formation as a percentage of GDP), population growth (POP), inflation rate (INF), trade openness (OPEN), and real interest rate (RIR) are extracted from the World Development Indicators (WDI, 2015). We define the performance of the sectors as: (i) agriculture, value added (% of GDP); (ii) industry, value added (% of GDP); and (iii) service value added (% of GDP). These variables are extracted from WDI (2015).

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[5] These are well-known stationarity tests, so we save space by not describing them here. The interested reader is referred to the references cited herein.

[6] The complete dataset is available upon request.

[7] Observations on HC are not available beyond 2010 in the sourced database. We updated it using the Barro-Lee database (see Barro and Lee, 2013) and interpolation.

[8] Observations are not available for price of export and import beyond 2010. So we updated them using the export and import value indexes obtained from WDI (2015).

We estimate (4) using the OLS estimator (with Newey-West and robust standard errors[9]), and the generalized method of moments (GMM) estimator. By using the Newey-West errors and the robust standard errors, we are able to report coefficient estimates which are robust to potential autocorrelation and heteroskedasticity in our dataset. We employ instrumental variables using the GMM estimator to cater for potential endogeneity problem in (4) which might bias the coefficient estimates.

3. Results

3.1 Results for Stationarity Tests

We begin our analysis by first constructing the real exchange undervaluation indexes discussed earlier, and examining their stationary properties.[10] Figure 1 in Appendix A shows how the two indexes compare to each other. The two indexes appear fairly close in resemblance.[11] Thus, the sensitivity analysis that we perform later is appropriate. In addition, we analyze the stationary properties of the other variables utilized in this paper. Table 1 shows the results of the stationarity tests of the variables. With the exception of the real interest rate and the two measures of exchange rate undervaluation, all the other variables are non-stationary at the conventional levels of significance.

To ensure that the non-stationary variables become stationary, we differenced them once. Table 1 also shows the results of the stationarity tests of the variables in their first differences. As the results indicate, these variables are now stationary at the conventional levels. Testing for cointegrating relationships may not be necessary since the variables have mixed order of integration.

[9] See Newey and West (1987), for these errors.

[10] We used 1000 bootstrap replications for the quantile regression based undervaluation index. The estimated regression was $lnRER_t = .794 - .627lnGDP_t$; t-statistic and p-value for the $lnGDP_t$ coefficient were -8.79 and 0.00, respectively. This indicates a strong evidence of the Balassa-Samuelson-Bhagwati effect. We set the smoothing parameter to 6.25, for the HP based undervaluation index.

[11] Note that all computations are carried out in Stata 13. The do-file is available upon request.

Table 1: Tests for Stationarity of the Variables in Levels and First Difference

Variable	DF-GLS t-statistic	Phillips-Perron Z(t)-statistic
LNAGRIC	0.603	-0.967
LNIND	-0.423	-0.176
LNSERV	-0.305	-0.387
LNK	-1.485	-1.889
LNPOP	-0.713	-1.668
LNHC	-0.375	-0.063
LNINF	-1.044	-2.908*
LNOPEN	-1.419	-1.870
LNPRIVY	0.472	-2.759*
LNTOT	-1.555	-1.982
RIR	-3.055***	-3.701***
QRER	-3.880***	-3.052**
HPRER	-7.522***	-5.143***
ΔLNAGRIC	-6.913***	-7.715***
ΔLNIND	-5.239***	-5.482***
ΔLNSERV	-4.957***	-4.950***
ΔLNK	-3.328***	-7.328***
ΔLNPOP	-3.888***	-3.804***
ΔLNHC	-2.450**	-2.649*
ΔLNINF	-6.395***	-6.882***
ΔLNOPEN	-5.048***	-6.522***
ΔLNPRIVY	-9.642***	-5.050***
ΔLNTOT	-3.631***	-5.704***

Notes:

(1) The optimal lag for DF-GLS is chosen by Minimum MAIC; the optimal lag for Phillips-Perron is based on Newey-West.
(2) LN is the natural logarithm operator.
(3) Δ is the first difference operator.
(4) *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively.

3.2 Real Exchange Rate Undervaluation and Sectoral Performance

We have no reason to worry about spurious outcomes, since all the variables are free from unit roots. Next, we present the results of the regression estimates for the agricultural sector. These results are shown in Table 2a. Panels [1] and [2] show the OLS estimates using the Newey-West errors and the robust standard errors, respectively. For this estimation technique, exchange rate undervaluation positively and significantly affects agricultural sector performance. Panel [3] reports the results obtained when we corrected for potential endogeneity using the GMM technique. For this case as well, the exchange rate undervaluation affects agricultural sector performance positively and significantly. The GMM estimate of the real exchange rate undervaluation coefficient appears smaller when compared to the OLS estimates. The potential presence of endogeneity problems in the OLS estimates may have led to the slightly overestimated impact of the real exchange rate undervaluation on agricultural sector performance. It is fair, nevertheless, to say that exchange rate affects agricultural sector performance positively, if anything at all.

Table 2a: Exchange Rate Undervaluation and Agriculture Sector Performance

∆LNAGRIC	[1] Newey-West	[2] Robust	[3] GMM
QRER	.280***	.280**	.156**
	[3.38]	[2.57]	[2.10]
∆LNK	.161	.161	.151*
	[1.30]	[1.23]	[1.74]
∆LNPOP	.270**	.270*	.118**
	[2.02]	[1.74]	[2.23]
∆LNHC	1.769**	1.769	.098
	[2.22]	[1.59]	[0.05]
∆LNINF	-.002	-.001	
	[-0.07]	[-0.05]	
∆LNOPEN	.378**	.378**	
	[2.46]	[.068]	
∆LNPRIVY	.069	0.076	.007
	[1.61]	[1.07]	[0.12]
∆LNTOT	.469**	.469**	
	[2.49]	[2.61]	
RIR	.000	.000	
	[0.17]	[0.13]	
CONSTANT	-.050***	-.050**	-.036*
	[-3.29]	[-2.58]	[-1.75]
R-squared		0.334	0.359

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

Table 2b reports the results obtained from the two estimation techniques for the industrial sector. For the two OLS cases, the coefficient of the real exchange rate undervaluation term appears positive and significant at the conventional levels of significance. The GMM technique also finds real exchange rate undervaluation to impact on the industrial sector positively and significantly at 5% level (sees Panel [3] of Table 2b). Similar to the results reported for the agricultural sector, the OLS technique reports slightly overestimated coefficients for the real exchange rate undervaluation index when compared to the GMM technique. More importantly, we can conclude that exchange rate undervaluation exerts a positive impact on the industrial sector.

Table 2b: Exchange Rate Undervaluation and Industrial Sector Performance

ΔLNIND	[1] Newey-West	[2] Robust	[3] GMM
QRER	.057**	.047**	.035**
	[2.14]	[2.16]	[2.11]
ΔLNK	.004	.004	.067*
	[0.12]	[.12]	[1.82]
ΔLNPOP	-.037	-.037	.067
	[-0.62]	[-0.57]	[0.32]
ΔLNHC	-.711***	-.711**	-.011
	[-3.12]	[-2.65]	[-0.02]
ΔLNINF	.009	.009	
	[1.33]	[1.28]	
ΔLNOPEN	.112***	.112**	
	[2.72]	[2.50]	
ΔLNPRIVY	.012	.012	.016
	[0.69]	[0.64]	[0.62]
ΔLNTOT	.012	.012	
	[0.24]	[0.25]	
RIR	-.003***	-.003***	
	[-6.01]	[-5.49]	
CONSTANT	.012**	.012**	-.008*
	[2.68]	[2.29]	[-1.63]
R-squared		0.519	.132

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

The impact of exchange rate undervaluation on service sector performance is shown in Table 2c. In Panels [1] and [2], we report the results for the OLS technique using the Newey-West and robust standard errors, respectively. The results here are quite contrasting to those reported earlier for the agricultural and industrial sectors. Real exchange rate undervaluation negatively and significantly impact on the performance of the service sector. This holds even after controlling for potential endogeneity using the GMM technique (see Panel [3] of Table 2c).

A possible explanation of these results resides in the nature of outputs produced by these sectors. The agricultural and industrial sectors of the South African economy usually produce outputs that are exportable. It means that as the rand depreciates, other factors remaining the same, outputs from these sectors become cheaper for external buyers. The external demand for goods from these sectors will increase, thereby exerting upward pressure on prices of these goods, which enhances the profitability, and production in these sectors.[12] The World Bank, for example, attributed the dismal agricultural sector performance in many African countries to their overvalued currencies (see World Bank, 1984; Edwards, 1989).

Outputs produced in the service sector, in contrast, are mostly locally consumed. The inputs used in this sector are, however, imported. This means that as the rand depreciates, inputs become expensive. The producers of services will therefore try to cut costs on inputs by increasing the prices of services, which will put downward pressure on domestic demand for services. Falling demand for services will have negative implications for the production of services in the economy. Therefore, real exchange rate undervaluation is expected to exert negative influence on service sector performance in South Africa.

Table 2c: Exchange Rate Undervaluation and Service Sector Performance

ΔLNSERV	[1] Newey-West	[2] Robust	[3] GMM
QRER	-.024**	-.024**	-.080**
	[-2.27]	[-2.38]	[-2.81]
ΔLNK	-.018	-.018	-.077**
	[-0.93]	[-0.83]	[-2.40]
ΔLNPOP	-.004	-.004	-.044
	[-0.13]	[-0.12]	[-0.33]
ΔLNHC	.339**	.338**	.059
	[2.24]	[2.07]	[0.15]
ΔLNINF	-.002	-.002	
	[-0.47]	[-0.45]	
ΔLNOPEN	-.113***	-.113***	
	[-4.12]	[-3.80]	
ΔLNPRIVY	-.011	-.011**	-.0138**
	[-0.71]	[-0.87]	[-2.84]
ΔLNTOT	-.080**	-.080**	

[12] This argument is in line with the one put forth by Pick and Vollrath (1994) and Rodrik (2008).

	[-2.13]	[-2.20]	
RIR	.002***	.002***	
	[4.88]	[5.62]	
CONSTANT	-.004	-.004	.010**
	[-1.24]	[-1.32]	[2.17]
R-squared		0.692	.140

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

3.3 Sensitivity Analysis

The results presented earlier are based on the index of real exchange rate undervaluation constructed using quantile regression. One critical question is whether these results would hold when we use a different index to measure real exchange rate undervaluation. The answer to this question has important policy implication. An affirmative response would mean that our earlier findings would hold irrespective of how we analyze the problem. However, a contrary response implies that our conclusion could be misleading. To be sure that our findings are not questionable, we perform a sensitivity analysis of our main undervaluation index using an alternative index. This index, as discussed earlier, is based on the HP filtering technique. In the next few paragraphs, we discuss how the real exchange rate undervaluation measured in this sense affect the performance of the three sectors of the South African economy.

Table 3a reports the results of the impact of real exchange rate undervaluation (measured in the HP filter sense) on the performance of the agricultural sector. Panels [1] and [2] show that the real exchange rate undervaluation positively and significantly affects the performance of the agricultural sector. The results hold when we controlled for endogeneity using the GMM technique in Panel [3]. The results compare favorably with those obtained for the *QRER* index. The difference is the size of the effect. Real exchange rate undervaluation has a relatively moderate effect on agricultural sector performance when considered under the *QRER*. The conclusion, however, still stands: real exchange undervaluation induces the performance of the agricultural sector in South Africa.

Table 3a: Alternative Measure of Undervaluation and Agriculture Sector Performance

ΔLNAGRIC	[1] Newey-West	[2] Robust	[3] GMM
HPRER	.438*	.438*	.826**
	[1.77]	[1.87]	[2.28]
ΔLNK	.184	.184	.321*
	[1.12]	[1.07]	[1.95]
ΔLNPOP	.159	.159	.374
	[1.00]	[.97]	[1.61]
ΔLNHC	.981	.981	.859
	[1.18]	[0.94]	[0.79]
ΔLNINF	-.013	-.014	
	[-0.52]	[-0.44]	
ΔLNOPEN	.369**	.369**	
	[2.27]	[2.20]	
ΔLNPRIVY	.049*	.049	.047
	[1.94]	[0.89]	[0.82]
ΔLNTOT	.368*	.368**	
	[1.92]	[2.05]	
RIR	.000	.000	
	[0.03]	[0.02]	
CONSTANT	-.040**	-.040**	-.040***
	[-2.74]	[-2.17]	[-3.08]
R-squared		0.320	0.148

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

The estimates for the industrial sector when undervaluation is defined in terms of the HP filter are shown in Table 3b. Panels [1], [2] and [3] report the results using the OLS and GMM estimators, respectively. Here, real exchange rate undervaluation is found to exert a positive and significant influence on the performance of the industrial sector. The estimated influence remains valid after controlling for endogeneity (see Panel [3]). The results conforms to the ones we found using *QRER*. The coefficients are slightly overestimated using *HPRER*, though.

Table 3b: Alternative Measure of Undervaluation and Industrial Sector Performance

ΔLNIND	[1] Newey-West	[2] Robust	[3] GMM
HPRER	.155**	.098***	.244*
	[2.49]	[3.28]	[1.85]
ΔLNK	.006	.044	.053
	[0.15]	[1.26]	[1.25]
ΔLNPOP	-.017	-.053	-.070
	[-0.30]	[-1.46]	[-0.65]
ΔLNHC	-.713***	-.844***	-.460**
	[-3.44]	[-3.67]	[-2.60]
ΔLNINF	.006	.012	
	[0.99]	[1.23]	
ΔLNOPEN	.105**	.012	
	[2.51]	[0.18]	
ΔLNPRIVY	.012	.016*	.012
	[0.68]	[1.98]	[0.72]
ΔLNTOT	.004	.024	
	[0.10]	[0.34]	
RIR	-.004***	-.004***	
	[-6.49]	[-4.84]	
CONSTANT	.012***	.013**	-.006
	[3.08]	[2.09]	[-1.34]
R-squared		0.531	0.133

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

In Table 3c, we report the estimates for the service sector when the *HPRER* is used as our measure of real exchange rate undervaluation. As with the previous tables, Panels [1], [2] and [3] show the results obtained using the OLS and GMM estimators. The results indicate that real exchange rate undervaluation exerts negative and significant influence on the service sector performance. And this is true, even after controlling potential endogeneity. Note that the estimated coefficient of the real exchange rate undervaluation term for this case appears slightly higher than the previous estimate.

Table 3c: Alternative Measure of Undervaluation and Service Sector Performance

ΔLNSERV	[1] Newey-West	[2] Robust	[3] GMM
HPRER	-.052*	-.052*	-.248*
	[-1.78]	[-1.91]	[-1.83]
ΔLNK	-.023	-.023	-.064*
	[-1.21]	[-1.02]	[-1.85]
ΔLNPOP	-.002	-.002	-.099
	[-0.08]	[-0.08]	[-1.31]
ΔLNHC	.400***	.400**	-.236**
	[2.85]	[2.64]	[-2.17]
ΔLNINF	.000	.000	
	[0.01]	[0.01]	
ΔLNOPEN	-.110***	-.110***	
	[-4.17]	[-3.71]	
ΔLNPRIVY	-.010	-.010	-.016**
	[-0.59]	[-0.72]	[-1.60]
ΔLNTOT	-.069*	-.069*	
	[-1.79]	[-1.92]	
RIR	.003***	.003***	
	[5.35]	[5.96]	
CONSTANT	-.005	-.005	.009***
	[-1.67]	[-1.69]	[3.25]
R-squared		0.699	0.158

Note: *, **, *** indicate rejection of the null hypothesis at 10%, 5%, and 1%, respectively. Values in parenthesis denote t-statistics.

4. Concluding Remarks

Real exchange rate misalignment has been found to influence the performance of economies around the globe. Some empirical studies find real exchange rate undervaluation to stimulate economic performance, and overvaluation to hurt economic performance. Other empirical studies simply admonished against any misalignment of the real exchange rate, arguing that real exchange rate misalignments are not favourable for economic performance. Most recent studies, however, side with the former conclusions (i.e. real exchange rate misalignments are crucial to economic performance). The question is: through what channels does real exchange rate undervaluation influence economic performance? This question has stimulated current empirical and theoretical research. This paper sheds light on the channels through which real exchange rate undervaluation stimulates (mars) the performance of the South African economy. This forms the key contribution of our paper. In addition, we introduce two methods for constructing the index of real exchange rate undervaluation, which differs from the ones found in the existing studies. The first follow the approach used in Rodrik (2008) but departs from this author's approach by using the quantile regression estimator. The second measure of real exchange rate undervaluation is the cyclical component of the real exchange rate obtained using the Hodrick-Prescott filter. We decomposed the South African economy into three sectors, namely: agriculture, industry, and service. Using the OLS and GMM estimation techniques; a time series data covering 1962-2014; and a standard regression model for each sector, we established two important results: (i) real exchange rate undervaluation exerts a positive impact on economic performance by enhancing agricultural and industrial sectors; and (ii) a negative impact on economic performance by reducing the performance of the service sector. These results are found to be robust to the measure of real exchange rate undervaluation we employed, serial correlation, omitted variables heteroskedasticity, and potential endogeneity.

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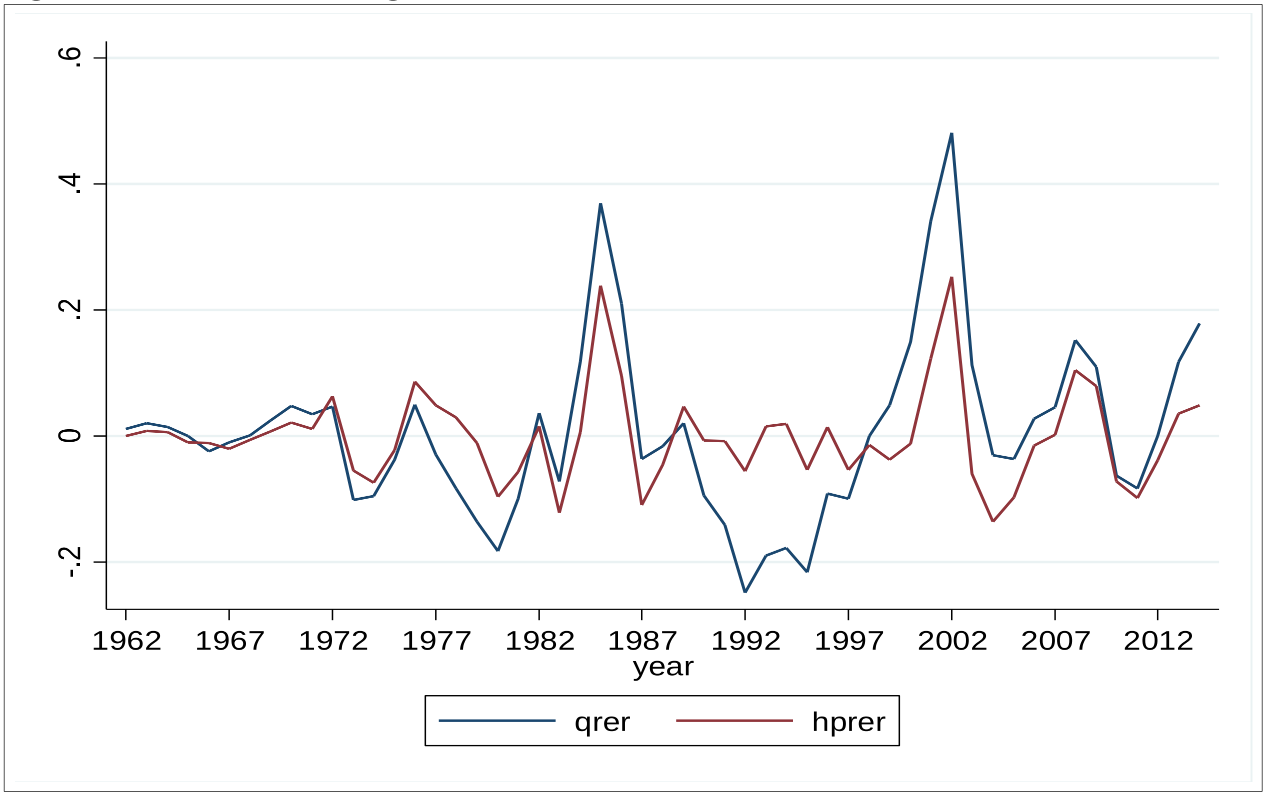
Appendix A

Figure 1: Plot of the Exchange Rate Undervaluation Indexes



Note: qrer = real exchange rate undervaluation index constructed using quantile regression; hprer = real exchange rate undervaluation index constructed using HP filter. Clearly, the indexes are very similar over the period 1962-2014.

Technical Appendix

The Hodrick-Prescott Filter

The Hodrick-Prescott (HP) filter is a filtering technique mostly utilized in empirical macroeconomics to filter a time series variable into its cyclical and trend components. Whittaker (1923) first developed this technique. However, it was made popular as an empirical tool in the seminal paper of Hodrick and Prescott (1997). The main importance of the HP filter is its ability to generate a smooth-curve representation of a time series, which is susceptible to long-run impacts than cyclical fluctuations.

The HP filter builds on the idea that a time series variable, say x_t, can be filtered into a trend (τ_t) and cyclical component (c_t). Suppose that $x_t = \tau_t + c_t + \mu_t$, where μ_t is the error term of the time series variable at time *t*. Then, there exist a positive value of a multiplier λ, such that τ solves the minimization problem:

$$\min_{\tau}\left(\sum_{t=1}^{T}(x_t - \tau_t)^2 + \lambda\sum_{t=2}^{T-1}[(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2\right)$$

where the sum of the squared deviations $d_t = x_t - \tau_t$ penalizes the short-run fluctuations in the time series. The second term is a multiple of the multiplier (λ) and the sum of squares of the second differences in the trend component of the series. This term penalizes deviations in the growth of the trend component of the time series. Higher values of λ imply higher penalties. For quarterly data, Hodrick and Prescott (1997) recommend that we set λ=1600. Ravn and Uhlig (2002) recommend that we choose $\lambda = 6.25$ and 129600 for annual and monthly data, respectively.