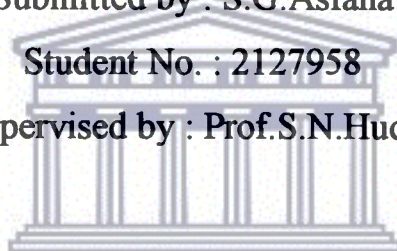


**Exchange Rate Misalignment And International
Trade Competitiveness : A Cointegration Analysis
For South Africa**

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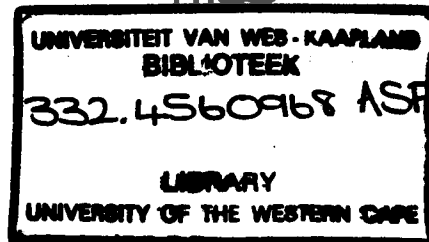
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THESIS



ACRONYMS

ADL	Autoregressive Distributive Lag Model
CAPCON	Capital Control
DEER	Desired Equilibrium Exchange Rate
EB	External Balance
ECM	Error Correction Model
EG	Engle-Granger approach
ERER	Equilibrium Real Exchange Rate
FEER	Fundamental Equilibrium Exchange Rate
GCN	Government Consumption of Nontradables
GDP	Growth Domestic Product
IB	Internal Balance
INV	Ratio of investment to GDP
NATREX	Natural Real Exchange Rate
OLS	Ordinary Least Square
OPEN	Trade Openness
PPI	Producer Price Index
PPP	Purchasing Power Parity
REER	Real Effective Exchange Rate
RER	Real Exchange Rate
RESBAL	Resource Balance
TECH	Technological Growth
TOT	Terms Of Trade
TPI	Technological and Productivity Improvement
TRES	Trade and Exchange Restrictions
VAR	Vector Autoregressive Representations

EXCHANGE RATE MISALIGNMENT AND INTERNATIONAL TRADE
COMPETITIVENESS: A COINTEGRATION ANALYSIS FOR SOUTH
AFRICA

SAMUEL GHEBRETENSAE ASFAHA

KEY WORDS

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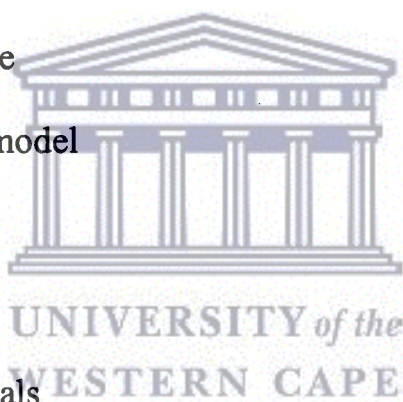
External balance

Exchange rate fundamentals

Cointegration analysis

Tradables

Nontradables



ABSTRACT

EXCHANGE RATE MISALIGNMENT AND INTERNATIONAL TRADE COMPETITIVENESS: A COINTEGRATION ANALYSIS FOR SOUTH AFRICA

SAMUEL GHEBRETENSAE ASFAHA

Issues pertaining to the misalignment of exchange rate have become central in the analysis of open economy macroeconomics for developing countries. This is at least due to two reasons: first persistent overvaluation of currency is seen as a powerful early warning of potential currency crisis and second protracted periods of exchange rate misalignment are highly associated with poor economic performance in a number of developing countries. Owing to this fact, economists are in concession that aligning real exchange rates towards their equilibrium values is an important component of macroeconomic policy adjustments in order to achieve and maintain a sustainable development. For this purpose the estimation of the degree of the real exchange rate misalignment has become pivotal.

However, despite the concession among economists regarding the need to minimize the frequency and magnitude of exchange rate misalignment, the estimation of the equilibrium exchange rate (hence the misalignment) has been among the most controversial and challenging issues in modern macroeconomics. For several decades, the Purchasing power parity (PPP) approach-which is based on the law of one price-has been the most widely used methodology for the estimation of the equilibrium exchange rate in both developed and developing countries. In South Africa some attempts have been made to estimate the misalignment of the rand against major currencies on the basis of the PPP approach. However, large numbers of empirical studies show that PPP does not hold except in the 'ultra' long run. In addition, PPP's assumption of a constant equilibrium exchange rate makes it ill-fitted to serve as a bench-mark for the analysis of the exchange

rate in countries such as South Africa that experience substantial structural changes. As a result a number of macro-econometric models underlying on the macroeconomic determinants of exchange rate have been developed, albeit with little applicability in developing countries.

In this study, we have used Edwards' (1989) intertemporal general equilibrium model of a small open economy in order to estimate the degree of the real exchange rate misalignment and its impact on the international trade competitiveness of the South African economy for the period 1985:1-2000:4. For this purpose a dynamic single equation error correction model of a first order autoregressive distributed lag model, ADL (1,1), and five years moving average technique have been employed to estimate the exchange rate misalignment. Whereas impulse response analysis and variance decomposition techniques of a cointegrated VAR (vector auto regression) have been established to assess the impact of the misalignment on trade competitiveness.

The findings of the study reveal that the real exchange rate had been consistently overvalued during the period 1988:3-1998:2 but undervalued during periods 1998:3-2000:4. For most of the periods during 1985:1-1988:2 the rand had been undervalued. Moreover the study discloses that exchange rate misalignment debilitates South Africa's international trade competitiveness accounting for 20 percent of the variation in competitiveness.

September 2002

DECLARATION

I declare that Exchange Rate Misalignment And International Trade Competitiveness: A Cointegration Analysis For South Africa is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the resources I have used or quoted have been indicated and acknowledged by complete references.

SAMUEL GHEBRETENSAE ASFAHA

SEPTEMBER 2000.

SIGNED:



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CHAPTER ONE

INTRODUCTION

1.1. BACKGROUND

Achieving a higher level of export and investment has been considered as a vital strategy for sustainable and higher development. Accordingly a number of developing countries have adopted an export-led growth strategy with a desire of building vibrant and competitive economies. One such example in South Africa is the GEAR (The Growth, Employment and Redistribution) strategy, which among other things opts to build a dynamic and competitive private sector led economy through export promotion.

In this regard the role of exchange rate policy in the expansion of export is well established and documented in the economics literature. Exchange rate policy, although on its own cannot guarantee development, plays an important role through creating appropriate environment for higher rates of investment and exports. It does so by affecting competitiveness and profitability of an economy (Elbadawi, 1998). The current exchange rate policy adopted by the Reserve Bank of South Africa allows a large degree of market determination (with the confines of the prevailing exchange control regulations) albeit the bank's intervention to iron out excessive fluctuations in the rate (Kahn, 1995:3). This intervention in the market coupled with the available exchange control on resident outflow may distort the prevailing exchange rate from reflecting its market determined true value.

While the economic ills associated with excessive intervention in the exchange rate market is loudly outspoken, the floating exchange rate regime is not vindicated from certain caveats of which higher short-run volatility is a major one. Moreover, allowing market forces to freely set exchange rates would not guarantee the removal of exchange rate misalignment, although the magnitude of the misalignment would be minimized. The appreciation of the dollar in 1985 is a good example in this context.

There has been a consensus among economists that both the volatility and misalignment of exchange rate negatively impacts economic performance of an economy. Higher short-run volatility of exchange rate is nuisance to investors. However, citing a number of empirical researches, Goldstein (1995) and Sercu and Uppal (2000) have argued that the volatility of exchange rate seems to have a lesser impact nowadays due to the availability of instruments such as swaps, options, futures and forwards that hedge exchange rate risks.

As a result the misalignment of exchange rate have become a central issue in the analysis of economic policies in emerging and developing countries. The main *raison d'être* are that persistent overvaluation of currency is seen as powerful early warning of currency crises (Kamnisky et al, 1997); and are strongly associated with poor economic performance in a number of developing countries (Edwards, 1989; Razin and Collins, 1987).

Misalignment of currency affects growth, primarily through its effect on the competitiveness of the tradables sector vis-à-vis the rest of the world and subsequent impact on investment, hence capital accumulation. If a RER is persistently more appreciated than is ought to be (i.e., overvalued) then it erodes international competitiveness and profitability of both exporting and import competing sectors (Razin and Collins, 1987). This effect is usually manifested by persistent current account deficit and a net outflow of capital (Kahn, 1995). Similarly, a more depreciated RER, although may not be as problematic as overvalued currency, may hamper growth by raising inflation; hence reduces the affordability of imported goods especially capital and intermediary goods that account for large share of developing countries imports (Gordon, 1994).

Therefore, adjustment of the RER towards its “true value”, i.e., the equilibrium exchange rate (as we shall see shortly) is strongly recommended as an essential component of macroeconomic policies aimed at achieving a higher and sustainable growth. For this purpose, it is critical for an economy to continuously assess the degree of the misalignment of its currency in order to avoid (potential) economic distresses.

Nonetheless, the estimation of the exchange rate misalignment has been a controversial and challenging issue (Montiel, 1999). For several decades the Purchasing power parity (PPP) approach, which is based on the law of one price, has been the most widely used methodology for the estimation of the equilibrium exchange rate in both developed and developing countries. In South Africa some attempts have been made to estimate the misalignment of the rand against major currencies on the basis of the PPP approach¹. However, large numbers of empirical studies show that PPP does not hold except in the 'ultra' long run. In addition, PPP's assumption of a constant equilibrium exchange rate makes it ill-fitted to serve as a bench-mark for the analysis of the exchange rate in countries such as South Africa that experience substantial structural changes. As a result a number of macro-econometric models underlying on the macroeconomic determinants of exchange rate have been developed, albeit with little applicability in developing countries.

Underlying on the above stipulations, this study attempts to estimate the degree of the misalignment of the rand and its effect on international trade competitiveness of the South African economy for the period 1985:1-2000:4 based on Edwards' (1989) intertemporal general equilibrium model. The model captures most stylized features of a small open economy such as exogenous terms of trade fluctuations, exchange and trade restrictions and capital controls. Subsequently, the model is now fast becoming a standard model for empirical analysis of the behavior of the real exchange rate in developing countries.

1.2. MOTIVATION

Until a year ago the cause of the Asian financial crisis of 1997/98 had been a mystery for me. Fortunately, last year in a lecture note in Advanced Macroeconomics, I came across an article by Edwards (1994): "*Exchange rates in emerging economies: what do we know? What do we need to know?*" Broadly discussing alternative choices of exchange rate policies for developing countries, Edwards has pointed that amongst 'crony capitalism' and poor governance issues exchange rate misalignment had played a crucial role in deepening

¹ Two examples that are cited by Aron (1997:5) are Union Bank of Switzerland (*UBS Economics Research Note*, 13 February 1996) and the South African Foundation (*Growth for all*, February 1996).

the crisis. The misalignment had particularly led to a higher and self-fulfilling speculative capital outflows that squeezed the liquidity and solvency of the financial institutions in Asia.

While I was animated by the new insight I gained about the cause of the Asian crisis, the South African rand has gone through unprecedented depreciation that had ignited a hot debate among scholars, politicians and business in the country that led to the recent appointment of the Myburgh Commission of inquiry into the depreciation of the rand. Broadly speaking, the debate can be categorized between two hard-liners: those arguing that the depreciation indicated deterioration of the macroeconomic fundamentals and those arguing that the depreciation was merely a result of speculative-attacks with the economic fundamentals remained intact. This debate coincided with my newly gained insight regarding the exchange rate misalignment has sparked in me one particular question: does this episode of the depreciation imply a shift away from existing exchange rate equilibrium or a shift to a new equilibrium level? Simply stated: does this depreciation imply an episode of misalignment?

Enthralled by this question I have further dug into the subject. Particularly, after reading an article by Dr Janine Aron (1997) on a publication by *Center for Research into Economics and Finance in Southern Africa*, I realized that only little study has been done on exchange rate misalignment in South Africa. The most influential ones were those by Union Bank of Switzerland (*UBS Economic Research Note*, 13 February 1996), and by the South African Foundation (*Growth for All*, February 1996). However, both of these studies have used the purchasing power parity (PPP) approach that assumes constant real equilibrium exchange rate. Although PPP is the most widely used approach for the estimation of exchange rate misalignment, it is less appropriate for countries such as South Africa with substantial structural changes. This fact has amplified my excitement and has motivated me to estimate the misalignment of the exchange rate on the basis of 'fundamentals approach' that assumes a variable equilibrium exchange rate determined by economic fundamentals.

1.3. RATIONALE

The misalignment of exchange rate has been a source of serious economic distress for a number of developing countries. Razin and Collin (1997) have outlined that there are at least two possible channels through which RER misalignment might influence growth. First, it could influence domestic and foreign investment, thereby influencing the capital accumulation process. Capital accumulation is a well-established “engine of growth”. Second, a RER that is out of line could affect the tradables sector, and the competitiveness of this sector vis-à-vis the rest of the world. This sector’s performance is also generally thought to be an important component of the economy’s overall growth.

Therefore, the estimating of the degree of the real exchange rate misalignment is believed to contribute towards avoiding potential economic crisis; hence creating a stable economic environment and higher and sustainable economic growth. Moreover, by assessing the impact of the exchange rate misalignment on the trade competitiveness of the South African economy, the study is believed to impart insights into the dynamics of export expansion. In so doing, the study provides a new dimension of policy considerations for the success of the Growth, Employment and Redistribution (GEAR) strategy, which is a comprehensive macroeconomic growth path envisaged by the South African government.

1.4. OBJECTIVES OF THE STUDY

The objectives of the study can be simply stated as:

1. Estimating the degree of the real exchange rate misalignment of the rand for the period 1985:1-2000:4.
2. Estimating the extent to which the misalignment impacts the international trade competitiveness of the South African economy.

1.5. THE RESEARCH QUESTIONS

In line with the purpose of the study outlined above, this study intends to answer the following two questions:

1. To what extent had the real exchange rate in South Africa been misaligned during the period 1985:1-2000:4?
2. To what extent does the misalignment of the exchange rate affect the international trade competitiveness of the economy?

1.6. THE HYPOTHESES

From the above questions the following hypotheses were posited for testing:

1. The real exchange rate in South Africa had been overvalued for most of the periods under consideration.
2. The overvaluation of the exchange rate has negatively impacted the international trade competitiveness of the South African economy for a prolonged period of time.

1.7. LIMITATIONS OF THE STUDY

The objective of this study is limited to the estimation of the degree of the exchange rate misalignment and its impact on the trade competitiveness of the South African economy for the period 1985:1-2000:4. The impact of the misalignment on trade is further limited to the investigation of the response of trade competitiveness, as proxy by unit labor cost and volume of merchandise export, to a one percent change in the RER misalignment index. Moreover, questions pertaining to causes of the RER misalignment and policy issues for correction of the misalignment are beyond the parameter of this study.

1.8. ORGANIZATION OF THE STUDY

The rest of the study is organized as follows. Chapter 2 reviews relevant existing literatures of exchange rate misalignment with a particular focus on conceptual and methodological issues of exchange rate misalignment and its impact on international trade competitiveness of the South African economy. The chapter begins by critically evaluating alternative analytical frameworks such as the purchasing power parity (PPP) approach, the Mundell-Fleming model and the Swan-Salter or dependent economy models that are developed to explain the behavior of real exchange rates.

In chapter 3 we examine the econometric methodologies that are used to estimate the exchange rate misalignment and its impact on the international trade competitiveness of the South African economy. This chapter first scrutinizes the time series property of the data with a special emphasis on unit-root and cointegration tests.

Chapter 4 provides the empirical results of the study together with the diagnostic tests that are done to assure the statistical accuracy of the estimations.

Finally, chapter 5 summarizes salient points of the study and draws relevant policy recommendations.

CHAPTER TWO

REVIEW OF THE LITERATURE

2.1. Overview

In the preceding chapter, we have attempted to provide the reader with a comprehensive introduction underlying on the importance of measuring the exchange rate misalignment. The current chapter narrates the main theoretical and conceptual issues that frame the exchange rate misalignment and international trade competitiveness. Section 2.1 critically explores different definitions and analytical models of the real exchange rate, mainly focusing on the conceptual and empirical challenges embodied in the availability of multiple definitions and models. Section 2.2 provides the reader with a detailed conceptual understanding of the exchange rate misalignment highlighting on the dynamics of the equilibrium and the actual real exchange rate. In section 2.3 and 2.4 we will discuss the current controversies and challenges surrounding the estimation of the exchange rate misalignment. Moreover, we will critically analyze the most widely used models of equilibrium exchange rate (hence exchange rate misalignment) in terms of their robustness and applicability for developing countries. These are then followed by a brief conclusion.

2.2. Real Exchange Rate: Concepts And Measurements

The economic literature generally broadly defines the RER either as external or internal RER (Hinkle and Nsengiyumva, 1999a). Within each of these two broad definitions, there are several alternative formulations derived from different analytical approaches. For example there are three alternative versions of the external RER. The first is based on the purchasing power parity (PPP); the second on the Mundell-Fleming one composite good model and the third on the law of one price and competitiveness in the pricing of internationally traded goods. Similarly, the internal exchange rate, which is generally

defined as the relative domestic price of tradables to nontradables, has different alternative definitions based on two-good, three-good or multiple good models.

Based on the PPP, the RER generally refers to the nominal exchange rate adjusted for price level differences between countries. There are two alternative versions of PPP: absolute and relative. The absolute PPP hypothesis states that the exchange rate between two currencies equals the ratio of the absolute price of an identically standardized basket of goods in the two countries. The relative PPP, on the other hand, states that changes in the exchange rate, measured in percentage, equals the difference between the inflation in the two countries. PPP is a theoretically appealing concept. However, as we will see shortly in section 2.4.1, there is little empirical justification for it as long and persistent deviations from PPP has been intensively documented, especially in the short and medium term.

The second external RER concept is based on the standard Mundell-Fleming open economy macroeconomic model. This model assumes that the economy specializes in the production of a single (composite) good, which is an imperfect substitute for the single (composite) goods produced by the rest of the world. Based on this model, the RER refers to the relative price of foreign good in terms of the domestic goods, where the price of each country's good is determined by its cost of production. Therefore, the price index in the definition of the external RER in this model refers to an output price index or production cost index of the economy².

In the Mundell-Fleming model the external RER is identical and interchangeable with domestic terms of trade. Moreover, as Agènor and Montiel (1996) have pointed out the model endogenizes the terms of trade by assuming that the home country is small for its importable goods but large in the market for its exportable goods. The Mundell-Fleming model would therefore be an appropriate framework for determining the RER in industrialized countries, which have relatively stable terms of trade that is partly endogenously determined as they can influence the price of their exports in international

² In the Mundell-Fleming model, the output price index or production cost index for the economy is composed of exports and goods produced and sold domestically by a country. Whereas, the price index in the PPP approach is composed of the imports plus goods produced and sold domestically.

market. However, the Mundell-Fleming model is less applicable for developing countries, whose production structures are characterized by heavy reliance on a few primary products and exogenous terms of trade.

The third version of the external RER is based on competitiveness in the pricing of internationally traded goods. Based on this approach, the external RER refers to the relative cost of producing traded goods, measured in a common currency, in the home and foreign country. In this approach the RER uses output price, production cost or factor cost indexes for all goods as in the expenditure PPP and Mundell-Fleming model. Therefore, the external RER for traded goods can be thought as measuring competitiveness only among internationally traded goods produced in the home and foreign countries.

Hinkle and Nsengiyumva (1999b) have argued that the choice of empirical price index for measuring competitiveness in producing traded goods is problematic. The empirical literature nevertheless suggests four alternative price indexes: unit labor costs for traded goods, wholesale price index, value added deflators for traded goods and export unit values. Empirical application of these different indexes result in different values for the external RER, thereby complicating the choice of any particular index. Moreover, lack of data limit the application of this model in developing countries.

As already indicated the internal RER measures the relative price of tradable and nontradable goods within a country. The theoretical models of internal RER are widely used for empirical studies in developing countries (For example, see Devarajan, 1999; Edwards, 1988 and 1989; and Baffes et al, 1999). Hinkle and Nsengiyumva (1999b) indicate that the theoretical models for the internal RER are two-good, three-good and multi-good macroeconomic models.

The two-good model, also known as the dependent-economy model or the Swan-Salter model contains two production-sectors, one producing traded goods and the other non-traded goods. This model assumes a constant exogenous terms of trade between exportables and importables. Agénor and Montiel (1996) have noticed that the model's

assumption of exogenous terms of trade captures an important stylized fact of the developing countries. However, the assumption of constant terms of trade obscures the model from reflecting the variability of the external terms of trade, which is among the important determinant of exchange rate movements in developing countries.

To allow for variability of the terms of trade, the three-goods model disaggregated the traded goods sector into exportable and importable sectors. Hinkle and Nsengiyumva (1999c) underscored that the disaggregations of the traded goods sector results in two real exchange rates: one for importables and one for exportables thereby complicating the analysis of the internal RER.

The internal RER, thus, poses both conceptual and empirical problems. The conceptual problem emanates from the difficulty of arriving at operational definition of tradable and non-tradable goods in a way that draws neat division of goods into “tradable” and “non-tradable”. The empirical problem, on the other hand, arises from unavailability of separate price data for tradable and non-tradable goods. Hence the use of proxies has been the second best practice used in the calculation of the internal RER.

In general, there exist conceptual and empirical difficulties in the measurement of the actual real exchange rate. As Montiel and Hinkle (1999:5) have pointed out, “multiple definitions of the RER, drawn from different analytical frameworks and suitable for use in different circumstances, have long complicated the analysis of the real exchange rate.” As a result the choice of any particular definition or theoretical model for an empirical purpose is a nontrivial task.

This research adopts the real effective real exchange rate (REER) index of the South African economy as published by the reserve bank. Kahn (1995:6) has pointed out that the reserve bank’s REER index is a weighted RER that “adjusts the nominal effective exchange rate by relative producer price indices [of the domestic and the major trading partners’ markets with the year 1990 as the base year].”

Therefore, the REER index of the reserve bank is a variant of the PPP-based exchange rate scenario. Therefore, using this index as a measure of competitiveness poses at least two important limitations. One of the limitations is that producer price indices (PPI) of different countries include different commodities and where commodities are identical the weights assigned to them are likely to differ. These differences in commodities and weights in turn give misleading picture of the true competitiveness of the economy relative to its trading partners. The other major, and perhaps most important, limitation is that it focuses on tradable goods sector, as the major components of the basket of goods used to calculate the producer price indices are tradable goods (Kahn, 1995:5). As a result, the PPP based RER fails to capture resource movements or resource pull effects between the traded and nontraded goods sector in response to relative price changes between the two sectors. However, Aron (1997) has stressed that using this index is a desirable and worthwhile exercise because of its policy relevance.

2.3. Real Exchange Rate Misalignment-Conceptual Issues

Real exchange rate misalignment refers to a sustained departure of the actual RER from its long-run equilibrium path. Such a situation could arise in two cases: when the actual RER fails to reflect fundamentals driven changes in the long run equilibrium and/or when the RER moves away from the EREER in response to 'non-fundamentals' driven changes. The latter is often associated with changes in expectations and macroeconomic policies that are incompatible with maintaining internal and external balance. From a theoretical standpoint, Edwards (1994:43) has underlined that the concept of RER misalignment arises from "institutional or other type of rigidities that prevent the RER from adjusting towards its equilibrium level."

Misalignments occur under both fixed and floating exchange rate regimes. Goldstein (1995:19-20) has argued that in fixed rate and adjustable systems, misalignment reflect poor policy fundamentals that prohibit the exchange rate to adjust to changes in economic fundamentals. Whereas in floating exchange rate regimes, bubble factors such as speculative attacks that moves the exchange rate too much in relation to fundamentals are

the primary cause of misalignments. Generally as Goldstein (1995:21) has attributed large misalignments of exchange rate are manifestations of poor policy fundamentals.

It is intuitively clear that understanding the cause and dynamism of movements in both the actual and equilibrium exchange rates are key starting point in the analysis as well as correction of RER misalignment. Subsequently, we will discuss these two issues briefly below.

2.3.1. The Long-Run Equilibrium Real Exchange Rate (ERER)

Following the original description of Nurkse, as cited by Montiel (1999), the ERER is defined as the value of the RER that is consistent with a simultaneous attainment of internal and external equilibrium. Internal equilibrium refers to a situation that the non-tradable goods market clears. External equilibrium, on the other hand, is attained when the current account is sustainable³. Theoretically, an exchange rate is labeled “overvalued” when it is more appreciated than the equilibrium and “undervalued” when it is more depreciated than the equilibrium.

The ERER can be explained by the aid of a diagram.

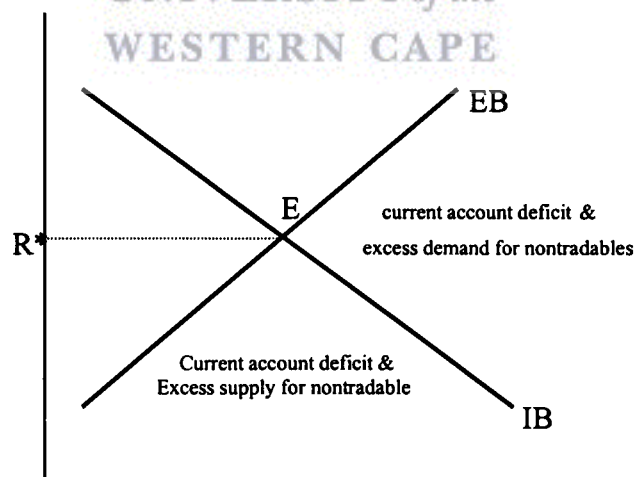


Figure 1 Source: Clark et al, 1994 (Originally done by Krugman, 1990).

³ Sustainability of the current account refers to a situation when the intertemporal budget constraint that states that the discounted sum of a countries current account has to be equal to zero is satisfied (see Edwards (1989), for the detailed analysis).

In the diagram the IB schedule refers to a situation of internal balance that is a condition attained when the nontradable goods market clears. The IB schedule slopes downward because starting at a position of equilibrium a decrease in domestic demand, say due to a fall in private or government spending, creates excess supply of nontradables at the original RER. Restoration of equilibrium, thus, requires a depreciation of the RER (i.e., an upward movement of RER on the vertical axis) that shifts supply towards traded goods and demand towards nontradable goods. Thus a fall in domestic demand for nontradables is accompanied by depreciation of the RER making the IB schedule slope downward. Points to the right of the IB schedule show excess demand for non-tradables in the domestic goods market while points to the left show excess supply of nontradable goods. Both cases thus reflect a situation of internal imbalance.

Similarly, the EB schedule represents a situation of external balance, which is a situation of current account sustainability. The EB schedule slopes upward. Starting at any point on the EB schedule, a rise in domestic demand for tradables create current account deficit at the original RER. Therefore, restoration of equilibrium requires a depreciation of the RER to shift demand from tradables to nontradables and output from nontradables to tradables. Points to the right of the EB schedule reflect excess domestic demand for tradables, hence current account deficit while points to the left of the EB schedule show current account surplus.

The equilibrium real exchange rate (ERER), R^* in the diagram, is the level of the RER that is simultaneously consistent with internal and external balance. This is attained at point E in the diagram, where the IB and the EB schedules intersect.

The changes in the RER, i.e., the appreciation and the depreciation, can be identified as justified or unjustified depending on the nature of the change (Edwards, 1988). Justified changes are equilibrium phenomena caused by real events in the economy such as technological progress, changes in the external terms of trade and so on. Whereas, unjustified changes are departures of the RER from the equilibrium path. The latter

phenomenon is what we refer as real exchange rate misalignment that could also be perceived as a situation of RER disequilibrium.

2.3.2. The Dynamics Of The RER

In an analytical investigation, Montiel (1999) has identified three types of macroeconomic variables: predetermined variables, policy variables and exogenous variables as primary factors of movements in the RER. Predetermined variables are such variables as the economy's net indebtedness and stock of capital that are fixed at any moment in time but evolve endogenously overtime in response to current and future expected values of policy and exogenous variables. Policy variables, however, follow a dynamic path that may (or may not) depend on current situation of the economy depending on the regime that is in place⁴. The third variables are such variables as the world economic conditions that are by definition exogenous to the economy.

In Montiel's (1999) analysis the exogenous variables are classified into "bubble" variables⁵, which affect the economy through their effect on expectations, and "fundamental" variables that affect the economy through their effect on the underlying domestic fundamentals independently of any effects they may exert through expectations.

Using X_1 , X_2 , $B(t)$ and X_3 to represent current values of predetermined variables, current and expected values of policy variables, bubble variables and fundamental variables respectively, the reduced form of the RER can be written as:

$$\text{RER}(t) = F(B(t), X_1(t), X_2(t), X_3(t)) \quad [\text{eq. 2b.1}]$$

⁴ For example, a fixed exchange rate regime does not incorporate feedback from short-run economic developments in the economy.

⁵ The inclusion of bubble factors in the analysis captures the so-called "rational bubbles" that are speculative factors generating self-fulfilling price increases.

As mentioned above, the evolution path of the predetermined variables overtime depends on the current and expected values of the policy and exogenous factors. Thus, eq. 2b.1 becomes:

$$RER(t) = F(B(t), X_1([X_2(t), X_3(t)]), X_2(t), X_3(t)) \quad [\text{eq. 2b.2}]$$

Montiel (1999:221) refers this as short-run equilibrium exchange rate that in the absence of bubble factors is often described as ‘short-run fundamental driven’ to differentiate them from the long-run ERER. This implies that apart from the bubble factors that affect only the actual RER, the difference between the RER and the ERER lies on the time dimension adopted. In fact, Clark et al (1994:1) have asserted that the time horizon is important as “those factors that have the most [crucial] influence on [the] exchange rates over the short term are not necessarily the same ones that ... exercise the most [crucial] influence over the long term.”⁶ The short run fundamentals driven RER can then be abstracted from eq. 2b.2 by excluding the bubble factor:

$$RER(t) = F(0, X_1(X_2, X_3), X_2, X_3)$$

Being a long-run phenomenon, the equilibrium exchange rate (ERER) in contrast is determined by sustained or permanent component of the fundamentals (see Montiel, 1999, Elbadawi, 1994, Baffes et al, 1999, Edwards, 1985 and 1989) and not by bubble effects. In this case the ERER is:

$$\begin{aligned} ERER &= F(0, X_1^*(X_2^*, X_3^*), X_2^*, X_3^*) \quad [\text{eq. 2b.3}] \\ &= F(X_2^*, X_3^*) \end{aligned}$$

Where X_1^* represents a steady-state value of the predetermined variables, X_2^* and X_3^* are sustainable values of the policy and the exogenous variables respectively. eq. 2b.3

⁶ For example, variables such as short-term interest rates might be the most influential fundamentals if the relative time horizon is short, say, 2 months. In contrast, if the relative time horizon is the long term, say, a decade, then the most important fundamentals might be such factors as technological progress and investment propensities.

highlights that the long-run ERER is determined by sustainable level of policy and exogenous variables that are referred in the economics literature as equilibrium exchange rate fundamentals. From a theoretical perspective a simple comparison of eq. 2b.2 and eq. 2b.3 reveals that bubble factors such as speculations, unsustainable domestic macroeconomic policies and transitory external shocks are the major causes of exchange rate misalignments.

2.4. Effect Of Misalignment On Trade Competitiveness

International trade competitiveness is an important determinant of a country's external payment position (Clark et al, 1994:4). In simple terms the trade competitiveness can be defined as producing better products at lower costs than other countries competing in the international market (Nam, 1993:71).

Movements in the real (effective) exchange rate have been regarded as an important indicator of a country's trade competitiveness position (see Elbadawi, 1998 and Golub, 2000). However, the evidence regarding the trade competitiveness that is provided by the time series movement of the real effective exchange rate per se would be misleading, since it does not distinguish between equilibrium and disequilibrium episodes of the movement (Clark et al, 1994:6 and Mongardini, 1998:6). The implication is that appreciation (or depreciation) of exchange rate does not necessarily reflect a loss (or gain) of competitiveness. The latter is affected through the relative movements of the exchange rate with respect to its equilibrium path.

Several empirical studies have confirmed that the misalignment of exchange rate has been among the primary causes of severe economic distresses in several developing countries. For example, thoroughly examining the cause of the Asian financial crises, Corsetti et al (1998) and Kamnisky et al (1997) argue that persistent overvaluation of currency provides a powerful early indicator of a potential financial crisis. In somehow similar studies, Edwards (1988, 1989 and 1994) and Razin and Collins (1997) have found that a protracted

real exchange rate misalignment, particularly, overvaluation retards the medium to long-run growth prospects of countries.

In general, the effect of the misalignment, most notably the overvaluation, on the economic performance is channeled via its effect on trade competitiveness (see Clark et al, 1994 and Corsetti et al, 1998). Intuitively it is obvious that the overvaluation of the exchange rate embodies anti-export bias that erodes incentives and ability of exporters to compete in international markets. The same intuition clarifies that the overvaluation erodes the competitiveness of import-competing sectors in the face of relatively cheaper imports.

Moreover, Krugman (1987:278), and Clark et al (1994:5) strongly argue that a protracted currency overvaluation causes a sustained loss of trade competitiveness, which is usually manifested through prolonged trade deficit and capital outflows. The main explanation that backs up this argument is the so-called a 'hystereses effect'. Elaborating on the hystereses-explanation, Krugman (1987:290) has underlined that the competitiveness of an economy does not simply depend on "price and installed capacity ... [but] also depend[s] crucially on invisible investments [also called invisible assets] in market position such as distribution networks, customer loyalty [and reputations]." This implies that the effect of exchange rate misalignment on competitiveness is not contemporaneous but rather is through a time lag.

2.5. Issues In Empirical Measurement Of The ERER

There is a wealth of theoretical and empirical literature on the equilibrium exchange rate. Nevertheless, estimation of the ERER has remained to be among the most controversial and challenging issues in modern macroeconomics. Isard and Faruquee, pointed out that:

There are two schools of thought within the economics profession that question the usefulness of attempts to measure the ERER. The first argues that the RER can never become substantially misaligned ... while the second [school of thought] accepts the concept of [the] misalignment but is skeptical on the ability of any particular methodology to deliver accurate estimates of the degree of misalignment (Isard and Faruquee, cited in Montiel, 1999:224).

Due to this lack of concession, economic theory provides little guidance on “appropriate” estimation methodology of the ERER. As a result several analytical models have been developed in attempts of bridging the deficiencies in the literature.

Broadly speaking, the models can be categorized in to two: those models that are relevant for industrialized countries and those that represent stylized features of developing countries (Montiel, 1999; Mongardini, 1998). The key difference between these two broad categories lies on the specification of the ERER. Nevertheless, there is a general consensus between the two categories regarding the definition of the equilibrium exchange rate as the level of exchange rate that results in the simultaneous attainment of internal and external balance.

The models in the first category reflect salient features of the industrial countries thereby postulating a natural rate of output or natural rate of unemployment. Under this category, the PPP and its variants are most widely utilized approaches in the empirical estimation of the equilibrium exchange rate. Other models that are widely used includes *inter alia* Williamson’s (1985) fundamental exchange rate (FEER), the IMF desired equilibrium exchange rate (DEER), and the natural equilibrium real exchange rate (NATREX) of Stein and associates (1995).

The PPP, being the most widely used approach in empirical estimation of the ERER for both industrial countries and developing countries, we have systematically explored its main features below with a relatively more detail.

2.5.1. The Purchasing Power Parity (PPP) Approach

To begin with, PPP simply defines the nominal exchange rate as the ration of home and foreign country prices and can be expressed as:

$$S_t = P_t/P_t^* \quad [1]$$

Where S is the nominal exchange rate, P_t and P_t^* are home and foreign country price indices respectively. In empirical estimation [1] can be transformed into a linear log equation as:

$$S_t = \alpha + (P_t - P_t^*) + \varepsilon_t \quad [2]$$

Where S is the log of the nominal exchange rate, P_t and P_t^* are the logs of home and foreign price indices, α is a constant and ε_t is a stationary random variable. Similarly, the PPP approach refers the RER as the nominal exchange rate adjusted for price differences between domestic and foreign currencies, i.e.

$$\text{RER} = S_t + P_t^* - P_t \quad [3]$$

Substituting [3] into [2] we get,

$$\text{RER} = S_t + P_t^* - P_t = \alpha + \varepsilon_t \quad [4]$$

With α being a constant, ε_t assumed to be a white noise error term [4] captures the underpinning structure of the PPP hypothesis that the RER is constant overtime and so does the ERER by implication (see Aron, 1997, Montiel, 1999; Edwards, 1988). This is an extremely restrictive assumption. Nonetheless, as MacDonald (2000:7) has underlined, “[d]espite the restrictiveness of [the] PPP [assumption], it is often [unfortunately] the first model of equilibrium economists use to assess if a currency is misaligned.”⁷

In recent years, many researchers choose to go for less restrictive version of the PPP that simply requires the RER to be mean-reverting or stationary (MacDonald, 2000:7). This implies that the central issue in measuring the ERER on the basis of PPP is a question of determining if movements in the RER are transitory movements around a well-defined ERER (Montiel, 1999:234; MacDonald, 2000:8). For the PPP hypothesis to hold the RER

⁷ A good example, mentioned by MacDonald (2000), is the exchange rate misalignment that is regularly published by the economist magazine based on its Big-Mac Index, which is a PPP based calculation.

should be stationary, i.e. its movements should be transitory around its mean, which is simply the ERER.

This assertion was traditionally tested using regressions like shown below and testing for unit root, i.e., for $\beta_1=1$:

$$S_t = \alpha + \beta_1(P_t - P_t^*) + \varepsilon_t$$

With recent developments in time series econometrics, however, the test has transcended to testing whether the variables, i.e. S , P_t and P_t^* , are cointegrated. The cointegration test, as we will see in section 3.2, is a test for the presence of a stationary linear combination of S_t , P_t and P_t^* despite them being nonstationary individually.

The general finding, from both traditional and modern tests, was that the equilibrium definition of the PPP and its variants poorly performed for the post-Bretton Wood system of generalized floating exchange rate (see Frenkel, 1981; Meese and Rogoff, 1983). These studies confirmed that the PPP-based RER exhibits a strong random walk with no mean reversion at all. However, recent studies done over long time horizons (6-7 decades) suggest that PPP exhibits strong, but slow mean reversion properties (Breuer, 1994; Froot and Rogoff, 1994; and Rogoff, 1996). These recent studies, therefore, have revived that PPP can provide a meaningful benchmark for evaluating and forecasting RER developments over the 'ultra' long term for industrialized countries. This however does not validate PPP as optimal framework for short to medium term nor for 'reasonable' long-term rates that are of usually most interest.

The performance of PPP for developing countries has also been tested. In the African context the most recent tests include that of Holmes (2000) and Odedokun (2000). Establishing a panel data unit root test for 27 African less developed countries, Holmes (2000) has found no evidence in support of PPP. Similarly, Odedokun's (2000) study that comprises 35 African countries has resulted in inconclusive evidence in that the PPP hypothesis are met in 17 countries while rejected in the rest 18 countries. In general PPP

seems to be less appropriate framework for analyzing the behavior of the ERER. In fact, Aron (1997:3) has strongly warned, “PPP-calculations of real exchange rate misalignment [based on the assumption of the constant ERER] may be seriously misleading, especially, for transitional economies like South Africa [that have undergone through substantial structural shifts].”

A number of supply and demand side explanations have been hypothesized to rationalize the persistent nature of the deviation of the PPP from its ERER. The most dominant one, however, is the so called the Balassa-Samuelson effect. The Balassa-Samuelson effect, which is a variant of the PPP, is a supply-side hypothesis that projects the persistent disequilibrium in PPP to its failure to capture the effect of productivity differentials among countries. Assuming that productivity growth is faster in the traded goods sector of an economy, the hypothesis states that countries with a higher productivity growth relative to their trading partners will experience a persistent appreciation in their ERER⁸ (Balassa, 1964 and Samuelson, 1964). This implicitly affirms Edwards’ (1988:5) assertion that the ERER is neither an immutable number as envisaged by the ‘restrictive’ version of PPP nor necessarily stationary as assumed by the less restrictive version.

Several studies support the Balassa-Samuelson hypothesis (e.g. Faruquee, 1995; Rogoff, 1996). However, other studies such as *interalia* by Gordon (1994) and Canzoneri et al (1996) have found out that the hypothesis poorly explains some medium-term movements of the RER between industrial countries. Accentuating on the failure of the PPP and its variants, empirical estimation of equilibrium exchange rate and misalignment in both industrial and developing countries has curved in favor of structural models. The next section briefly outlines the structural models with a critical examination of their robustness and applicability to the developing countries.

2.5.2. Structural Models Of The ERER

The Structural models of the ERER differ from PPP mainly because of their reliance on real macroeconomic fundamentals that affect the RER. The Mundell-Fleming model and its variants have been the main analytical frameworks in the context of the industrialized countries. Practically, the estimations of the structural models have been undertaken in both Partial-equilibrium approaches (e.g. Bayoumi et al, 1994; Wren-Lewis and Driver, 1998) and general equilibrium approaches (Williamson, 1994; Stein, 1994; Allen, 1995; Devarajan, 1999).

The Partial-equilibrium approach to the specification of the structural models is a relatively simple approach. Broadly speaking, this approach relies on the estimation of trade-balance equations, although different assumptions have been proposed regarding to the actual specification of the models. Montiel (1999:246) has severely criticized the approach for “its ... ad hoc trade-balance specification and its partial equilibrium specification [that fails to capture feedback effects from the RER to the fundamental determinants].” Similarly, Wren-Lewis and Driver (1998) have criticized the approach for its poor performance in out-of-sample forecasts of the ERER.

As a result of the above limitations of the partial equilibrium approach, policy-oriented researches of the ERER in industrialized countries seem to favor the general equilibrium model approach. As already mentioned the most important models in this category are the FEER, DEER and the NATREX. One common characteristic of these models is their postulation of a natural rate of output or unemployment.

Williamson's (1994) fundamental equilibrium real exchange rate (FEER) is a suitable example of the general equilibrium approach. It defines the ERER as the value of the RER that is consistent with internal and external balance in the medium term. In the model internal balance is perceived as achieving a level of potential output with full employment

⁸ The implication is that the relative price of tradables to non-tradables decline in countries with faster growth than its trading partners resulting a secular equilibrium appreciation

and a low and sustainable rate of inflation; while external balance is perceived as achieving current account equilibrium. However, somewhat different from the other models, which we will see shortly, the current account balance in this model is conceived as some “sustainable normative target” determined by subjective judgment regarding the country’s investment needs and saving rates (Williamson, 1994: 190).

The FEER has been the basic analytical scenario widely implemented by the international monetary fund (IMF) for calculating the equilibrium exchange rate in industrial countries. These calculations have been performed based on IMF’s current multicurrency macro-econometric model (MULTIMOD). The resulting EREER is referred as desired equilibrium exchange rate (DEER), in order to emphasize the normative nature of the estimation (Montiel, 1999). The FEER and DEER models while provide useful and consistent framework that takes into account the dynamic aspect of economic behavior including the feedback effects they are complicated as they require the estimation of large number of equations. Clark et al (1994) has noticed that the complexity makes it difficult to check the appropriateness of model specification in such models.

Other closely related model of the EREER is the so called the natural real exchange rate (NATREX). First proposed by Stein (1994) and Stein et al (1995), the NATREX attempts to bridge the deficiency of the FEER-DEER models by using positive rather than normative target for the external balance in a small, as opposed to fully dynamic, models. The NATREX is defined as the level of the RER that is consistent with simultaneous attainment of internal and external balance, with internal balance referring to achieving a natural rate of unemployment and external balance referring to achieving balance of payment equilibrium with out involving reserve movements. Stein (1994) tested the robustness of the model for the United States with the result well supporting the model. However, Montiel (1999:253) has pointed out that the model is complicated and suffers from certain interpretation problems.

In summing up, both the partial and the general equilibrium structural models of the EREER have performed far better than the simple PPP-based estimations. Nonetheless, these

models have some inert limitations that stem from subjective judgments, as with the normative current account target in FEER-DEER models, complexity of model specification and interpretation problems. Moreover, the applicability of the models is limited to industrial countries as they are based on the Mundell-Fleming model that endogenizes the external terms of trade. In addition, the models postulate full output, low and sustainable inflation and natural rate of unemployment that do not reflect the true features in developing countries.

Shifting our attention to the developing countries we find that they have been subjected to large and frequent exogenous and policy shocks that, among other things, have raised a strong concern about the exchange rate misalignment (Montiel, 1999). For quiet a long time PPP has often been used as a benchmark to gauge the degree of the misalignment. However, the poor performance of PPP coupled with a pressing need for accurate estimation of the ERER have led to the acknowledgment of the role of fundamentals in the developing countries. Edwards (1989), in this regard, has done the seminal work by developing an intertemporal general equilibrium model of a small open economy using economic fundamentals that capture important stylized features of the developing countries. The features include exogenously fluctuating terms of trade, tariffs and other forms of trade restrictions, exchange controls and capital controls

Owing to this fact, the model has been used extensively in several empirical estimates of exchange rate misalignment for several developing countries (see Elbadawi, 1994; Mongardini, 1998; Baffes et al, 1999; Chowdhury, 1999; Otero, 1999). Since Edwards' model is the main theoretical framework this research adopts, we sketch it out briefly below.

2.6. The Theoretical Framework

The main theoretical framework adopted in the estimation of the RER misalignment in this study is Edwards' (1989) intertemporal general equilibrium model of a small open economy. The model is developed based on microeconomic foundations in an attempt to

capture how “both policy induced and exogenous shocks affect the path of equilibrium relative prices in the economy” (Edwards, 1989:17). The model, closely related to Williamson’s (1994) FEER, defines the equilibrium exchange rate as the relative price of tradables to nontradables that is consistent with the simultaneous attainment of internal and external balance. External balance is defined as attaining a sustainable current account position while internal balance is attained when the nontradables market clears.

2.6.1. The Model

The model assumes a small open economy with large number of profit maximizing firms producing three goods: exportables (X), importables (M) and nontradables (N)⁹. The economy is perfectly competitive with Production characterized by constant returns to scale. Consumers maximize intertemporal utility subject to income constraint and consume all the three goods. Similarly, government consumes the three goods and minimizes cost subject to a budget constraint. The government levy tax on income and tariffs on imports, capital and exchange control is also assumed. The government can borrow from abroad but there is no ponzi-game.¹⁰ The agents are endowed with perfect foresight and time is limited to two periods-the present and the future.

Based on these assumptions Edwards has developed large number of behavioral relations that reflect the behavior of each category of the agents: producers, consumers and government and their interrelation with the external sector. Undertaking a Painstaking investigation on the behavioral relationship, Edwards articulated the main fundamentals of the ERER and the dynamic path followed by the ERER in response to shocks in the fundamentals. The fundamentals are external terms of trade (TOT), government consumption of nontradables (GCN), capital control (CAPCON), trade restrictions and exchange controls (TRES), technological progress (TECH) and investment (INV)¹¹. Thus,

⁹ Thus the model implicitly assumes that imports and exports are not perfectly substitutable.

¹⁰ That is, a debt in period 1 must be paid-off in period 2.

¹¹ Based on an analytical model that extends Dornbusch’s (1983) open economy macroeconomics model, Montiel (1999) derived similar fundamentals of the ERER for developing countries.

the structural relationship between the EREER and the fundamentals can then be captured by:

$$\log e_t^* = b_0 + b_1 \log F_t + \mu_t$$

Where, e_t^* is the equilibrium exchange rate, F_t is a vector of fundamentals, μ_t is a disturbance term with mean zero and stationary random variable, and b_0 and b_1 are parameters to be estimated. However, the equilibrium exchange rate is unobservable; hence we use the actual real exchange rate (which is observable) to build an empirical model that is consistent with [eq.1].

$$\log e_t = b_0 + b_1 \log F_t + \mu_t \quad [\text{eq.2}]$$

Where, e_t is the actual real exchange rate.

However, movements in the real exchange rate do not necessarily reflect an equilibrium path as speculative bubbles and inconsistent macroeconomic policies could affect it. Nonetheless, in the long run the RER has a mean-reversion property, where the mean is the equilibrium exchange rate towards which the actual RER converges in the absence of new disturbances. A general error correction model (ECM) can capture this dynamics of the RER and can be specified as:

$$\Delta \ln e_t = \alpha (\ln e_{t-1} - \beta F_{t-1}) + \sum u_j \Delta \ln e_{t-j} + \sum \gamma_j \Delta F_{t-j} + v_t$$

Where F_t is the vector of fundamentals and v_t is an independent and identically distributed, mean zero, stationary random variable and α is a parameter that measures the speed of adjustment of the exchange rate disequilibrium. The ECM is stable for $\alpha < 0$.

Practically, the model was first tested by Edwards (1989) himself in the context of a traditional partial adjustment model, using pooled data from 12 developing countries. Similarly, Elbadawi (1994) has tested the model using a single equation cointegration

analysis, after correcting for short-run dynamics. Both these tests revealed that the model outperforms the PPP approach.

2.6.2. The ERES Fundamentals

The kernel of Edwards' model is the specification of the fundamental determinants of the equilibrium exchange rate. At this juncture, it is worthy to explore the dynamic path that the ERES follows in response to disturbances in each of the exchange rate fundamentals: TOT, GCN, CAPCON, TRES, TPI and INV. To this end, Edwards (1989) has outlined the path in a very sophisticated fashion. Below, we have presented a simplified version of Edwards' original outline.

Terms of trade (TOT): TOT is one of the most important external real exchange rate fundamentals that reflects the foreign price shocks that developing countries face. Edwards (1988 and 1989) observed that changes in TOT imply higher domestic prices of importables and thus generates intertemporal and intratemporal substitution effects as well as income effects. As a result the net effect on the ERES is ambiguous. However, the bulk of the empirical literature (for example see Edwards, 1988:7; and Baffes et al, 1999:438) suggests that the income effects of TOT changes overwhelm the substitution effect. Thus, an improvement (deterioration) in TOT leads to an equilibrium real appreciation (depreciation).

Government expenditure (GCN): Government expenditure is another important fundamental variable that affects the ERES. The direction of the movement in ERES associated with changes in government expenditure depends on composition of the expenditure between tradable goods and nontradable goods. If the major portion of the increase in government expenditure is on nontradable goods, then there will be excess demand for nontradables in the short run that bids up the price of nontradables thereby resulting in RER appreciation. However if the large proportion of the increase in government expenditure is directed towards the tradable goods sector, then the relative price of nontradables fall resulting in RER depreciation. The empirical literature, however,

seems to suggest that the share of government expenditure towards nontradables outweigh that of tradables thereby predicting a positive coefficient (for example see Elbadawi, 1994; Mongardini, 1998; Baffes et al, 1999).

Capital controls (CAPCON): Capital controls refer to any restriction or control that results in some impediment on free borrowing and lending of capital to and from the rest of the world. A relaxation of capital controls may affect the long run path of RERE positively or negatively. Edwards (1989) has shown that the liberalizations of capital controls increase the inflow of capital and leads to expansion of monetary base. Chowdhury (1999:8) explains that the expansion of the monetary base “raises current expenditure over income and increases the demand for nontradables.” As a result, prices of nontradables increase in order to maintain internal balance hence resulting in appreciation of the ERER. Therefore, the net effect on ERER of the relaxation of capital controls depends on the net inflow of capital.

Trade restrictions (TRES): This variable refers to countries’ trade policy stance that is mainly reflected by the magnitude and structure of import tariffs and quotas. Trade restrictions, i.e., tariffs and quotas, increase the domestic price of tradables and thus result in both income and substitution effects. Depending on whether the income or substitution effects of trade restrictions dominate the ERER either depreciates or appreciates. Edwards (1988:7) has pointed out that unlike the change in TOT the substitution effect of trade restrictions dominates the income effect. Thus tightening restrictions (i.e., a rise of tariff or a reduction of quotas) leads to a higher relative increase in the price of nontradables thereby resulting in real appreciation of the ERER. On the other hand, declines in trade restrictions, i.e. a shift towards trade liberalization, result in real depreciation of the ERER.

Technological and productivity improvements (TPI): TPI is a non-policy domestic variable that generally increases productivity efficiency. This variable is used to capture the so-called the Ricardo-Balassa-Samuelson hypothesis that states that technological and productivity improvements in rapidly growing economies tend to be concentrated in the

tradable goods sector¹². As a result, the relative price of tradable goods falls thereby resulting in appreciation of the equilibrium exchange rate path¹³

2.6.3. Empirical Framework

The data set spans fifteen years, starting in the first quarter of 1985 and ending in the fourth quarter of 2000. All variables except the technology are in logarithms. For the real exchange rate variable the Producer-price-index (PPI) based real effective exchange rate published by the Reserve Bank of South Africa is used¹⁴. However, data is readily available for the real (effective) exchange rate variable, the TOT and the ratio of investment variable (INV) that are easily obtained from the web site of the Reserve Bank of South Africa. Proxies are constructed for the other variables. These proxies are government consumption on current account (GCA) for the government consumption of nontradables; domestic resource balance (RESBAL)¹⁵ for capital controls¹⁶; openness of the economy (OPEN)¹⁷ for trade and exchange restrictions; the rate of growth of real output (TECH) for the technological and productivity growth variables. Nor does data is readily available for trade competitiveness; hence we used unit labor cost and volume of export as proxies.

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¹² The Ricardo-Balassa-Samuelson hypothesis is widely discussed and broadly accepted hypothesis in the literature (see Edwards, 1989 (136) and Baffes et al (1999)).

¹³ See Balassa, B. (1964) and Samuelson, P. A. (1964).

¹⁴ This CPI-based exchange rate differs from the real exchange rate definition in Edwards model that is based on the relative price of tradables to nontradables. Although this CPI-based effective exchange rate is prone to severe theoretical shortcomings (see Kahn, 1995), modeling it has a more valuable policy relevance (see Aron, 1997).

¹⁵ Following Baffes et al (1999), the domestic resource balance is calculated as: $RESBAL = (\text{export} * TOT - \text{import}) / GDP$, with all the variables in constant 1995 price.

¹⁶ A number of studies including Edwards (1989) have used net capital inflow to proxy capital control. However, in our estimation this variable appeared to be insignificant. Thus, we substituted the ratio of domestic balance to GDP as an alternative proxy (for the same proxy, see Baffes et al, 1999:460).

¹⁷ OPEN is expressed as the ratio of the sum of export to gross domestic product (GDP) and import to gross domestic expenditure (GDE), $[(X/GDP) + (M/GDE)]$, at constant 1995 price.

2.7. Summary

This chapter has outlined the conceptual frameworks of exchange rate misalignment and its impact on the trade competitiveness of an economy. The different analytical models and methodological approaches of equilibrium exchange rate that are developed for measuring exchange rate misalignment have been also critically scrutinized. In the following chapter we will Cautiously examine the property of the data set used within the context of contemporary econometrics modeling practices with a due emphasis on the econometric methodologies used in this study.



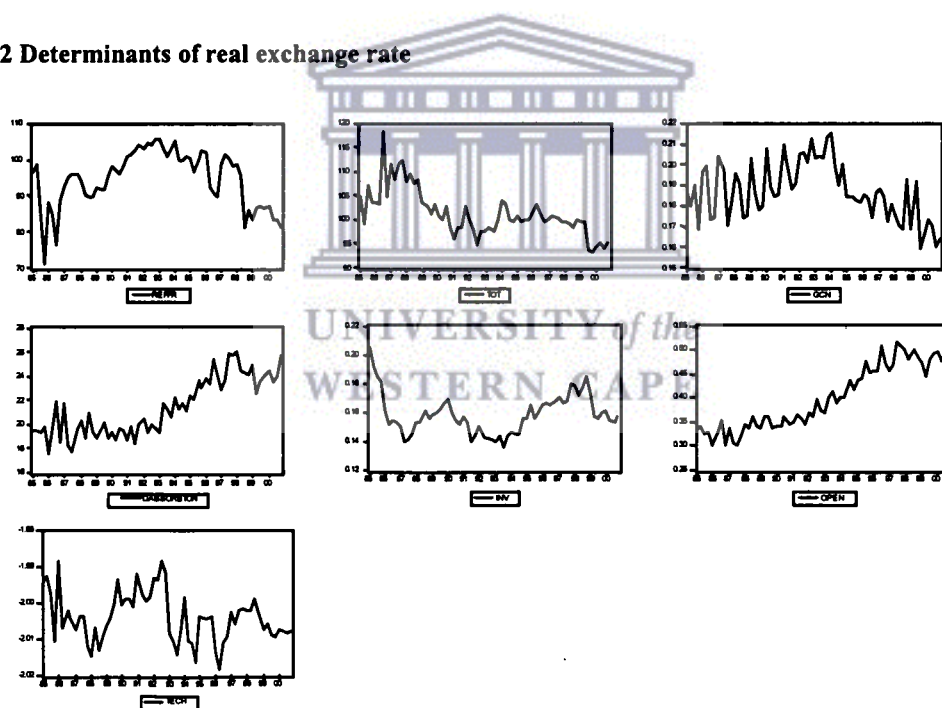
CHAPTER THREE

THE METHODOLOGICAL FRAMEWORK

3.1. The Data

The data set spans fifteen years, starting in the first quarter of 1975 and ending in the fourth quarter of 2000. All variables except the technology are in logarithms. For the real exchange rate variable the Producer-price-index (PPI) based real effective exchange rate that is quarterly published by the Reserve Bank of South Africa is used¹⁸.

Figure 2 Determinants of real exchange rate



Source: computed from data obtained from the reserve bank of South Africa

¹⁸ This CPI-based exchange rate differs from the real exchange rate definition in Edwards model that is based on the relative price of tradables to nontradables. Although this CPI-based effective exchange rate is prone to severe theoretical shortcomings (as sketched in section 1A), modeling it has a more valuable policy relevance (see Aron, 1997).

As with most macroeconomic time series data, the data used in this study appears to be nonstationary. This is clear even from visual inspection of the graphs shown above. Most nonstationary variables exhibit stochastic trends that can be removed by differencing once (Baffes et al, 1999:427). In econometrics parlance, the non-stationarity of a variable implies that its mean, variance and covariance are time-variant. One property of non-stationary variable is that it drifts away from its mean stochastically (randomly) with no mean-reversion property. Since such property influences the statistical properties of alternative estimates, an important first step in econometrics modeling is the determination of the order of integration of the variables in the data set. Variables that are non-stationary at level but become stationary when differenced once are integrated of order one, $I(1)$, whereas, variables that are stationary at level are integrated of order zero, $I(0)$, as they require no differencing. Although rare for macroeconomic data, some variables may require repeated differencing to become stationary, i.e., they are integrated of order d , ($I(d)$, $d > 1$).

3.1.1. Determining The Order Of Integration

The determination of the order of integration of the variables can be readily established using standard econometric tests for the presence of unit roots¹⁹. Most widely used tests, in both theoretical and empirical grounds, are the Dickey-Fuller (DF), the augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. Although each of these tests has limitations that arise from its low power properties²⁰, the ADF test appears to outperform the other alternatives even in small samples (Hamilton, 1994). Nonetheless, we have accompanied the ADF test by DF and PP tests to confirm the consistency of its result.

Table 2, in the Appendix, shows the results of the unit-root test for the real exchange rate and its fundamental variables. The tests reveal that except for the terms of trade (TOT) and

¹⁹ However, it is important to note that all the standard test for unit root developed to date are known for their low-power property in finite samples, meaning that the tests may fail to consistently differentiate between trend-stationary and unit root processes (see, Harris, 1995, Campbell and Perron, 1991).

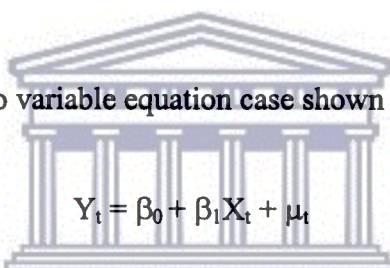
²⁰ That is the tests may over-reject the null of nonstationary when it is true or over-accept the null when it is false.

the technological and productivity growth (TECH) variables that are I(0) the other variables are I(1).

3.1.2. The Econometric Framework

Modern econometrics theory warns that using the I(1) variables at level results in spurious or misleading regression outcomes, except when there exists a cointegration relationship among the variables (Engle and Granger, 1997). In their seminal paper, Engle and Granger defined cointegration as a stationary linear combination of the stochastically trending I(1) variables thereby implying the presence of long run relationship. Thus, a cointegrated group of variables is stationary despite it being a linear combination of individually nonstationary variables.

For example, let us see the two variable equation case shown below.


$$Y_t = \beta_0 + \beta_1 X_t + \mu_t$$

If both Y_t and X_t are I(1), then the existence of cointegration implies that the linear combination of Y_t and X_t is stationary, i.e. $\mu_t = Y_t - \beta_0 - \beta_1 X_t \sim I(0)$.

Stock (1987) has shown that OLS is 'superconsistent' for cointegrated variables. This means that the OLS estimators of β_0 and β_1 converge to their respective true parameters at a much faster rate than the usual OLS estimators of stationary variables. This implies that the OLS estimators are unbiased and efficient. However, Monte-Carlo simulations by Banerjee et al (1993) and Inder (1993) have shown that OLS estimators of cointegrated variables in finite samples are subject to a substantial bias and inefficiency. Moreover, Phillips and Durlauf (cited in Harris, 1995:53) have found the asymptotic distribution of the OLS estimator of β and its associated t-static to be non-normal and thus invalidating standard tests of hypothesis.

Thus, an error correction model that incorporates both the short run and long run dynamics of the relationship among the integrated variables have been recommended by far as the best alternative (see Harris, 1995). Unlike, first differencing technique that removes the stochastic trend components of the nonstationary variables thereby converting them into their stationary variant at the risk of losing long run valuable information, the ECM removes the stochastic trend without losing any long run information embodied in the levels of the variables.

Ascribing to this behavior, ECM has fast become a standard approach in econometrics modeling. Moreover, as previously seen in section 2.4, the ECM is consistent with the estimation of exchange rate misalignment on the basis of Edwards' model.

3.2. The Empirical Methodology

In the foregoing sections we have noticed the frameworks that are used in modern econometric modeling practices. Moreover, we have established the property of the data set used in the study. With this backing the following sections accentuate the particular methodologies that will be used to estimate the real exchange rate misalignment and its impact on trade competitiveness of the South African economy.

3.2.1. Estimating the exchange rate misalignment

The empirical estimations of exchange rate misalignment are all about estimating the equilibrium exchange rate (ERER) and computing the percentage deviation of the actual exchange rate from the equilibrium. The estimations the ERER involve three steps. The first step is estimating the long run parameters of the relationship between the RER and its fundamental variables. The second step is calculating sustainable components for the fundamental variables by removing temporary components from the time series. The third step is deriving the ERER by combining the long run parameters obtained the static model step one with the sustainable components of the fundamental variables.

3. 2.1.1. Step one: estimating an ECM

The first step is to estimate the long-run structural or steady state relationship between the real effective exchange rate variable and the exchange rate fundamentals. However, as already mentioned above, running a regression at level when the variables are I(1) and non-cointegrated results in spurious hence unreliable and misleading outcomes. Moreover, even if the variables are cointegrated there could be small-sample bias in the OLS estimator. Therefore, the first step in the estimation of the equilibrium exchange rate is to estimate an error correction model, which by definition embodies the short run and long run dynamic relationships between the exchange rate and its fundamentals. The general error correction model stated in the theoretical framework can be displayed as:

$$\Delta \ln e_t = \alpha(\ln e_{t-1} - \beta F_{t-1}) + \sum u_j \Delta \ln e_{t-j} + \sum \gamma_j \Delta F_{t-j} + v_t \quad \text{eq.2.1}$$

Where F_t is the vector of fundamentals and v_t is an independent and identically distributed, mean zero, stationary random variable and α is a parameter that measures the speed of adjustment of the exchange rate disequilibrium. The ECM is stable for $\alpha < 0$.

Generally there are two approaches for the estimation of the ECM: or single equation approach such as the Engle-Granger and the autoregressive distributive approaches and the systems equations approach such as Johansen's maximum likelihood which is a multivariate cointegration approach.

The single equation is relatively less complicated than the alternative systems equations approach. The single equation approaches imply the existence of a single cointegration vector between the exchange rate and its fundamentals and that all the fundamental variables are weakly exogenous. Weak exogeneity refers to the property of the joint distribution of the real exchange rate and the fundamentals (Baffes et al, 1999:456). If a variable is said to be weakly exogenous then it affects other variables in the system without itself being affected back by the system.

The econometric literature, backed up supported by Monte-Carlo simulations, reveals that the single equation approaches are appropriate methodologies only in the presence of unique cointegration vector and when all the right hand side variables are weakly exogenous. However, in the presence of more than one cointegration vectors and/or endogeneity of one or more of the right-hand side variable(s), the single equation approaches could result in erroneous parameter estimates and hence misleading policy inference (see Harris, 1995:63). In such a case one has to employ the system equations approaches such as Johansen's maximum likelihood method.

Therefore, testing for the number of cointegration vectors, also referred as determination of the cointegration rank and weak exogeneity of the right-hand side variables are two key steps in the selection of appropriate methodology.

Determining the cointegration rank is a property of the full system (Baffes et al, 1999:432). Thus, clearly, Johansen's maximum likelihood test of cointegration rank is the appropriate test in this case. This test is a test of the general unrestricted model of the joint distribution of the data generating process (DGP). Empirically, this is done within a vector-autoregressive (VAR) specification with all variables of interest entering as jointly endogenous variables. Table 3 in the Appendix discloses the result of the test. The test reveals the existence of one cointegration equation between the real exchange rate and the fundamental variables. The existence of a unique cointegration relationship is a necessary but not sufficient condition for the EG approach.. Sufficiency requires for all the fundamental variables to be weakly exogenous. Box 1 in the Appendix shows that all the exchange rate fundamental variables, save the investment to GDP ratio variable²¹, are weakly exogenous.

²¹ Baffes et al (1999) found similar situation with the INV variable being endogenous for Côte D'Ivoire. To overcome the endogeneity problem they used two-stage-least-squares (2SLS) technique and found comparable result with the Engle-Granger approach. Encouraged by this result, on the one hand, and to avoid cumbersome task, on the other hand, we continue with the Engle-Granger approach assuming weak exogeneity for the investment variable.

3.2.1.1.1 The Autoregressive Distributive Lag (ADL) Model

As briefly mentioned in the previous section, in the presence of a unique cointegration vector and exogeneity of the right-hand side variables, the single equation estimators such as the EG and ADL models are equally appropriate, unbiased and efficient as the multivariate or full-system estimators (see Harris, 1995).

For two nonstationary variables, Y_t and X_t , the presence of cointegration implies that their linear combination is stationary, i.e., $\varepsilon_t \sim I(0)$. In the EG approach testing for cointegration is equivalent to testing for stationarity of the disequilibrium error, ε_t .²² Therefore the first step in the EG approach is to obtain the residual or disequilibrium term from a static model estimated by OLS. This static model that shows the long run equilibrium relationship is the form:


$$Y_t = \gamma_0 + \gamma_1 X_t + \varepsilon_t \quad [\text{Eq.1}]$$

If the variables are cointegrated, then $\varepsilon_t = Y_t - \gamma_0 - \gamma_1 X_t$ is stationary. If this is confirmed then the second step is to estimate the short run ECM as:

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_t - (1 - \alpha) \varepsilon_{t-1} + \mu_t \quad [\text{Eq.2}]$$

Or equivalently as:

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_t - (1 - \alpha) [Y_{t-1} - \gamma_1 X_{t-1}] + \mu_t \quad [\text{Eq.3}]$$

Where, μ_t is an independent and identically distributed, mean zero, stationary random variable, α is a speed of adjustment parameter, and ε_{t-1} (i.e., $Y_{t-1} - \gamma_0 - \gamma_1 X_{t-1}$) is a one period lag of the disequilibrium error retained from the static model.

²² For this purpose DF, ADF or PP tests for unit root can be used albeit with different critical values than the respective tests. Because these tests are based on OLS, their residuals are minimized. Thus they tend to over-reject the null hypothesis of nonstationarity for the residuals thereby over-accepting the null of cointegration. Considering this fact, McKinnon (1991) has calculated the new critical values.

In the two-step approach the static model of [Eq.1] is estimated by OLS on the basis of the ‘superconsistency’ assumption of OLS for cointegrated variables. However, in finite samples, it has been shown that the estimated parameter β of the static model is generally biased, and non-normal. Moreover, as Harris (1995:60) has pointed out, when more complicated dynamic models are required to capture the equilibrium relationship between Y_t and X_t , estimating the static model, [Eq.1], will push more complicated dynamic terms into the residual term, ϵ_t , with the result that the latter can exhibit severe autocorrelation.

Banerjee et al (1993) and Inder (1993) argue that a greater precision in the estimation of β can be achieved by estimating the full dynamics of the model in one-step. This can be done using the autoregressive distributed lag model (ADL), which is a dynamic linear regression model. The general ADL(p,q) model can be specified as:

$$Y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + \beta_0 x_t + \beta_1 x_{t-1} + \dots + \beta_q x_{t-q} + \mu_t$$

Where, μ_t is the usual white noise error. In this study the first order ADL, i.e. ADL(1,1), model is used partly for simplicity and partly due to the limited number of observations in the data set. The ADL(1,1) can be written as:

$$Y_t = \alpha_0 + \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + \mu_t$$

The error correction representation of the ADL(1,1) model is specified as:

$$\Delta Y_t = \phi_0 + \phi_1 \Delta X_t - (1 - \alpha) Y_{t-1} + \phi_2 X_{t-1} + \mu_t$$

Where, $\phi_0 = \gamma_0 (1 - \alpha)$, $\phi_1 = \gamma_1 (1 - \alpha)$ and $\phi_2 = \gamma_2 (1 - \alpha)$. This means that the long run parameters of the equilibrium relationship are obtained by the dividing the long-run coefficients of the ADL estimators by the speed of adjustment parameter, $(1 - \alpha)$.

3. 2.1.2. Second step: calculating sustainable fundamentals

Calculating the sustainable component of each of the exchange rate fundamental variable is the second important step in the estimation of the equilibrium exchange rate. This requires elimination of transitory shocks from the fundamentals. The intuition is that movements in the equilibrium exchange rate are perceived as medium to long-term phenomena that is consistent with the simultaneous attainment of internal and external balances. Therefore, the equilibrium exchange rate is affected only by the permanent or sustainable components of disturbances in the fundamentals while transitory disturbances die-out before affecting the equilibrium exchange rate.

There are a number of methods for computing the sustainable component of the time series data. The most commonly used ones, however, are the counterfactual estimates (see Baffes et al, 1999), the Beveridge-Nelson (B-N) decomposition technique (Beveridge and Nelson, 1981) and the moving-average (MA) technique (see Edwards, 1989 and Mongardini, 1998).

The counterfactual estimates are computed exclusively on the basis of normative judgements as to what are the “desirable” values of the variables of interest. This method requires a great deal of information about the economy under consideration. As Baffes et al (1999:445) put it this method may provide a better methodological alternative “... when small samples make it virtually impossible [for] time-series decomposition methods [such as the Beveridge-Nelson and moving average techniques], ... to distinguish persistent but unsustainable changes ... from genuinely sustainable changes.” However, solely, based on normative judgement this method is likely to embody a ‘judgement-bias’.

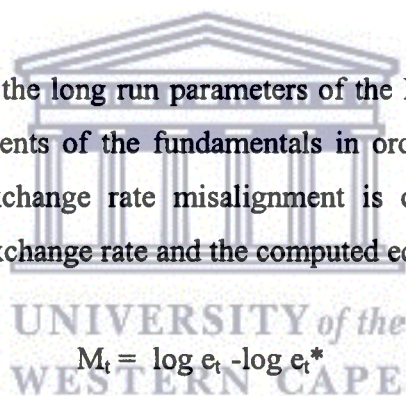
The B-N technique is a statistical method that assumes that the fundamentals each follow a univariate ARIMA (p,1,q) process, with the autoregressive and moving average parts generating stationary fluctuations about an underlying random walk while movements by the unit root part is permanent (Beveridge and Nelson, 1981). However, the B-N technique is computationally complicated and cannot always be applied as the underlying ARIMA

specification may not be available for all variables (Otero, 1999:661). Moreover, as Baffes et al (1999:444) have spelled out the B-N decomposition technique models turning points of the variables in economically implausible ways.

In this research, following Edwards (1989) and Mongardini (1998), we have used five quarters moving-average technique in order to isolate the permanent components of the exchange rate fundamental variables from their respective transitory components. One major limitation of this technique is that it drops the first four observations of the fundamentals. To overcome this limitation, we have smoothed the data beginning from the first quarter of 1984, thus no observation is dropped from the specified sample period.

3.2.1.3. Step three: calculating the ERER

The third step is to combine the long run parameters of the ECM obtained from step one with the sustainable components of the fundamentals in order to derive the equilibrium exchange rate. Then the exchange rate misalignment is computed as the percentage difference between the real exchange rate and the computed equilibrium value, i.e.



$$M_t = \log e_t - \log e_t^*$$

Where, M_t is the exchange rate misalignment at period t , e_t and e_t^* are the actual and equilibrium exchange at period t respectively.

3.2.2. Estimating the impact of RER misalignment on trade competitiveness

In order to investigate the effect of misalignment on the competitiveness of the South African economy we have established impulse-response analysis and variance decomposition techniques of a cointegrated VAR between the exchange rate misalignment index and the two proxies of competitiveness-unit labor cost index and volume of merchandize export. The impulse response analysis shows the behavior of the trade

competitiveness proxies in response to a one unit positive shock (change) in the RER misalignment index. For the purpose of calculating the impulse response function we estimated an unrestricted vector autoregressive (VAR) between each proxies of the competitiveness and the exchange rate misalignment indices:

$$A(L)X_t = \mu_t ,$$

Where $X_t = (\Delta t, \Delta m)$, where t and m are the trade competitiveness index and the misalignment index respectively. On the basis of Akaike's information criteria and the Bayesian information criteria the lag length of the VAR is chosen to be four in order to assure Guassian error term.

The inverse of $A(L)$, gives the moving average representation $X_t = A(L)^{-1}\mu_t$. The dynamic response of the variables Δt and Δm to a unit shock in Δm and Δt respectively is evaluated by orthogonalizing μ_t by means of a Choleski factorization so that $\varepsilon_t = B\mu_t$, with B chosen to be a lower triangular matrix such that $B\Omega B' = I$, where I is a diagonal matrix. Thus $X_t = C(L)\varepsilon_t$, where

$$C(L) = A(L)^{-1} B(L)^{-1} = \begin{vmatrix} C_{11}(L) & C_{12}(L) \\ C_{21}(L) & C_{22}(L) \end{vmatrix}$$

The response of Δt and Δm to a unit shock in t is given by $C_{11}(L)$ and $C_{21}(L)$ respectively. Similarly, C_{12} and C_{22} give the response of the trade competitiveness and the RER misalignment indices to a unit shock in the misalignment index respectively. Several econometrics soft wares routinely do such computations. Moreover, we have done a variance decomposition²³ analysis in order to determine the extent of the variations in the unit labor cost index that is attributed to the variations in the exchange rate misalignment.

²³ The variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR.

3.3. Summary

This chapter has briefly outlined the methodology used in this study within the context of the modern practices of econometric modeling. The existence of a unique cointegration relationship and weak exogeneity of the exchange rate fundamental variables are also confirmed. With this backing we have spelled out the dynamic single equation error correction model (ECM) of a first order autoregressive distributive lag, ADL(1,1), as appropriate approach for modeling the exchange rate misalignment in this particular study. We have also pointed out that impulse response analysis and variance decomposition techniques of a cointegrated vector autoregression (VAR) modeling are employed in assessing the impact of the misalignment on South Africa's international trade competitiveness. The following chapter provides a vigilant analysis and interpretation of the empirical results that are obtained from the study.



CHAPTER FOUR

EMPIRICAL RESULT: PRESENTATION AND ANALYSIS

4.1. Overview

In the previous two chapters we have outlined the main theoretical literatures of exchange rate misalignment and its impact on exchange rate misalignment. Briefly browsing through the current econometrics modeling practices, the preceding chapter underlined the appropriate methodology that is employed in this study. The current chapter presents the empirical results of the study with a cautious interpretation and analysis. The chapter has two main parts: the first part presents and analysis the estimated misalignment whereas the second part deals with the empirical results of the impact of the misalignment on competitiveness based on the results from the impulse response and variance decomposition analyses outlined in the previous chapter.

4.2. Estimating The Real Exchange Rate Misalignment

As outlined in the previous chapter, the estimations of the real exchange rate misalignment embody three steps. The current section thus attempts to present and analyze the outcomes of the three steps in as simple and comprehensive manner as possible. In doing so we will first present and analyze the error correction model (ECM) of the ADL(1,1) approach followed by the derivation of the equilibrium exchange rate. We will then compute the misalignment of the exchange rate.

4.2.1. The ADL(1,1) Error Correction Model (ECM)

Table 1 shows the estimated parsimonious Error Correction Model of the real exchange rate. The result is satisfactory by all of the diagnostic tests shown at the bottom of table 1.

The tests cover: the adjusted R^2 that measures the goodness-of-fitness of the model showing that 67.64 percent of variations in RER is explained by the fundamentals.

Table 1: Error Correction Model (ECM)

ADL(1,1) ECM		
	Coefficient	t-statistics
Constant	17.42	3.90
Adjustment Speed		
log(REFFR _{t-1})	-0.42	-5.35
Long-Run Parameters		
log(TOT _{t-1})	1.60	3.42
Log(GCN _{t-1})	0.61	2.70
Log(INV _{t-1})	-0.52	-2.39
Log(OPEN _{t-1})	1.30	3.26
Log(RESBAL _{t-1})	-1.32	-3.01
TECH _{t-1}	7.33	3.39
Short-Run Parameters		
Δlog(TOT)	-0.05	-0.11
Δlog(GCN)	0.52	3.04
Δlog(INV)	-0.83	-2.75
Δlog(OPEN)	0.19	-0.81
Δlog(RESBAL _{t-2})	0.12	0.88
ΔTECH	8.98	3.73
Dummies		
Dum98	-0.24	-2.95
Dum00	-0.17	-6.05
Dum92	-0.10	-2.11
Dum85	-0.26	-3.32
Diagnostic Tests		
Adjusted $R^2 = 0.6764$; $F(17,60) = 8.7478$ [0.0000]; $\sigma = 0.0574$; DW = 2.0372; AR 1-5 $F(5,55) = 1.4433$ [0.2294]; ARCH 5 $F(5, 50) = 1.8693$ [0.1154]; X_i^2 $F(13,47) = 1.3930$ [0.1768]; RESET $F(1, 59) = 0.1719$ [0.6894]; Normality $\chi^2(2) = 4.1433$ [0.1260]		

Note: The long-run parameters are obtained by dividing the long-run parameters of the ADL (1,1) ECM by the speed of adjustment parameter.

An F-test that all the right-hand side variables, except the constant term, have zero parameter elasticities. σ is the standard deviation of the regression. DW is the Durbin-Watson statistic test for first order autocorrelation (which is strictly not applicable in the presence of a lagged dependent variable). The LM test shows the Breusch-Godfrey test for serial autocorrelation up to the fifth lag obtained from regression of the residual from the original model on all the regressors of the model and lagged residuals. The ARCH test is a test for autoregressive conditional heteroscedasticity up to the fifth lag, obtained by regressing the squared residuals from the model on their lags (here up to the fifth lag) and a constant. The X_i^2 test shows White's heteroscedasticity test obtained by regressing the squared residuals on the level and square of the regressors of the original model. The RESET test is Ramsey's general test of mis-specification obtained by adding powers of the fitted values from the model. The last test is the Jarque-Bera test for normality of the distribution of the residual term. None of the diagnostic tests except the F-test that all the elasticities are zero are significant at 95 percent critical values suggesting that the model be correctly specified.

The estimated long run parameters of the model fairly corroborate the theoretical model. The speed of adjustment is fairly fast showing that 42 percent of the disequilibrium in exchange rate is offset by short run adjustments in each period. This coefficient is significant at 5 percent level and has the right sign indicating that negative short run adjustments correct positive deviations from the equilibrium.

The elasticity of the RER with respect to the terms of trade is found to be 1.60 in the long run showing that a one-percent improvement in the terms of trade appreciates the real effective exchange rate by 1.60 percent. This result is consistent with the bulk of the literature showing that the income effect of this variable dominates the substitution effect.

In line with the literature, the estimated elasticity for the government consumption (GCN) variable is positive and significant indicating that the larger share of government consumption is on nontradables. The estimated coefficient shows that the exchange rate appreciates by 6.1 percent in response to 10 percent increase in GCN.

The coefficient of INV, the ratio of investment to gross domestic product, is negative and significant indicating that the exchange rate depreciates by 5.2 percent in response to 10 percent increase in INV. This result is consistent with the theory that an increase in investment shifts consumption towards traded goods (Edwards, 1989). Intuitively, this result discloses that increase in fixed investment in developing countries results in a higher demand for imports thereby pressurizing domestic currency to depreciate.

Contradictory to the bulk of the empirical evidence as pointed out by Edwards (1989) and Elbadawi and Soto (1995), the coefficient of the openness variable, OPEN, is appeared to be positive and significant. This result shows that the income effect of trade liberalization dominates the substitution effect and reflects the fact that the trade liberalization and the subsequent integration of South Africa to the rest of the world, from its previously isolated status, has led to a large net influx of capital.

The estimated coefficient for the domestic absorption variable (DABS) is negative and significant at 5 percent level. This elasticity shows that the real effective exchange rate depreciates by 1.32 percent in response to a percentage increase in domestic absorption. This result is consistent with the findings obtained by Edwards (1989), Elbadawi and Soto (1985) and Baffes et al (1999) and shows that a decrease in net capital inflows, which induces an increase in resource balance²⁴, results in equilibrium depreciation.

The technological advancement variable that is used to proxy the Ricardo-Balassa-Samuelson effect is also statistically significant and positive, as expected by theoretical model. The result shows that a percentage improvement in production technology appreciates the RER by 7.33 percent in the long run and by 8.98 percent in the short run. The result suggests that technological and productivity growth has a dominant effect on both long run and short run movements of the real exchange rate.

The short-run parameters of Table1 show the short run impact of the fundamentals on the RER (in the estimation of equilibrium exchange rate the short-run parameters are not of

²⁴ See Baffes et al, 1999:438.

interest, but they are included in the model for measurement precision in obtaining the long-run parameters). The short-run dynamics of the ECM also include four dummy variables that are established on the basis of CUSUM and one-step-ahead residual forecast tests of parameter stability.²⁵ The dummies are statistically significant and capture quantitatively unexplained factors that impacted the RER to depreciate. The first dummy, Dum98 that assigns 1 for 1998:3 and 1999:1, coincides with the contagion of the Asian financial crisis and the subsequent huge outflow of capital. Whereas, the other dummy variables-Dum00 (assigning 1 for 2000:2), Dum92 (assigning 1 for 1992:4), and Dum85 (assigning 1 for the 1985:1 and 1986:3)-can be regarded as outlier dummies.

4.2.2. Estimating The Equilibrium Exchange Rate

As pointed out in the previous chapter, combining the long run parameters of the ECM with the sustainable components of the fundamentals derives the equilibrium real exchange rate, ERER. The resulting ERER index can be specified as:

$$\begin{aligned} \text{Log(ERER)} = & 17.42 + 1.60\text{log(TOT}^*) + 0.61\text{log(GCN}^*) - 0.52\text{(INV}^*) + 1.30\text{log(OPEN}^*) \\ & - 1.32\text{log(RESBAL}^*) + 7.33\text{(TECH}^*) \end{aligned}$$

Where the asterisks over the variables indicate that they are the sustainable components of the fundamentals.

²⁵ This is routinely done by several econometric softwares and involves recursive least squares to the model over successive time periods by increasing the sample period by one additional observation.

Figure 3. South Africa: The logarithm of actual vs. equilibrium effective exchange rate (1985:1-2000:4)

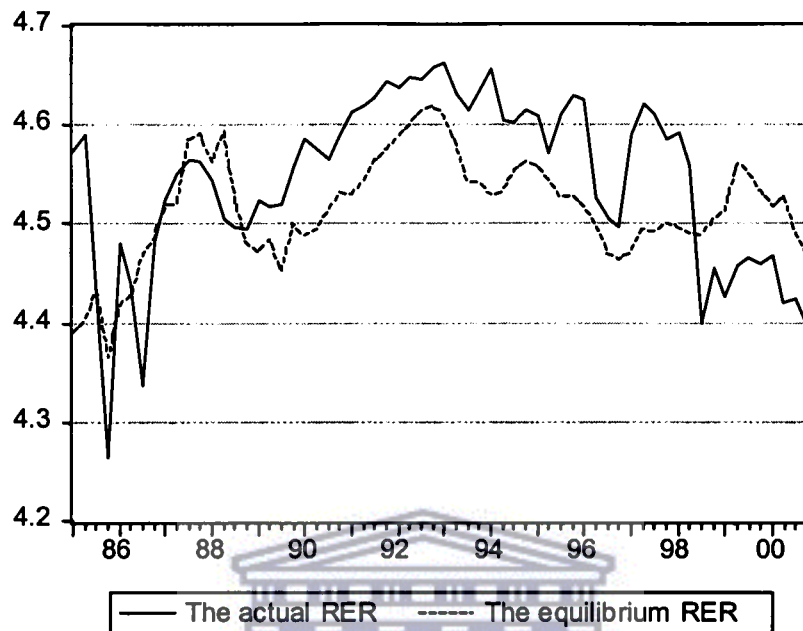
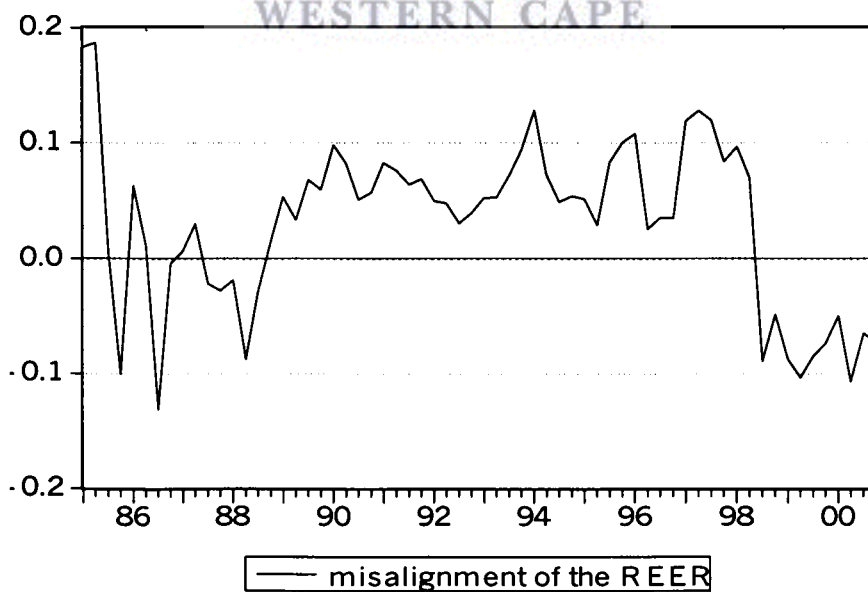


Figure 4. South Africa: Real Effective Exchange Rate Misalignment (1985:1 – 2000:4)



Two distinct natures of the misalignment episode can be discerned from figure 2. The first is the overvaluation episode that ranges from 1988:3 until 1998:1, while the second episode is the period of undervaluation that constitutes two distinct periods ranging from 1985:1-1988:2 and 1998:2-2000. The first episode had been characterized by a relatively tranquil and stable political condition while political instability of the mid-1980s that includes the debt crisis of 1985 and the gold price shock of the 1980s²⁶ and the financial crisis of the late 1990s characterized the second episode. For example in the second half of 1997 alone, the country experienced a speculative short-term capital outflow close to 5.8 rand (South Africa Foundation, 1998:5).

4.3. Effect Of The RER Misalignment On Trade Competitiveness

In the previous chapter we have delineated that the impulse response analysis and the variance decomposition technique of a cointegrated VAR are the methods that this study employs to analyze the effect of exchange rate misalignment on international trade competitiveness of the South African economy. The succeeding sections in the current chapter depict and evaluate the results of these methods.

4.3.1. Impulse Response Analysis

Figure 5 and Figure 6 below show the response of trade competitiveness, respectively using unit labor cost and volume of merchandise export as proxies, to a positive one standard deviation shock in real exchange rate misalignment. In figure 5 the positive shock in exchange rate misalignment, which is an overvaluation, results in a significant increase in the long-run elasticity of the unit labor cost. However, in the first two quarters that can be perceived as the short run elasticities the effect of the misalignment on unit labor cost is small. After the second quarter the increase in unit labor cost is relatively significantly large, reaching 1.8 percent in the sixth quarter. Similarly, Figure 6 shows the response of merchandise export to one standard deviation shock in real exchange rate misalignment. In the short run, especially from the second to the sixth quarters the exports of merchandise

²⁶ See Kahn (1994:6).

goods increase by average of 1.5 percent. However, from the sixth quarter onwards the export declines by a sustainable average of 1.6 percent.

In general, the result from both figure 5 and figure 6 is consistent with the literature and shows that an increase in RER misalignment results in a significant and persistent deterioration of the trade competitiveness of the South African economy with a time lag of 2 to 6 quarters.

Figure 5. South Africa: Response of unit labor cost to real exchange rate misalignment shock (percent).

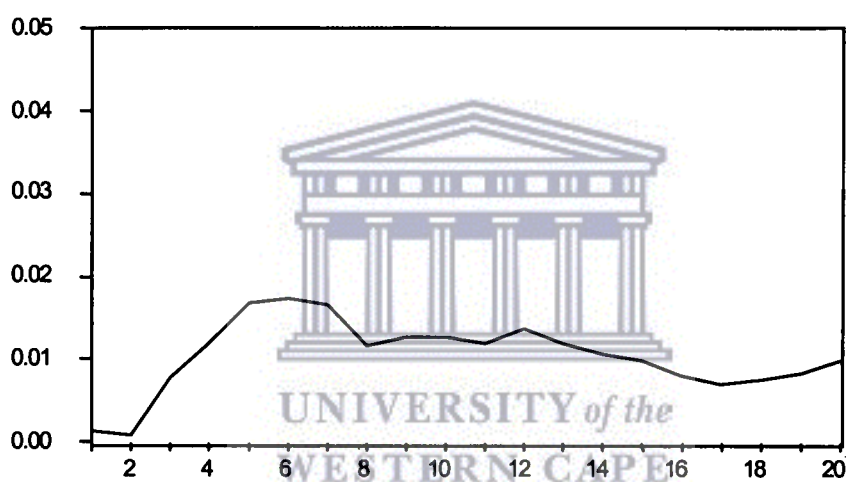
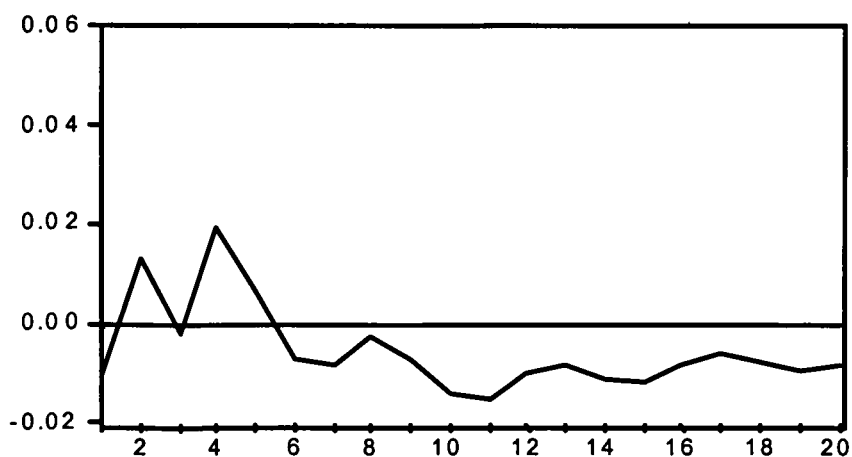


Figure 6. South Africa: Response of merchandize export to real exchange rate misalignment shock (percent).



4.3.2. Variance Decomposition Analysis

Figure 7 and Figure 8 present the forecast variance decompositions that are another important ways of assessing the relative importance of shocks in real exchange rate misalignment in accounting for variation in trade competitiveness of the South African economy at various time horizons. Consistent with the above finding, the exchange rate misalignment accounts for a smaller variation in both unit labor cost and merchandize export in the short run, average of two quarters. However, in long time horizon the exchange rate misalignment accounts for more than 20 percent of the variation in unit labor cost and merchandize export. This result can be interpreted as revealing that movements in exchange rate misalignment accounts for about 20 percent of the variation in the long run trade competitiveness of the South African economy.

Figure 7 variance of unit labor cost due to real exchange rate misalignment (percent).

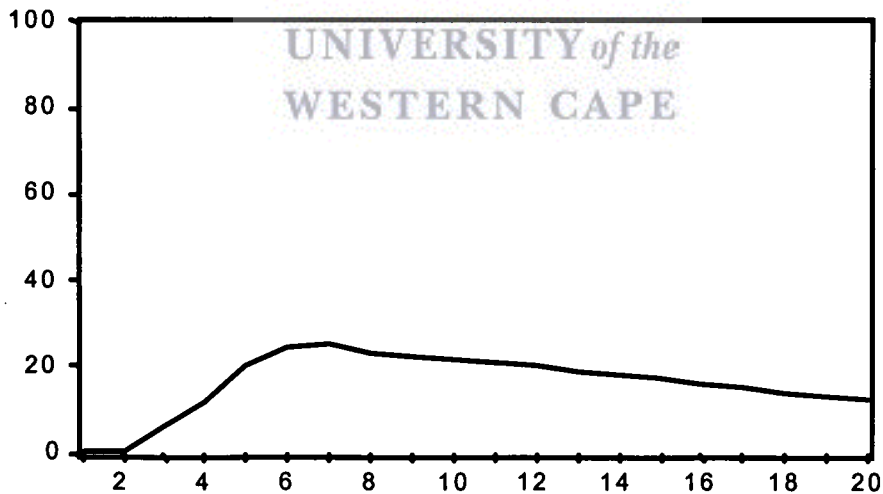
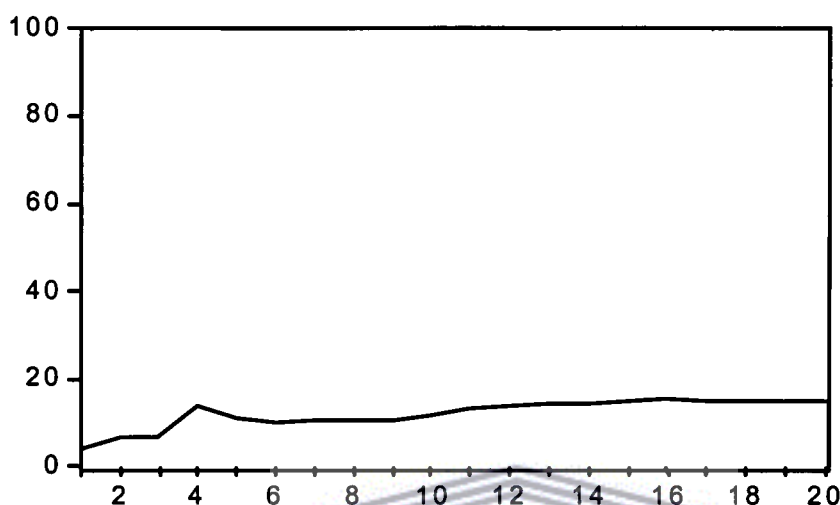


Figure 8. South Africa: Figure 5 variance of unit labor cost due to real exchange rate misalignment (percent)



In summing up, the result from the empirical estimations show that the real exchange rate had been overvalued during the period 1988:3-1998:2, whereas it had been undervalued for most of the periods between 1985:1-1988:2 and consistently undervalued during 1998:3-2000:4. The overvaluation episode of the misalignment had been characterized by periods of relative political stability, removal of sanction and integration of the South African economy into the global market. In contrast, political and social unrest and Periods of international financial crisis that have impacted the South African economy characterize the two distinct episodes of the currency undervaluation. Revealing that exchange rate misalignment accounts for about 20 percent of the variation in unit labor cost and volume of merchandise export in South Africa, the study disclosed the incapacitating effect of exchange rate misalignment on South Africa's trade competitiveness. Moreover, consistent with the 'trade-hysteresis' literature, this study shows that the impact of the misalignment on trade competitiveness is felt over prolonged periods, albeit through time lags of two to four quarters.

4.4. Summary

This chapter has presented the results of the study with a brief analysis and interpretations. The results have shown that the real exchange rate of the rand had been misaligned with uninterrupted overvaluation during the periods of 1988:3-1998:2 and conversely undervalued in a row during 1998:3-2000:4 and during most periods of 1985:1-1998:2. The results from the impulse response and variance decomposition analysis have shown that the misalignment of the exchange rate and especially the overvaluation episodes debilitate the international trade competitiveness of the South African economy for a prolonged period of time by accounting for about 20 percent of its variation. The next chapter provides a conclusion of the research and draws policy recommendations intended for minimizing the frequency and magnitude of exchange rate misalignment. Moreover, the chapter offers few comments for further studies.



CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

Questions pertaining to the misalignment of exchange rate have become central issues in the analysis of macroeconomic policies in emerging and developing countries due to at least two reasons: first persistent overvaluation of currency is seen as powerful early warning of currency crises. And second, situations of protracted real exchange misalignment have been associated with poor economic performance in a number of developing countries. Although the impact of overvaluation is more accentuated, undervaluation of a currency also halts economic performance through inflation and through discouraging consumption and investment.

The misalignment of exchange rate, especially overvaluation, affects growth primarily through its effect on the competitiveness of the tradables sector vis-à-vis the rest of the world and subsequent impact on investment hence capital accumulation. The impact of the misalignment on competitiveness is a prolonged problem. This is mainly due to the 'hysteresis effect' that competitiveness does not depend on price of goods alone but also on invisible assets in market position such as distribution networks and customer loyalty. Thus the overvaluation of currency that makes domestic goods relatively expensive can lead to a loss of the invisible assets that are difficult to regain. As a result it is crucial for economies to consistently assess and adjust substantial currency misalignments in order to avoid (potential) economic distresses.

However, the estimation of the exchange rate has remained to be among the most challenging and controversial issues in modern macroeconomics. As a result a number of analytical frameworks have been developed in attempts of bridging the controversies. For several decades the purchasing power parity approach (PPP) that is based on the law of one

price has been the most widely used analytical scenario in most developed and developing countries. However, large number of empirical studies that have been undertaken in the context of both developed and developing countries has shown that PPP does not hold except in the ultra long run. Moreover PPP's assumption of a constant equilibrium exchange rate makes it ill fitted to serve as a benchmark for the analysis of the exchange rate in countries such as South Africa that has experienced substantial structural changes.

Counting on the failure of PPP a number of structural macro-econometric models that relay on the macroeconomic fundamentals of exchange rate have been developed, albeit with little applicability for developing countries. Nonetheless, Edwards (1989) did the seminal work in the developing countries context by developing a model of equilibrium exchange rate that captures most stylized features of the developing countries. This model, called Edwards' intertemporal general equilibrium model of a small open economy, assumes exogenously fluctuating terms of trade, existence of capital, exchange and trade controls.

Based on Edwards' model of equilibrium exchange rate, this study has attempted to estimate the degree of exchange rate misalignment in South Africa. To this end an error correction model (ECM) was estimated using a one-step Engle-Granger approach followed by five years moving average technique to derive sustainable components of the exchange rate fundamental variables. Combining the long-run parameters of the ECM with the sustainable components of the exchange rate fundamentals then derived the equilibrium exchange rate. Finally, the misalignment was computed by subtracting the logarithm of the actual exchange rate from the logarithm of the equilibrium exchange rate.

The result has shown that the exchange rate was misaligned for most of the periods under the study. Similarly, impulse response and variance decomposition analyses of cointegrated VAR (vector error regression) were established to simulate the impact of the exchange rate misalignment on the international trade competitiveness of the South African economy. Consistent with the bulk of the literature, the simulation results have shown that the exchange rate misalignment debilitates South Africa's long-term international trade competitiveness for a prolonged period of time. Moreover the result has disclosed that the

exchange rate misalignment accounts for about 20 percent of the variation in the trade competitiveness of the economy, although the effect is felt only through a time lag of two to four quarters on average.

5.2. Recommendations

As we have seen in the introduction section of this study, achieving a higher level of export and investment has been regarded as vital development strategy for attaining and maintaining sustainable and higher levels of development. We have also mentioned that the Growth, Employment and Redistribution (GEAR) strategy in South Africa is one such strategy that aspires to build a vivacious and dynamic export-led economy where the private sector plays a central role.

Achieving this goal is however a nontrivial task that among other things requires the implementation of appropriate and consistent economic policies that would enable market forces to set accurate prices for both commodities and currencies. Being a relative price of baskets of commodities, exchange rate plays a dominant role in the expansion of the volume of exports.

The economics literature shows a strong evidence of consensus among economists that both the volatility and misalignment of exchange rate negatively impacts economic performance of an economy. Higher short-run volatility of exchange rate is nuisance to investors. However, citing empirical researches, Goldstein (1995:5) has showed that the volatility of exchange rate seems to have a lesser impact due to the availability of instruments such as swaps, options, futures and forwards that hedges exchange rate risks. Therefore, more emphasis has recently been given to the misalignment of exchange rate, which impacts economic performance, and more directly trade- competitiveness for a prolonged period of time. Therefore, policy makers should regularly monitor the real exchange rate path for the purpose of corrective interventions that aim at aligning the exchange rate as close to its equilibrium path as possible.

Ensuring values of exchange rate that are closely aligned to the equilibrium exchange rate, however, is a complicated and challenging task that requires the removal of any policy, institutional or structural rigidities that prevents the real exchange rate from reflecting changes on the macroeconomic fundamentals of the economy. Moreover, bubble factors such as self-fulfilling speculative attacks on exchange rates can move the actual exchange rate away from its equilibrium path thereby resulting in exchange rate misalignments. Although, the cause of speculative attacks cannot readily be known, as they could partly be exogenous to the system, it is apparent that poor domestic policy fundamentals make currencies more susceptible for frequent speculative attacks. Therefore, authorities should at all times strive to maintain sound, consistent and credible macroeconomic policies to insulate the exchange rate from negative speculations and subsequent misalignment and economic distresses.

5.3. Comment For Future Research

Inflation targeting has been adopted as the overriding policy framework of the Reserve Bank of South Africa. Under this framework the Bank is ultimately accountable to the public on whether it has achieved a pre-publicized range of inflation target, which is set to be 3 to 6 percents.

In order to meet the target, the bank has been intervening in financial markets primarily to influence the dynamics of exchange rate movements. For example, in response to the depreciation of the rand the bank has hiked interest rates four-times this year alone. As a result, it could be argued that the bank's intervention in the financial market merely to meet the targeted inflation level sets restriction on the flexibility of the exchange rate and exposes the currency for speculations and subsequent misalignments. Moreover, as this study revealed, exchange rate misalignment debilitates the international trade competitiveness of the South African economy. Thus, the ultimate success of the bank, from social benefit perspective, could be measured by the net benefit gained from lower inflation and the (potential) loss of competitiveness due to the upward pressure on exchange rate that might be exerted by the Bank. Thus, it would be informative to

policymakers if future studies in the area address the trade-off in welfare between achieving the inflation target and associated exchange rate misalignment and loss of competitiveness.



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APPENDIX

Table 2: Unit Root Test for the RER Fundamentals.

	Levels of the variables			First differences of the variables		
	DF	ADF	PP	DF	ADF	PP
Variables with intercept						
Log(REFFR)	-2.27	-2.63	-2.45	-11.09**	-4.82**	-11.09**
Log(TOT)	-3.37*	-4.02**	-3.34*	-14.04	-4.12	-13.82
Log(GCN)	-2.39	-2.75	-3.18*	-16.38**	-4.27**	-16.98**
Log(OPEN)	-1.74	-0.97	-1.13	-17.97**	-4.54**	-19.09**
Log(INV)	-1.66	-1.28	-1.37	-13.12**	-3.47**	-13.48**
TECH	-8.99**	-4.57**	-9.15**	-18.78**	-7.66**	-22.88**
Log(RESBAL)	-2.30	-1.21	-1.75	-13.18**	-5.84**	-18.41**
Variables with intercept and time trend						
Log(REFFR)	-2.39	-2.73	-2.56	-11.08**	-4.85**	-11.08**
Log(TOT)	-3.34**	-4.08**	-3.28	-14.14**	-4.24**	-13.96**
Log(GCN)	-1.82	-0.36	-1.29	-16.93**	-5.12**	-18.79**
Log(OPEN)	-1.78	-1.08	-1.13	-18.31**	-5.40**	-20.62**
Log(INV)	-3.00	-2.24	-2.83	-13.08**	-3.45**	-13.45**
TECH	-9.02**	-4.65**	-9.18**	-18.70**	-7.63**	-24.42**
Log(RESBAL)	-5.25**	-2.42	-5.46**	-13.18**	-5.78**	-18.23**

Note: DF, ADF and PP refer to Dickey-Fuller, Augmented Dickey-Fuller and Phillips Perron unit-root tests. * and ** refer to rejection of the null of nonstationarity at 5% and 1% respectively.

Source: computed from data obtained from the South African reserve bank statistic. The sample Period is 1985:1-2000:4.

Table 3: Test for Cointegration Rank.

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesize No. of CE(s)
0.446475	111.1884	109.99	119.80	None *
0.362934	75.11003	82.49	90.45	At most 1
0.293659	47.60619	59.46	66.52	At most 2
0.179313	26.39907	39.89	45.58	At most 3
0.143626	14.34462	24.31	29.75	At most 4
0.067262	4.886666	12.53	16.31	At most 5
0.010424	0.639184	3.84	6.51	At most 6

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Box 1: Test for Weak Exogeneity.

Cointegration Restrictions: $A(2,1)=0$, $A(3,1)=0$, $A(5,1)=0$,
 $A(6,1)=0$, $A(7,1)=0$ (Restriction on TOT, GCN, RESBAL, OPEN and
TECH respectively).

Result:

The LR test, Chi-Square(5) = 6.717384, p-value = 0.242521

The p-value is significantly greater than the standard 10% rejection value suggesting accepting the null of exogeneity. Also note that $A(4,1)$, the restriction test for INV, was rejected both separately and jointly with the other variables indicating that investment is endogenous.



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