EXCHANGE RATES BEHAVIOUR IN GHANA AND NIGERIA: IS THERE A MISALIGNMENT?

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DECLARATION

Except for references specifically indicated in the text, and such help as has been acknowledged, this thesis is wholly my own work and has not been submitted to any other University, Technikon or College for degree purposes.

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ABSTRACT

Exchange rates are believed to be one of the major driving forces behind sustainable macroeconomic growth and it is therefore important to ensure that they are at an appropriate level. Exchange rate misalignment is a situation where the actual exchange rate differs significantly from its equilibrium value, resulting in either an overvalued or an undervalued currency. The problem with an undervalued currency is that it will increase the domestic price of tradable goods whereas an overvalued currency will cause a fall in the domestic prices of the tradable goods. Persistent exchange rate misalignment is thus expected to result in severe macroeconomic instability. The aim of this study is to estimate the equilibrium real exchange rate for both Ghana and Nigeria. After so doing, the equilibrium real exchange rate is compared to the actual real exchange rate, in order to assess the extent of real exchange rate misalignment in both countries, if any such exists.

In order test the applicability of the equilibrium exchange rate models, the study draws from the simple monetary model as well as the Edwards (1989) and Montiel (1999) models. These models postulate that the variables which determine the real exchange rate are the terms of trade, trade restrictions, domestic interest rates, foreign aid inflow, income, money supply, world inflation, government consumption expenditure, world interest rates, capital controls and technological progress. Due to data limitations in Ghana and in Nigeria, not all the variables are utilised in the study. The study uses the Johansen (1995) model as well as the Vector Error Correction Model (VECM) to estimate the long- and the short-run relationships between the above-mentioned determinants and the real exchange rate. Thereafter the study employs the Hodrick-Prescott filter to estimate the permanent equilibrium exchange rate. The study estimates a real exchange rate model each for Ghana and Nigeria. Both the exchange rate models for Ghana and Nigeria provide evidence of exchange rate misalignment. The model for Ghana shows that from the first quarter of 1980 to the last quarter of 1983 the real exchange rate was overvalued; thereafter the exchange rate moved close to its equilibrium value and was generally undervalued with few and short-lived episodes of overvaluation. In regard to real exchange rate misalignment in Nigeria prior to the Structural Adjustment Program in 1986 there were episodes of undervaluation from the first quarter of 1980 to the first quarter of 1984 and overvaluation from the second quarter of 1984 to the third quarter of 1986; thereafter the exchange rate was generally and marginally undervalued.

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I dedicate this thesis to my loving parents, Mr and Mrs Mapenda.

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INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

An analysis of the behaviour of exchange rates is important because there is a growing body of evidence that highlights the significant role they play in macroeconomic stability and economic growth. Some major events have taken place worldwide which highlight the importance of exchange rates in maintaining economic stability and these include the 1994 economic crisis in Mexico, the collapse of the currency in Argentina, the collapse of the Latin American currencies in the 1980s, and the exchange rate crises in England and Spain in the 1990s. In addition, empirical evidence has shown that the real exchange rate is a good measure of how well a country's economy is performing in international trade. Examples of literature and empirical studies include Edwards (1989) and Eichengreen (2008) who suggest that the exchange rate plays an important role in the growth of an economy, due to its effect on a country's competitiveness in international trade. It is thus important for policy makers to ensure that the exchange rate is well aligned in order to stimulate the growth of the economy.

Of particular importance is limiting the extent of exchange rate misalignment to avoid economic underperformance. Aliyu (2007:3) argues that exchange rate misalignments can be associated with worsening terms of trade, a fall in export competitiveness and stunted economic growth. In addition Kemme and Roy (2006:208) argue that less-developed or emerging market economies ought to maintain the real exchange rate (RER) at or near its equilibrium level in order to realise successful development strategies. In light of the above assertions, it is important to analyse the extent of possible exchange rate misalignment in Ghana and in Nigeria.

Exchange rate misalignment is defined as "a situation in which actual real exchange rate (RER)[1] differs significantly from its long-run equilibrium value" (Montiel, 1999:1). By definition, when the value of the observed RER at current period is above the equilibrium RER value, it indicates an overvalued RER. If the value of the RER at current period is below the value of the equilibrium RER, it is said to be an 'undervalued' RER. The main problem with real exchange rate misalignment

[1] The commonly used exchange rate, the Real Exchange Rate (RER), can be defined as the relative price of tradable goods to non-tradable goods (Edwards, 1988).

is that an overvalued currency will make foreign goods relatively cheaper than domestic goods. This will result in an increase in the demand for foreign goods as domestic consumers shift their consumption from domestic goods to foreign goods. This will cause a fall in demand for domestic goods, which will place downward pressure on the prices of domestically produced goods. The brunt of the fall in prices is in the tradable goods sector, thus an overvalued currency results in a fall in the domestic prices of goods in the tradable sector which would affect domestic production. An undervalued currency on the other hand will raise the domestic prices of products in the tradable goods sector.

Prolonged RER misalignment is expected to result in severe macroeconomic instability. Edwards' (1988:312) policy evaluations reveal that among developing countries, the countries which perform better than others with regard to macroeconomic performance, have a real exchange rate which is at an appropriate level. Furthermore, Ghura and Grennes (1993) use cross-sectional as well as time series data for 33 sub-Saharan African countries and their evidence confirms a negative relationship between RER misalignment and economic performance[2]. This has motivated further studies on the effects of exchange rate misalignment in low income countries such as those by Edwards (1989), Hinkle and Montiel (1999) and Di Bella *et al* (2007).

Sectors such as agriculture, which have a strong tradable component, are likely to be affected significantly by exchange rate misalignment. This is particularly relevant to Ghana and Nigeria, whose agricultural sectors are important contributors to their Gross Domestic Products. The Dutch disease in Nigeria due to oil boom of the 1970s for instance brought about tough competition for their export sectors, particularly the agricultural sector, thus weakening the economic performance of these sectors. A loss in competitiveness in the tradable goods sector prompted the Structural Adjustment Programs in Ghana and Nigeria in 1983 and 1986 respectively, in an attempt to correct the misaligned exchange rates.

The aim of this study is to estimate the real exchange rate (the equilibrium RER) using a set of variables referred to as the fundamental determinants of the RER. In so doing, the equilibrium RER

[2] Economic performance is characterized by economic growth, exports, imports, saving and investment.

is established and it is compared to the actual RER over time. The difference between the two exchange rates is the exchange rate misalignment.

This study will estimate the equilibrium exchange rate using a unique combination of variables postulated by the Edwards (1989) model and the Montiel (1999) model, for each country. The study will also explore the effect of some variables for example the nominal exchange rate, discussed in the simple monetary model. Furthermore, this study aims to employ recent econometric tests for cointegration to estimate the equilibrium RER as well as to assess the level of exchange rate misalignment.

Although much empirical evidence for exchange rate determination and exchange rate misalignment is available for developed countries (see MacDonald (1998), Zhang (2001), Lee *et al* (2001), Cheung *et al* (2007)), studies for both Nigeria and Ghana are very scant. Therefore, this study also aims to add to the body of existing literature in these two countries.

1.2 OBJECTIVE OF THE STUDY

The main objective of this study is to ascertain whether the RERs in both Ghana and Nigeria are misaligned. Ghana and Nigeria are of particular interest because both countries have followed a similar trajectory in the steps leading to the liberalisation of their exchange rates. It will therefore be interesting to ascertain whether the exchange rates are in line with their estimated equilibrium value. The specific objectives are:

i. Model the Ghana REER in order to determine its equilibrium real exchange rate;
ii. Model the Nigeria REER in order to determine its equilibrium real exchange rate;
iii. Identify if these exchange rates are misaligned; and
iv. Make recommendations of how to correct the misalignment, if any exists.

1.3 METHODS OF RESEARCH

The study aims to model the equilibrium exchange rates of Ghana and Nigeria by carrying out a formal assessment of RER using cointegration analysis. This is achieved by identifying a long-term relationship between RER and a set of macroeconomic fundamentals. The cointegration method to be applied for this analysis is the Johansen method (1995) along with the Vector Error Correction Model (VECM). Upon identifying cointegrating vectors within the model using the Johansen

technique, a VECM can be estimated by specifying a number of cointegrating vectors, then normalising the model using the accurate cointegrating relations. Examples of studies that have included the VECM to model exchange rates include Youngblood and Apaloo (2006) in Ghana, Aliyu (2007) in Nigeria and Iossifov and Loukoianova (2007) in Ghana. The estimation will also include diagnostic checks on the residuals from the estimated VECM to ensure that they are white noise (Johansen, 1995).

Upon estimating the long-run equilibrium exchange rate, the study will apply the Hodrick-Prescott (H-P) filter, which estimates the permanent values of the fundamental variables. The Montiel (1999: 224) model proposes that the permanent values of the policy and exogenous variables are the long-run fundamental determinants of the long-run real exchange rate. The results from the H-P filter, along with the results from the cointegration tests will be used to estimate the possible level of misalignment.

The study will use quarterly data obtained from the International Monetary Fund (IMF), International Financial Statistics (IFS) and the World Bank databank. Due to limits regarding the availability of data, the scope of the research is from the first quarter of 1980 to the last quarter of 2006 for Nigeria and from the first quarter of 1980 to the last quarter of 2007 for Ghana.

1.4 THE STRUCTURE OF THE STUDY

The study is organised as follows: Chapter 2 reviews the theoretical and the empirical literature on the exchange rate determination. Chapter 3 provides an overview of the foreign exchange rate and the trends of foreign exchange in Nigeria and Ghana. Model specification and estimation procedures are explained in Chapter 4 and the empirical findings will be discussed in Chapter 5. The thesis is concluded in Chapter 6 which gives a summary of findings and policy recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 INRODUCTION

This chapter is divided into three sections: the conceptual framework, the theoretical framework and the empirical literature. The conceptual framework discusses the alternative measures of the exchange rate as well as the concept of the equilibrium exchange rate and the importance of the real exchange rate. The theoretical framework discusses different models of the determination of the exchange rate as well as the various determinants of the exchange rate. Finally, the empirical section will assess if the observed findings in the literature are in line with the expectations articulated in the theoretical section.

2.2 CONCEPTUAL FRAMEWORK

2.2.1 THE FOREIGN EXCHANGE RATE

The exchange rate is defined as the price at which one currency is exchanged for another currency and the transactions are carried out either in the spot or forward exchange markets. The spot market for the exchange rate is a current market for the exchange rate, whereas the forward market is quoted and traded in the current period for future delivery. The following sections will discuss the spot rate as well as the various alternatives to the spot rate.

2.2.2 THE NOMINAL EXCHANGE RATE

The spot rate is also referred to as the nominal exchange rate. The nominal exchange rate measures the value of one currency in terms of another and it can be expressed in two ways: the direct and the indirect quotation. The indirect quotation expresses the price of a foreign currency in terms of the domestic currency. Assuming the naira (N) is the home currency and the United States of America dollar (USD) the foreign currency, an indirect quotation of N125 per USD can be written as follows; USD/N125. The direct quotation on the other hand expresses the price of the local currency in terms of a foreign currency. A direct quotation in this case will be the units of the USD per naira and is written as follows: N/USD0.008. The spot rate is particularly useful because it is directly observable thus making it possible to compare the prices of goods. A problem that arises with the spot rate however is that it fails to indicate a change in the strength of a home currency with respect

to the home country's trading partners (other than the United States of America). The spot rate also fails to indicate the effect of acquiring foreign goods and services on the exchange rate itself (Appleyard *et al,* 2006:470-471). Consequently, the alternative measures are analysed briefly in the following sections.

2.2.3 THE REAL EXCHANGE RATE (RER)

The RER is the alternative measure of the spot rate which accounts for price changes in the home country, and in the trading partner country. One of its most important attributes is that it is a good indicator of the overall economic performance of a country. There is no generally agreed measure of the RER; however, there are two common measures of RER which are recurring in literature. The first one is expressed in Equation 2.1. Assuming the United States dollar (USD) is the foreign currency, the measure of the bilateral RER which appears common in the literature is defined as follows,

$$RER = e = E.\frac{WPI^{US}}{CPI} \qquad 2.1$$

where:

E = the nominal exchange rate between the domestic currency and the USD;

WPI^{US} = a proxy for the foreign price of tradables and in this case it is the wholesale price index in the United States of America;

CPI = is the consumer price index in the domestic economy which is a proxy of the domestic price of non-tradables.

An increase in RER is indicative of a real depreciation whereas a decrease in RER is indicative of a real appreciation (Kemme and Roy, 2006:12). The most common challenge of using this definition of the RER is the problem of finding proxies as well as identifying which price indices to use.

The RER in foreign currency terms, can also be defined as the relative price of nontradables with respect to tradables:

$$RER_f = \frac{P^N}{P^T} \qquad 2.2$$

where:

P_T = Price of tradables

P_N = Price of non-tradables

In this case, an increase implies real exchange rate appreciation whereas a fall in the RER indicates real exchange rate depreciation. When the price of tradables rises relative to the price of non-tradables, the RER depreciates whereas if the price of non-tradables increases relative to the price of tradables, the RER appreciates. This definition of the RER is derived from the two-good model. Its advantages and limitations are discussed in the theoretical section to come.

Nominal exchange rates play a major role in the day-to-day operation of the foreign exchange market whereas the real exchange rate is often regarded as more significant in policy decisions and for economic performance. The next section will discuss another alternative to the spot rate.

2.2.4 THE MULTILATERAL /EFFECTIVE EXCHANGE RATE

The multilateral exchange rate is trade weighted which means that its value indicates its importance relative to the major trading partners of the target country. The following subsections will discuss the nominal effective exchange rate and the real effective exchange rate.

2.2.4.1 THE NOMINAL EFFECTIVE EXCHANGE RATE (NEER)

The NEER addresses the issue of evaluating the strength of an exchange rate against a number of countries. It is a trade-weighted index of the average value of a country's currency. The use of an example will illustrate how a nominal effective exchange rate is better suited to measure an exchange rate. Suppose the currency in question is the naira and there is a need to calculate its average strength in terms of other countries. Say for example, in the base year the naira is worth 0.50 British pound and 150 Japanese yen. In some later years the exchange rate is for example 0.65 British pound and 100 Japanese yen. In this example, the naira has appreciated in terms of the pound from 0.50 to 0.65 and it has depreciated in terms of the Japanese yen from 150 to 100. The index for the value of

the naira used on a later date, in terms of the pound is 1.3 (=0.65/0.5). While on the other hand, the index for the value of the naira used on a later date, in terms of the yen is 0.67 (=100/150).

To find the change in the naira value from the base year to a later year, the value of the naira is then weighed by the percentage of each country's trade. In this example, if 16 percent of Nigeria's trade is with the United Kingdom and 21 percent with Japan, the pound price of the naira would get a weight of 0.16 and the yen price of the naira would get a weight of 0.21. In a country's entire trade, the weights add up to 1. The end result is a trade-weighted index of the average value of a country's currency (Appleyard *et al*, 2006:473).

2.2.4.2 THE REAL EFFECTIVE EXCHANGE RATE (REER)

The REER is computed using the same weighting process as the NEER; however, it is calculated using the RER rather than the nominal exchange rate. Consider the following equation for $REER_{dc}$ in domestic- currency terms:

$$REER_{dc} = \prod_{i=1}^{m} \left[E_{dci} P_{Gi} \bar{\omega}_{id} \right] \cdot \frac{1}{P_{Gd}} \qquad 2.3$$

where:

m = the number of trading partners;

Π = product of the bracketed terms over m countries;

ω_{id} = appropriate weight for each foreign country i and the sum of the weights equals 1;

E_{dc} = nominal exchange rate expressed in domestic-currency terms

P_{Gd} ; P_{Gi} = domestic aggregate price indexes; aggregate price indexes for country i.

REER can also be expressed in foreign currency terms as follows:

$$REER_{fc} = \prod_{i}^{m} \left[\frac{E_{fci}}{P_{Gi}} \right] \omega_{id} . P_{Gd} = \frac{1}{REER_{dc}} \qquad 2.4$$

The REER in Equations 2.3 and 2.4 use the geometric averaging method. The REER can however be expressed using the arithmetic averaging method which is much simpler than the geometric averaging method. Equation 2.5 expresses the REER using the arithmetic method.

$$REER_{fc} = \sum_{i=1}^{m} W_i \left(\frac{E_{it}^{\Pr} / P_{it}^{\Pr}}{E_{i0}^{\Pr} / P_{i0}^{\Pr}} \right) \times 100 \qquad 2.5$$

where:

$E_{it}^{\Pr}$ and $E_{i0}^{\Pr}$ = the ratios of the bilateral exchange rates of the *i*th trading partner to the domestic country at time 1 and 0 respectively;

i = 1, 2,…n;

W_i = the weight associated to the *i*th foreign currency;

$\sum_{i=1}^{m} W_i$ = the sum of the weights, which must equal 1;

$P_{it}^{\Pr}$ = the price index of the *i*th foreign country at time *t* relative to the base

When calculating the percentage change in the real exchange rate using arithmetic average REER the base year used in the index plays a pivotal role. If at any point the base year is changed, the percentage change in the real exchange rate will also change. This is however not the case when calculating the percentage change in the real exchange rate using the geometric average REER. This is because the percentage changes are not affected by the base year used in the index. For this reason, the REER which is derived from the geometric averaging method is said to be consistent.

An additional limitation of the arithmetic method is that it tends to assign greater weights to currencies that have appreciated or depreciated relative to the home currency. The geometric index however treats the weights as symmetrical, whether they are depreciating or appreciating. The geometric averaging technique is therefore preferred over the arithmetic averaging method because of the properties of consistency and symmetry. Essentially a weighted-average exchange rate has an advantage over a bilateral exchange rate because it includes the third-country effects (Hooper and Morton, 1982:47). Against the background of these advantages this study will employ the IMF

International Financial Statistics' foreign currency defined geometric average REER to model the long-run equilibrium real exchange rate. In this study an increase in the REER is interpreted as an appreciation of the RER whereas a decrease in the REER implies a depreciation of the RER.

2.2.5 THE EQUILIBRIUM RER

The equilibrium RER is defined in Edwards (1989:4) as the relative price of non-tradables to tradables that results in the simultaneous attainment of equilibrium in the external sector and in the domestic (non-tradables) sector of the economy. The equilibrium exchange rate thus implies the attainment of both external and internal equilibrium.

Internal equilibrium means that the non-tradable goods market clears in both the current and future periods. The determinants of the internal RER are productivity differentials and demand-side factors such as consumption. The external equilibrium is concerned with the current account position and its determinants include the terms of trade, monetary and fiscal shocks and stock variables such as a country's net foreign asset position (Candelon *et al*, 2007:91). The determinants of the RER will be discussed in detail in the theoretical framework.

The equilibrium RER is a long-run equilibrium rate which is determined by the fundamentals in contrast to the short-run equilibrium rate which is determined by the forces of supply and demand of foreign exchange in unregulated markets[3]. Monetary and fiscal policy changes are examples of the short-run shocks which are expected to affect the RER in the short-run. The existing RER in an economy at any given time is determined by both fundamental and short-run shocks.

2.2.6 THE IMPORTANCE OF THE RER

The RER is a good proxy of the competitiveness of a country's tradable sector. An appreciation of the RER for instance (a rise in RER) indicates an increase in the domestic cost of producing tradable goods. If world relative prices remain constant, a RER appreciation will result in a fall in a country's international competitiveness. This is because the country is producing tradable goods at a higher price than before, relative to the rest of the world. Real exchange rate depreciation on the other hand indicates in fall in the domestic cost of producing tradable goods. This will increase the country's international competitiveness, if world relative prices are unchanged.

[3] See Obadan (1994:19) for a more detailed analysis.

The analysis of the competitiveness of the real exchange rate comes with its challenges, particularly in low income countries which are plagued by weakness in data and the occurrence of structural breaks. Such challenges may result in weak conclusions when assessing the behaviour of the RER. Policy makers in countries such as Ghana and Nigeria are however inclined to use RER in policy making decisions because RER measurements allow these countries to monitor their export sector, on which their economies rely heavily. It is important to note however, that the exchange rate alone does not suffice in explaining the trade competitiveness of a country. An appreciation of the RER may not necessarily lower a country's competitiveness in trade, just as a depreciation of the RER will not always result in a gain in competitiveness. Neglecting other macroeconomic fundamentals (such as changes in the prices of tradables) and using the RER solely as a measure of competitiveness can therefore lead to misleading inferences. Furthermore, Di Bella *et al* (2007:4) argue that the use of RER misalignment to assess the competitiveness of a country is insufficient as it is important to supplement it with other variables, namely, relative price measures, external sector outcomes, production costs and measures of institutional quality.

2.3 THEORETICAL FRAMEWORK

The theoretical framework aims to provide a definition for the exchange rate which will be employed in this study. In addition, the various models to determine the exchange rate will be discussed.

2.3.1 THE REAL EXCHANGE RATE: DEFINITION

Generally the RER is defined either using the internal approach or the external approach. The external approach is the nominal exchange rate adjusted for price level differences, between countries whereas the internal approach is the ratio of the domestic price of non-tradable goods to tradable goods in a single country. The external RER provides a relative comparison of the value of currencies by measuring the relative prices of domestic and foreign consumption or production baskets. Commonly used external RERs include the bilateral RER and the real effective exchange rate, discussed in the preceding section. The internal RER on the other hand is a reflection of the relative price incentive for producing or consuming tradable goods rather than non-tradable goods in a single economy.

Several alternatives of the RER have been derived for different analytical purposes. The following section will discuss the Mundell-Fleming one composite good model version of the external RER. Another version of the external RER is the Purchasing Power Parity theory which will be discussed in a later section. Alternative definitions of the internal RER, namely the two-good and the three-good model will also be discussed.

Mundell-Fleming one composite good model

The Mundell-Fleming one composite good framework can also be referred to as the complete specialisation model. The framework assumes that each country specialises in the production of one good with no perfect substitute. In this model, the real exchange rate is defined as the number of units of the domestically produced good that must be foregone to gain a single unit of a foreign good. Since manufactured goods tend to be imperfect substitutes, whereas raw materials may have close substitutes, this framework is applicable to countries whose trade is centred on manufacturing rather than countries whose trade is focused on raw materials (Montiel, 2003:313).

One of the limitations of the Mundell-Fleming one composite good model is the assumption of complete specialisation in production. This implies that the real exchange rate matches the terms of trade; although they are separate concepts all together. Furthermore, trade policies which may result in large fluctuations of the terms of trade are not taken into account. In addition, the role played by parallel markets, trade patterns and unrecorded trade which have a significant role in developing countries, may present a problem when applying the Mundell-Fleming one composite good framework.

As previously mentioned in the conceptual framework the issues that plague the external RER arise in empirical literature where multiple price and cost indexes exist, because they are not explicitly defined theoretically. Moreover, it is also unclear which basket and weights of the domestic and foreign goods should be used empirically.

Two-good internal RER for tradables and non-tradables

The two-good model, otherwise referred to as the two-sector Salter and Swan model, is an open economy version of the aggregate demand and supply model. The model assumes two goods, the tradables and non-tradables, and the real exchange rate is defined as the number of units of the non-traded goods required to purchase one unit of the traded good. The model aggregates exportables and importables together as one tradable good, hence the effect of the terms of trade is negligible. This model is therefore not useful when analysing the effects of fluctuations in the terms of trade on the RER.

Although this model is more applicable to emerging countries, it poses some empirical problems. This is because internal RER should be measured using domestic price indexes for tradable and non-tradable goods and these are not readily available in most developing countries. Most countries however have price data for imports and exports of the domestically produced goods which are used when computing the external RER. For this reason, the external RERs are often used as proxies for internal RERs (Hinkle and Nsengiyumva, 1999:114).

Other conceptual issues which arise in the two-good model are in the classification of the tradable goods. The definition of traded goods apart from imports and exports can also include those goods that are not necessarily traded but can be traded. For this reason, many goods can be argued to be tradable to various degrees. The three-good model addresses this issue and it will be discussed next.

The three-good internal RER model

The three-goods model consists of three goods: an importable good, an exportable good and a non-tradable good. As a result, two definitions of the internal RER arise in this model. The first definition of the internal RER is the relative price of non-tradables to exportables ($RERX_N$) or simply put the ratio of the non-tradable good to the domestic currency price of the exportable good. The second definition of the internal RER is the relative price of non-tradables to importables ($RERM_N$) in other words the ratio of the non-tradable good to the domestic currency price of the importable good. $RERX_N$ shows the price competitiveness of exportables in both production and consumption relative to non-tradable goods. Similarly, $RERM_N$ shows the internal price competitiveness of importables in both production and consumption relative to non-tradables (Hinkle and Nsengiyumva, 1999: 176).

In the three-good model there is a clear distinction between the prices of the importables and the exportables hence this framework is useful when analysing the macroeconomic effects of terms of trade changes, as well as the effect of commercial policy on the RER (Hinkle and Nsengiyumva, 1999: 176).

The three-good model however suffers a drawback in its definition of the non-tradables. As was the case in the two-good model, there is an array of definitions of what constitutes the non-tradables in empirical literature. These ambiguities are worsened by the various price indexes used to proxy the importable, exportable and non-tradable goods.

Due to the limitations that plague the internal RER, much of the empirical literature opts for the use of a blend of the internal and external RER. This thesis will use the multilateral real effective exchange. Upon selecting an appropriate definition and a measure of the RER, the next step is to focus on the models of the determination of the RER.

2.3.2 THE MODELS OF THE EQUILIBRIUM EXCHANGE RATE

This section will explore the models for determining the equilibrium RER which are recurring in literature. Furthermore, the section will provide a summary of the determinants of the equilibrium exchange rate. This is important as it will provide the study with a basic framework for the variables to include when modelling the equilibrium exchange rate in the chapters to come.

2.3.2.1 THE SIMPLE MONETARY MODEL OF THE FLOATING EXCHANGE

The monetary model discussed in this section is simplified; however, the conclusion drawn from it will suffice to explain the determinants of the equilibrium exchange rate. The monetary model is based on three assumptions. The first assumption is that the economy is characterised by a vertical (inelastic) aggregate supply curve and the second assumption is that the economy is characterised by a stable demand for money. Finally the third assumption is that the absolute purchasing power parity (PPP) theory that prices across countries are equal holds. While the absolute PPP method assumes that the RER is a unity, the relative PPP approach assumes that the RER is constant over the long-run. For the purpose of this study, it is thus useful to uncover further the relative PPP approach (Krueger, 1983:66).

The relative PPP is the prediction that the proportionate change in the home country's price level is equal to the proportionate change in the product of the foreign price level and the exchange rate (Krueger, 1983: 66). Now consider the equilibrium condition,

$$M_s = kPY = kSP^*Y \qquad 2.6$$

where:

M_s = Money stock

k = Positive parameter

P = Price level (*denotes a foreign variable)

S = Exchange rate

Y = real income

And if S is made the subject of the formula,

$$S = M_S / kP^*Y \qquad 2.7$$

In this simplified model the variables which determine the exchange rate are the ratio of money stock (Ms) to the income[4] measured at the foreign price level (P*Y). If the exchange rate S appreciates, the domestic output being produced is less competitive on the world market, which results in an excess supply of the home goods. Exchange rate depreciation on the other hand has the opposite effect.

The next section will analyse the effect of the exogenous variables on the exchange rate in the monetary model. It is important to assume that only two countries are involved in trade, a domestic and a foreign country.

The effect of money supply on the exchange rate

Consider an increase in the money supply, holding other exogenous variables (income and foreign price level) constant. Initially the price level is constant, and there is an excess supply of money.

[4] The income is also referred to as demand.

According to the quantity theory of money, individuals cope with this excess supply of money by making purchases of goods and services. The excess supply of money results in an excess demand for goods which drives up the domestic price level. Consumers will most likely opt for foreign goods which would be cheaper relative to domestic goods. The PPP theory suggests that a depreciation of the exchange rate, S, is necessary to restore equilibrium in the market. The depreciation of the exchange rate will lower its purchasing power and this will prevent the flooding of cheap foreign goods onto the domestic market.

The extension of domestic credit implies an increase in the money supply in the economy. Contrary to the monetary approach, Dufrenot and Yehoue (2005:7) argue that a high domestic credit to money supply ratio highlights an improvement in the central bank's balance sheet position, and this is expected to appreciate the exchange rate. For this reason the *a priori* expectations of the effect of money supply on the exchange rate are ambiguous.

The effect of income on the exchange rate

From Equation 2.7, it is clear that an increase in the real income in an economy while holding the money stock constant is expected to cause the exchange rate S to appreciate. If the level of real income increases while holding the money stock constant the domestic price level of goods will have fallen in order to restore equilibrium in the goods and money market. The fall in the domestic price level will make the domestic output 'over competitive' resulting in an excess demand for the home currency. In order for the PPP to hold the exchange rate has to appreciate. An increase in domestic real income will therefore result in an exchange rate appreciation. The opposite is true for a fall in the real income.

The PPP theory however fails to take into account the effect of income on the goods market. An increase in income would cause an excess demand for domestic goods which would have an inflationary effect on the domestic price level. This would cause consumers to substitute the domestically produced with cheaper foreign goods. An increase in imports would therefore require a depreciation of the exchange rate in order to prevent the flooding of cheaper foreign goods into the domestic market (Copeland, 1994:162).

The effect of foreign price level on the exchange rate

If the foreign price level increases, domestic goods become relatively cheaper at the initial exchange rate. Foreigners demand more of the domestic currency, which will drive the value of the domestic currency up. The appreciation of the exchange rate will continue until the competitiveness of the foreign market is re-established. Thus, an increase in the foreign price level will result in an appreciation of the domestic currency, *ceteris paribus*. The policy implication of this conclusion is that world inflation does not necessarily impact the domestic economy, and the domestic price level is determined in the domestic market devoid of foreign influences.

The role of interest rates in the monetary model

An increase in the domestic interest rates relative to those in a foreign country will result in an increase in the supply of foreign currency into the domestic currency, due to an increase in the investors drawn by the high interest rates. This will result in the appreciation of the domestic currency. A lower domestic interest rate relative to foreign interest rates has the opposite effect on the exchange rate.

2.3.2.2 THE RELATIVE PURCHASING POWER PARITY (PPP) APPROACH

The relative PPP theory uses two approaches: the base-year and the trend approach. The base-year approach establishes a base period where the observed RER is assumed to be at its equilibrium level. Misalignment is thus measured as the difference between the observed RER and the base period value, based on the assumption that the long-run RER has remained constant at its base level. The main limitation of this approach is its inability to take note of the permanent changes in the long-run RER which would cause RER to be non-stationary.

In the trend approach the long-run RER can be assumed to be a mean value to which the RER reverts back in the long-run. Exchange rate misalignment can thus be measured as the deviation of the RER from its mean value (Ahlers and Hinkle, 1999:296).

The relative PPP approach described above has its advantages. Apart from having a relatively simple method, it has limited data requirements, which is particularly useful when analysing misalignment in low-income countries. Furthermore, the relative PPP approach is particularly useful in countries which are plagued with inflation where the shocks to the external RER are largely nominal ones. The relative PPP approach is not time consuming, thus it is often used in multi-country cases where the

amount of time devoted to the study is limited. Due to its simplicity, the relative PPP approach is also useful as a starting point for analytical purposes, prior to using more sophisticated techniques (Ahlers and Hinkle, 1999:296).

The model has however been argued to have failed to perform in low-income countries (Edwards 1989, Copeland 1994), and one of the overarching reasons is because the relative PPP approach fails to take into account that the RER does not necessarily revert back to a mean value. The PPP approach fails to account for a new long-run equilibrium RER caused by the existence of structural breaks in data or permanent changes in its fundamentals. In addition, exchange rates are volatile and reversion to the mean may take a long time. As a result, the use of the relative PPP approach is not useful for policy purposes. It is therefore important to discuss more sophisticated techniques that avoid the limitations of the relative PPP approach. The next section will discuss alternative models of exchange rate determination.

2.3.2.3 THE EDWARDS (1989) MODEL

The Edwards (1989) model is a benchmark inter-temporal general equilibrium model of a small economy to assess the real exchange rate response to changes in a series of variables. For simplicity, this thesis will summarise the important issues pertaining to this model. The model assumes that all the variables are real; hence, monetary disturbances are not discussed (Edwards, 1989:15). The model assumes two periods, period 1 representing the present and period 2 representing the future period[5].

The model provides equations to satisfy the internal and external equilibrium and from these equations Edwards (1989) concludes it is possible to arrange the RER implicitly as functions of all the exogenous variables in both the short- and long-run,

$$RER = h(p^*, p^{*\sim}, \tau, \tau^*, \delta, \delta^*, V, T, T^{\sim}, G_X, G_X^{\sim}, G_M, G_M^{\sim}, G_N, G_N^{\sim}) \quad 2.11$$

$$RER^{\sim} = h^{\sim}(p^*, p^{*\sim}, \tau, \tau^*, \delta, \delta^*, V, T, T^{\sim}, G_X, G_X^{\sim}, G_M, G_M^{\sim}, G_N, G_N^{\sim}) \quad 2.12$$

where:

[5] A tidle (~) over a variable indicates that it is a period 2 (long-run) variable. Subscripts refer to partial derivatives with respect to that variable, for example, R_q is the partial derivative with respect to q (Edwards, 1989:18).

p*; p~*= World relative price of imports in periods 1 and 2;

τ; τ~ = Import tariffs in period 1 and 2;

δ = Domestic discount factor, equal to $(1\text{-}r)^{-1}$ where r is the domestic real interest rate;

δ^* = World discount factor, equal to $(1\text{-}r^*)^{-1}$ where r* is the world real interest rate. Since there is no tax on foreign borrowing, $\delta < \delta^*$;

V; V~ = Vectors of factors of production, excluding capital;

T; T~ = Lump sum tax in periods 1 and 2;

G_X, G_M, G_N = Quantities of goods X, M, and N consumed by the government in period 1;

G_X~, G_M~, G_N~ = Quantities of goods X, M, and N consumed by the government in period 2;

From Equations 2.11 and 2.12, the short-run and long-run RER respectively are subject to the changes in the world relative prices of imports in the short-run and in the long-run; the import tariffs in the short-run and in the long-run; the domestic interest rates; the world interest rates; the factors of production excluding capital; lump sum tax in the short-run and in the long-run; and government consumption of exports, imports and the non-tradables, in the short-run and in the long-run.

The importance of Equations 2.11 and 2.12 is to observe if there is a long-run relationship between the RERs and the exogenous variables. Furthermore it is important to take note of the how the long-run and the short-run RER will change in response to the shocks of the exogenous variables. In other words, the study aims to observe the sign of the partial derivatives of RER in response to their determinants.

2.3.2.4 THE MONTIEL (1999) MODEL

The Montiel (1999) model builds on the Edwards (1989) model and it suggests that the actual RER is an endogenous variable which depends on three macroeconomic variables, namely the predetermined, exogenous and the policy variables.

Predetermined variables are fixed but may change over time. They are influenced by the prevailing policy and an example of a predetermined variable is the economy's stock of net indebtedness. Exogenous variables on the other hand are current and expected future values of endogenous variables. The exogenous variables such as world economic conditions are not influenced by the state of the domestic economy (Montiel, 1999:222).

The policy variables can be viewed in two parts. The first is a policy variable which depends on the feedback from economic developments and hence it is affected by the state of the economy. The second type of exogenous variable gradually evolves over time irrespective of any feedback from the economy. An example of this type of policy variable is the gradual removal of trade restrictions over time.

The predetermined, policy and exogenous variables are all expressed over time because they all typically change over time. In the Montiel (1999) model the long-run equilibrium is based on the permanent values of the policy and exogenous variables as well as the steady-state values of the predetermined variables. This can be expressed in the following way;

$$q^* = F(X_2^*, X_3^*) \qquad 2.13$$

Where

q^* = the long-run equilibrium real exchange rate,

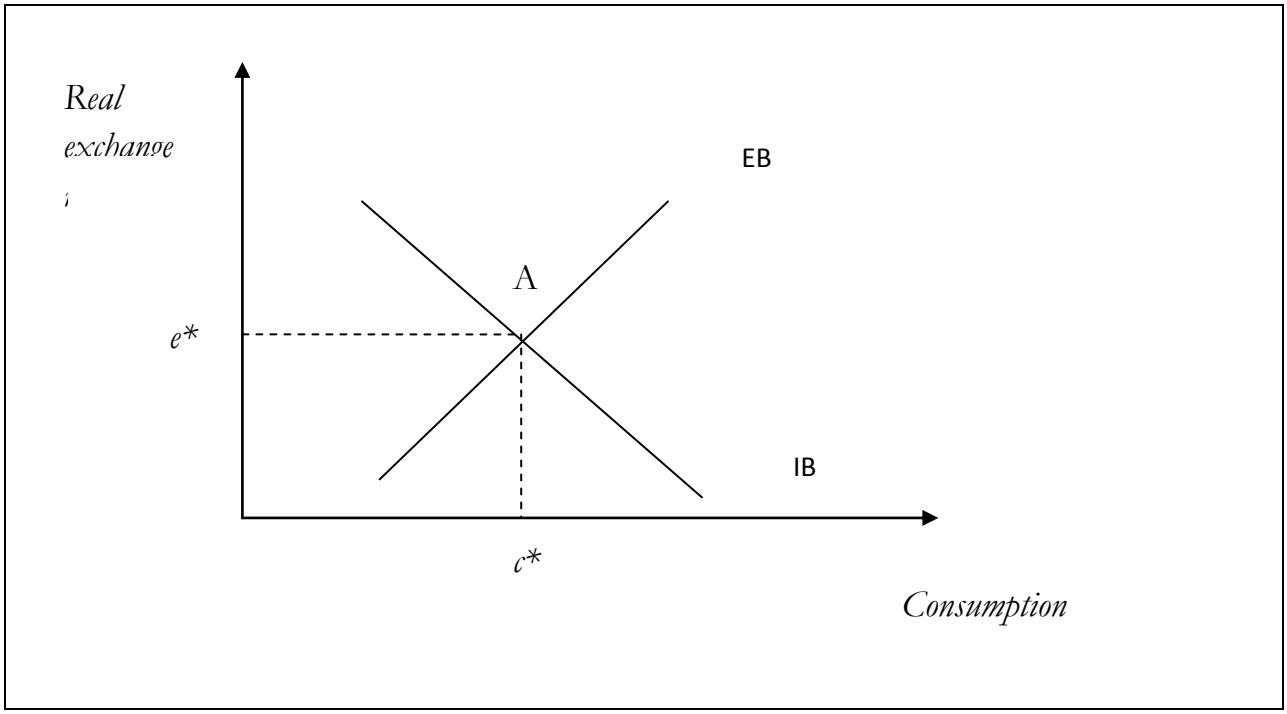
X_2^*, X_3^* = the steady state variables or the long-run fundamentals.

The Montiel (1999) model aims to define these long-run fundamentals in order to estimate the long-run equilibrium. To do so there must be internal and external balances, conditioned on sustainable values of the predetermined, exogenous and policy variables. The Montiel (1999) model builds on the three-good model with the simplifying assumptions of a financially open economy; exports not consumed in the domestic economy, and capital being fixed while labour is mobile across sectors. Generally, the long-run fundamental determinants described in the Montiel (1999) model are similar to those described in the Edwards (1989) model.

It is useful to illustrate the determination of the long-run equilibrium exchange rate using the internal balance (IB) condition and the external balance (EB) condition. The long-run equilibrium

exchange rate in Figure 2.1 is determined where the internal balance curve intersects with the external balance curve, at point A. The internal balance curve is downward sloping because as consumption (on the horizontal axis) increases, there is an increase in the demand for non-tradable goods. In order to offset this demand for non-tradables goods, the relative price of non-tradable goods should increase. This is achieved by a rise in *e*, or an appreciation of the RER. The external balance curve is upward sloping because as consumption increases more goods will be imported and this will increase the trade deficit. In order to maintain an external balance, more resources are channelled towards the production of traded goods, and this is achieved by RER depreciation or a fall in *e*.

Figure 2.1: The determination of the long-run equilibrium exchange rates.



Source: Montiel (1999:278)

The response of the long-run equilibrium RER to its fundamentals can thus be observed by analysing the movements of the internal balance or the external balance, in response to permanent exogenous shocks. The next section will discuss the effect of the fundamental determinants on the equilibrium long-run RER.

The determinants of the equilibrium RER, Edwards (1989) and Montiel (1999)

Exchange controls (Tariffs) and the equilibrium RER

An import/export tariff can be defined as a tax on importables/exportables (Bannock *et al*, 1978:430). Early models postulate that lowering a tariff will require a real devaluation in order to restore equilibrium. This is because when a lower tariff is imposed, it becomes cheaper to import goods; hence, the demand for imports increases. This income effect results in an increase in imports which in turn causes a trade account deficit. This will require an exchange rate devaluation to restore the trade balance. The Edwards (1989) model suggests that this traditional view is limited as it ignores inter-temporal effects and neglects the role of the non-tradable sector.

If we assume substitution in the demand for exports, imports and non-tradables, an imposition of an import tariff will result in equilibrium real appreciation in current and future periods. If an import tariff is imposed, it becomes more expensive to import the goods for which the import tariff has been imposed. In addition to a decrease in the demand of the imports, there is an increase in the demand for non-tradables. There has been a substitution of the tradable goods for the non-tradable goods. The price of non-tradables will begin to rise, and this will result in a rise in the equilibrium RER, an equilibrium real appreciation. This is the case when the substitution effect outweighs the income effect. An export tariff will have a similar effect on the exchange rate. An export tariff will limit the amount of the tradable goods leaving the country which results in an excess supply of these goods in the domestic market. This will lower the price of traded goods, resulting in an equilibrium real appreciation of the currency.

Openness to trade and the equilibrium RER

Openness to trade is the summation of exports and imports and thus implies a reduction in exchange controls. The effect of openness on the RER depends on whether the economy is a net importer or a net exporter. If the country's exports are greater than its imports, more foreign currency will enter the domestic economy hence the supply of foreign exchange increases resulting in an equilibrium real appreciation of the domestic currency. If on the other hand the country's imports are greater than its exports, there is an increase in the demand for foreign exchange. This will result in an equilibrium real depreciation of the domestic currency (Kemme and Roy, 2006: 214).

Terms of trade and the equilibrium RER

The terms of trade can be defined as "the ratio of the index of export prices to the index of import prices. An improvement in the terms of trade follows if export prices rise more quickly than import prices (or fall more slowly than import prices)" (Bannock *et al*, 1978:433). The external term of trade has to do with the 'world' relative price of exportable to importable.

According to Kemme and Roy (2006), an improvement in the terms of trade will increase the purchasing power in the domestic economy, causing the demand for all goods to increase. In a small country case, the price of non-tradables will rise whereas the price of tradables will remain the same, resulting in an equilibrium RER appreciation. This is an income effect. When a substitution effect is taken into account, an improvement in the terms of trade will increase the price of exportables and this will make consumers shift from the consumption of exportables to the consumption of importables. Because there are more imports entering the economy, the demand for non-tradable goods will fall resulting in a fall in the price of non-tradables and finally RER depreciation. Edwards (1989:51) notes that it is difficult to see how the effect of the terms of trade disturbances on equilibrium RER is distributed throughout time.

Commodity prices affect the RER through the effects of the terms of trade. Countries with some oil reserves for instance, will experience an exchange rate appreciation whereas countries without oil reserves will experience currency depreciation when the price of oil increases (MacDonald, 1998:123).

Capital control, capital flows and the equilibrium RER

Capital controls in the Edwards model (1989:39) are described as a tax on foreign borrowing which result in the domestic interest rate being higher than the world interest rate. Hence, a liberalisation of capital controls translates into a reduction of the tax on foreign borrowing. This will make borrowing from abroad cheaper thus increasing capital inflows into the country. This will generate an incipient demand for non-tradable goods causing the relative price of non-tradables to increase. A real equilibrium appreciation occurs to restore equilibrium in period 1. Two channels of the effect on the equilibrium real appreciation are noted and discussed briefly.

The first channel is a substitution effect where, a fall in the tax on borrowing makes future consumption relatively more expensive than current consumption. Inter-temporal substitution allows greater consumption to take place in the current period. This increases the demand for non-tradables, thus the price of non-tradables increases, resulting in an equilibrium real appreciation. The second channel involves an income effect where an inflow of capital increases the supply of foreign currency putting inflationary pressure on the non-tradables goods sector which results in an equilibrium real appreciation and a worsening of the current account in that period (Edward, 1989:41).

Foreign aid inflows are an example of capital inflows into a country. The effect of foreign aid inflows on the RER is particularly relevant in developing countries where foreign aid inflows play a significant role in their economies. A significant amount of foreign aid is likely to be channelled towards the non-tradable goods sector. This therefore results in an increase in the demand for non-tradable goods, which causes their price level to increase. As a result, the level of real exchange rate increases. Foreign aid inflow is thus expected to generate a real equilibrium appreciation. The tendency of net foreign inflows to cause an exchange rate appreciation is sometimes referred to as the Dutch disease problem and it is common in low-income countries. Dufrenot and Yehoue, (2005), van Winbergen (1986) and White (1992) argue that foreign aid will lead to an exchange rate appreciation as long as the aid inflows are channelled towards the non-tradable goods sector.

Government expenditure and the equilibrium RER

An increase in government consumption of non-tradables in period 1 is financed by public debt. This will have an effect on the equilibrium real exchange rate through two channels. In the first channel, the increase demand for non-tradables in period 1 will increase the price of non-tradables resulting in a real exchange rate appreciation. In the second channel, a higher level of government borrowing means that the government will have to increase taxes in period 2. A substitution effect will occur because the future income is expected to fall (due to a tax in period 2) and the future consumption of non-tradable goods is substituted for current consumption which results in a real equilibrium appreciation.

If the government however has a temporary demand for tradables, this will result in an equilibrium real depreciation in period 1. This therefore means that the effects of government expenditure on

the RER depend on whether government spending is either in the tradable goods sector or in the non-tradable goods sector (Edward, 1989:46-7).

Technology and the equilibrium RER

The Balassa-Samuelson effect postulates that less developed countries are likely to experience a RER appreciation in the process of catching up with more developed countries. This is because productivity growth is greater in the tradable goods sector than in the non-tradable goods sector. The theory assumes that wages in the tradable goods sector equalise with those in the non-tradable goods sector. Due to productivity difference in the two sectors, prices in the non-tradable goods sector increase relative to the prices in the tradable goods sector, causing the exchange rate to appreciate.

Technological progress can also generate an equilibrium real depreciation if supply side effects are taken into consideration. A technological advancement can increase the availability of non-tradables, to the extent of an incipient excess supply of non-tradable goods. This excess supply can be overcome by real exchange rate devaluation. It can also be argued that in the catching up process, consumers may temporarily increase the demand for tradable goods relative to non-tradable goods, putting inflationary pressure on the tradable goods resulting in a depreciation of the currency (Edward, 1989: 48).

The effect of world inflation on the equilibrium RER

If world inflation increases, transaction costs during trade are expected to increase. This will be incurred in the cost of production for all goods, resulting in a fall in the supply of both tradable and non-tradable goods. Depreciation in the exchange rate will offset the rise in transaction costs that are incurred in the production costs of tradable goods. While on the other hand an appreciation of the exchange rate will offset the rise in transaction costs in the non-tradable goods sector (Montiel, 1999:13).

The effect of the external interest rate on the equilibrium RER

In the Edwards (1989:43) model, a rise in world interest rates will make future consumption relatively more expensive and hence an inter-temporal substitution effect occurs where more is

consumed in the current period. This increases the demand for non-tradables, putting an upward pressure on the price of non-tradables, resulting in an equilibrium real appreciation.

2.3.2.5 THE BEER MODEL

The BEER model is based on a reduced form specification where the RER is linked to a set of economic fundamentals. The BEER model is of particular interest to this study because according to Aliyu (2006:5), it emphasises those variables which affect the relative prices of tradable to nontradable goods in both the home and foreign countries. The BEER model is thus estimated using fundamental determinants of the actual RER as opposed to calculating the level of RER which is consistent with an internal and external balance. This is particularly suitable for developing countries such as Ghana and Nigeria where data limitations present a problem. Estimation of the BEER draws from cointegration techniques in order to test the equilibrium relationship of the RER and its fundamental determinants. Dubas (2009:1613) argues that the BEER is estimated by using cointegration techniques to find the long-run relationship between the RER and a set of fundamental variables and only the permanent changes in the fundamental determinants drive the equilibrium exchange rate. This study employs this BEER based on cointegration analysis in order to estimate RER misalignment in Ghana and Nigeria.

Drawing from the models of equilibrium exchange rate, Table 2.1 provides a summary of the determinants of the RER and their effect on the real exchange rates.

Table 2.1: A summary fundamental determinants and the RER

	Simple Monetary model	Edwards (1989)model	Montiel (1999)
Openness		+/-	+
Domestic interest rates	+		
Foreign aid		+	+
Income	+/-		
Money supply/domestic credit	-		
World inflation	+		
Government expenditure		+/-	+/-
Balassa-Samuelson		+	+
Foreign interest rate		-	-
Capital inflows		+	+
Commodity prices		+	+
Terms of Trade		+/-	

Note: A positive sign is interpreted as causing an appreciation of the RER and a negative sign is interpreted as causing a depreciation of the RER. This will be useful in the subsequent section when assessing how each of these fundamentals performs in empirical literature. Source: Compiled by author based on different literature.

2.4 THE EMPIRICAL REVIEW

This section will analyse the empirical literature on the equilibrium exchange rate and the level of misalignment. This section aims to highlight whether the findings in the empirical literature are in line with the *a priori* assumptions regarding the effects of the determinants on the RER discussed in the theoretical section as well as to report any findings of exchange rate misalignment in the literature. Once the equilibrium exchange rate has been determined, it is useful to compare it to the actual exchange rate in the economy. This is done so as to assess the level of misalignment, if any exists. Hence, once the equilibrium exchange rate has been estimated, it is possible to determine whether the prevailing exchange rate is undervalued or overvalued.

It is important to note that the methodology used to estimate the equilibrium exchange rate has an effect on the result obtained. However, categorising the empirical literature based on which method was used poses a problem because few papers use the same method to estimate the equilibrium

exchange rate and the level of misalignment. Another basis for categorisation is the type of analysis used, and this study will use a country by country analysis. The analysis starts with literature available in the developed and transition countries then the focus will turn to developing countries and finally to Ghana and Nigeria.

2.4.1 LITERATURE FROM DEVELOPED AND TRANSITION COUNTRIES

Zhang (2001) investigates RER misalignment in China. The study uses the BEER approach and a sample period from 1952 to 1997. The fundamentals articulated in this paper are the index of gross fixed capital formation at fixed prices[6]; fiscal policy captured by the index of government consumption at current price; the growth of China's exports[7]; and the degree of openness measured as a ratio of the sum of the imports plus exports to GDP in domestic currency (Zhang, 2001:85).

The cointegration tests reveal that the sign of the coefficient of the productivity variable is not in agreement with the theoretical literature since it reveals that a rise in technological progress will result in a depreciation of the RER. The results also reveal that an increase in government spending will result in an appreciation of the RER which is in line with *a priori* expectations and this implies that government consumption is channelled towards the non-tradables goods sector. The growth in exports variable shows that an improvement in the terms of trade will result in an appreciation of the RER, which is in support of the theoretical literature in the case where the substitution effect outweighs the income effect. The openness variable results in exchange rate depreciation. This is in line with the *a priori* assumptions put forward in Montiel (1999) (Zhang, 2001:90). The findings provide evidence of exchange rate misalignment as China's exchange rate was overvalued from 1957 to 1977 and generally undervalued from 1978 to 1993. After 1977, where overvaluation may have appeared, it was small in magnitude and short lived.

De Broek and Slok (2006), apply a cross-sectional analysis as well as a time series analysis to assess the level of misalignment in 26 transition economies covering the period from 1991 to 1998. The cross-sectional analysis' sample includes 10 EU accession countries[8] and 16 other transition

[6] The index of gross fixed capital formation at fixed prices is a proxy for the Balassa-Samuelson effect

[7] The growth of China's exports is the proxy for the terms of trade variable which has no consistent data in China.

[8] The 3 Baltics, Bulgaria, Czech Republic, Hungary, Poland, Romania, the Slovak Republic and Slovenia.

economies[9]. The time series analysis estimates a BEER model using the productivity variable, the money-to-GDP ratio variable reflecting monetary shocks, the openness variable (measured as a summation of exports and imports as a ratio of GDP), the government consumption variable, the commodity prices variable and the terms of trade variable. The results suggest that an increase in productivity in the EU accession countries will result in the countries' exchange rates appreciating. These results are in line with the *a priori* assumptions articulated in the theoretical section of this chapter. In terms of the money-to-GDP variable the findings suggest that the exchange rate depreciated due to positive monetary shocks in the 16 transition countries, which is also in agreement with theoretical literature. In the EU accession countries and the OECD countries, increases in the openness variable and the government consumption variables depreciate and appreciate the exchange rate respectively. The term of trade variable is not statistically significant in any of the samples. Increases in commodity prices lead to exchange rate depreciation in the 16 transition countries, and this finding is not in line with the theoretical expectations (De Broek and Slok 2006:374-376).

The results of the cross-sectional analysis show that the exchange rates were generally misaligned at the beginning of the transition period, and as the years passed, the misalignment was corrected. The results from the time series analysis reveal that there were significant RER movements in the EU countries as well as in the transition countries. The paper notes that the sample period used was important because it is the period when the exchange rates became market determined in the transition economies. The paper also emphasises that RER determination models should be augmented to take into account the key aspects of the transitory reforms in order to capture accurately the movement of the RER (De Broek and Slok, 2006:380).

Kemme and Roy (2006:223) estimate the long-run equilibrium exchange rate for Poland and Russia using monthly data, covering the period from 1995 to 2001. They use ARIMA and GARCH error correction specification to estimate the short-run movements of the RER. The macroeconomic variables analysed include the openness of the economy variable; the effect of productivity variable; the terms of trade variable; the capital flows variable (net financial assets); and the share of government expenditure in GDP variable. The results show a negative coefficient for the openness

[9] Albania, Croatia, the Former Yugoslav Republic of Macedonia, Mongolia, and Russia, and the other countries of the former Soviet Union.

variable. In the long-run, the openness variable leads to a currency depreciation which is in support of the theoretical literature, and suggests that the country is a net importer. The effect of the productivity variable exhibits a Balassa-Samuelson effect in both countries which is in support of the Montiel (1999) model. An increase in the terms of trade variable results in exchange rate depreciation which is in line with *a priori* expectations in both countries in the long-run. The capital flows variable performs as expected as an increase results in a currency appreciation in both Poland and Russia. When a larger share of government expenditure is on non-tradables, an increase in government expenditure will result in an appreciation of the currency. While this is the case for Russia, it is not however the case for Poland where the government expenditure variable results in exchange rate depreciation. This depreciation can be attributed to an increase in government spending in the tradable goods sector. In the short-run, all the variables are retained as they were in the long-run, except for the capital flow, openness, government expenditure variables in Poland, and the terms of trade variable which is insignificant in Russia. The results also reveal that overall an increase in the nominal effective exchange rate as well as in domestic credit depreciated and appreciated the currency respectively (Kemme and Roy, 2006: 217-218).

The findings also reveal that Russia experienced periods of undervaluation and this was followed by prolonged periods of overvaluation. Around 2001 the RER for Russia was approaching the equilibrium value. The overvaluation is attributed to excessive capital inflows and high rates of inflation experienced at that time. In Poland, the significant and greatest misalignment was in 1995 and later in 1999. The paper also finds that the average misalignment for Russia was 8,8 percent, which was much greater than the misalignment in Poland which averaged 3,6 percent. These differences in misalignment are attributed to the different nominal exchange rate regimes of the two countries and the different responses each country implemented upon an exogenous shock (Kemme and Roy, 2006: 223).

Maeso-Fernandez *et al* (2006:514), analyse the relationship between economic fundamentals and exchange rates of transition country currencies. A BEER approach as well as a two-step approach is used, and the period covered is the transition decade of the 1990s. The determinants used in the model in this paper include the developments in real per capita income, relative government spending and the relative openness. The results reveal that increases in the real per capita income as well as in relative government spending result in an appreciation of the real exchange rate, whereas an increase in the relative openness results in a depreciation of the RER. These findings are all in

line with the *a priori* assumptions. Croatia is singled out of the sample to analyse the extent of the exchange rate misalignment. The results reveal that there is no evidence of misalignment for the Croatian kuna.

Candelon *et al* (2007:26), estimates the bilateral equilibrium exchange rate of 8 EU member states[10], using panel-cointegration techniques and the BEER approach with the sample period from 1993 to 2003. The determinants assessed in this paper include an openness variable, the demand variable[11]; and the productivity variable. The cointegration test results reveal that the openness variable has a depreciating impact on the RER which is in support of the general literature. The results also provide evidence of a positive Balassa-Samuelson effect. The government consumption variable provided insignificant results and while the signs for private and total consumption were significant they changed from being positive to negative when the sample size was reduced by two years (Candelon *et al,* 2007:26).

The results also reveal that in the Baltics, all the currencies were undervalued in early 2003 except for Estonia whose exchange rate was close to equilibrium. Latvia and Lithuania experienced misalignment of between 6 and 10 percentage points. Slovakia experienced periods of overvaluation whereas Poland experienced undervaluation. Slovenia experienced minute undervaluation whereas the Czech Republic and Hungary both showed mixed results (Candelon *et al*, 2007:102-103).

Cheung *et al* (2007) use a robust relative price and relative output framework and a pooled OLS technique to analyse the exchange rate behaviour of the renminbi, China's currency, from 1975 to 2004. The variables used to model to the renminbi are the real per capita income variable, a proxy for the Balassa-Samuelson effect; the capital account openness variable; government deficit; and the financial deepening variable (M2/GDP). The results reveal that all the variables tend to make the exchange rate appreciate with the exception of the government deficit and financial deepening variable which is statistically insignificant. The paper incorporates a corruption index to the estimation since China's economy is characterised by extensive corruption and a capital control regime. The results reveal that a reduction in corruption will most likely strengthen the currency in China (Cheung *et al*, 2007:770-780).

[10] Estonia, Latvia, Lithuania, Czech Republic, Hungary, Poland, Slovenia and Slovak Republic.

[11] The demand variable includes the ratio of government expenditure to GDP variable, the ratio of private consumption to GDP variable and the ratio of total consumption to GDP variable.

A bivariate analysis shows that the currency was undervalued from the 1980s to 2004. After controlling for serial correlation effects, the paper reports that the evidence for renminbi being undervalued loses significance. Furthermore, when more variables are added to the model, the results indicate an increase in exchange rate misalignment (Cheung *et al*, 2007:779-780).

Yajie *et al* (2007) apply the BEER model using the Johansen technique to estimate the equilibrium exchange rate for China between 1980 and 2004. The variables believed to have an effect on the equilibrium exchange rate are the terms of trade, the technological advances measured as per capita output, foreign exchange reserves[12] and monetary policy. All the variables conform to economic theory, as increases in the terms of trade, technological advances, and foreign exchange reserves lead to an appreciation of the exchange rate whereas monetary policy depreciates the currency. The paper also finds that since 1995 the REER is overvalued as it is above the estimated equilibrium RER. From 1999, however, the RER misalignment was found to be diminishing. There is evidence to suggest that in 2002 the equilibrium RER in China was undervalued.

Dubas (2009) assesses the importance of the exchange rate regime to limit misalignment. In the study, a panel cointegration technique and the BEER approach are used to estimate the equilibrium exchange rate of 102 countries[13], covering the period from 1973 to 2002. The determinants used to model the exchange rate include the terms of trade, productivity, government consumption, capital flows and excess credit. The study reveals that the productivity has the strongest effect on the exchange rate while government consumption and excess credit have the weakest effect. Furthermore, applying an intermediate exchange rate regime reduces the extent of exchange rate misalignment whereas crisis years in a country tend to increase the extent of misalignment. The study also reveals that the degree of misalignment is larger in developing countries overall, and in the case of developed countries the exchange rate regime does not matter in terms of limiting exchange rate misalignment (Dubas, 2009:1619).

Terra and Valladres (2010:123) apply the BEER model and Markov Switching model to estimate the RER misalignment for a set of 85 countries covering the period from January 1960 to December 1998. The explanatory variables used to model the exchange rate included international interest

[12] Foreign exchange reserves are a total stock of the net foreign assets accumulated by the Bank of China.

[13] 2 OECD countries and 81 developing countries.

rates, government expenditure, openness and the terms of trade. The findings reveal that a decrease in international interest rates appreciated the exchange rate in 82 percent of the countries. An appreciation of the currency is also associated with an increase in government expenditure in 81 percent of the countries, a decrease in openness in 58 percent of the countries and an increase in the terms of trade in 60 percent of the countries. Their results also reveal that in some countries there is no evidence of RER misalignment. In addition, it is evident that where RER misalignment may have occurred, the periods of overvaluation showed higher persistence relative to the periods of undervaluation.

2.4.2 LITERATURE FROM DEVELOPING COUNTRIES

Masters and Ianchovichina (1998) investigate exchange rate misalignment in Zimbabwe in the period 1967 to 1987. The paper compares the results of using two different models, the multilateral RER (MRER) model where RER is calculated from aggregate inflation statistics; and the internal RER (IRER) model which is a direct measure of domestic relative prices based on disaggregated national sources. The variables used in the model to estimate the equilibrium exchange rate include the terms of trade variable; the restrictiveness of trade policy variable; the net capital inflow variable; the domestic credit creation in excess of its sustainable level; and a time variable which is the proxy for the Balassa-Samuelson appreciation. In both models, all the variables result in an appreciation of the currency and these results are in line with the economic theory, with the exception of the time variable in the MRER equation which results in exchange rate depreciation (Masters and Ianchovichina, 1998:471).

Their findings reveal that using cross-country differences in overall inflation, as a proxy measure of a country's RER, can result in ambiguous results. In the Zimbabwe situation, it failed to capture the effects of the labour laws and other policy changes, thus failing to capture the changes in real production/consumption incentives. The study suggests the use of indices of domestic relative prices, especially in the case of single country studies when estimating the equilibrium RER, in order to avoid getting biased results (Masters and Ianchovichina, 1998:465).

Asfaha and Huda (2002) use a one-step Engel-Granger technique and a five year moving average technique to estimate the exchange rate misalignment in South Africa from 1985 to 2000. The long-run fundamentals in this case are terms of trade; government expenditure; the openness of capital controls; trade restrictions; technological and productivity improvements. An improvement to the

terms of trade as well as an increase in government expenditure result in the appreciation of the currency. This highlights that the bulk of government consumption is on non-tradables. The capital account openness variable is in support of the theoretical literature and strongly suggests that the openness of the capital account allows for capital inflows resulting in the appreciation of the exchange rate. The technology advancement variable which is a proxy for the Balassa-Samuelson effect is in agreement with the theoretical literature as it causes the exchange rate to appreciate (Asfaha and Huda, 2002:10-11).

Their findings suggest that from the third quarter of 1988 to the second quarter of 1998, the rand was overvalued. Episodes of undervaluation were present from the first quarter of 1985 to the first quarter of 1988 and also from the second quarter of 1997 to 2000. Using the Vector Autoregressive (VAR) techniques they found that the exchange rate misalignment during the period covered accounted for 20 percent variation of the South African economy's international competitiveness (Asfaha and Huda, 2002:14).

Eita and Sichei (2006) estimate the equilibrium exchange rate for Namibia covering the period between 1970 and 2004. They do so by applying the Johansen test for cointegration. The variables used to estimate the equilibrium exchange rate include terms of trade, the ratio of investment to GDP and an openness variable. The results reveal that the term of trade variable is not significant in the long-run. An increase in the ratio of investment to GDP and the openness to trade both appreciate the exchange rate. These results for the openness to trade are suggest that Namibia is a net exporter of goods. The results also reveal that there is evidence to suggest that investment is taking place more in the non-tradable goods sector. The results also show that the REER was overvalued throughout the estimation period with the exception of 1998 where it reaches its equilibrium value. Furthermore the extent of overvaluation is seen to be greater between 1975 and 1989 compared to the period between 1990 and 2002 (Eita and Sichei, 2006:21).

Iimi (2006) applies the BEER method to assess whether the exchange rate in Botswana is misaligned with its economic fundamentals for the period from 1985 to 2004. The paper estimates a reduced-form single equation model using a VECM. The fundamentals used to estimate the equilibrium exchange rate include the interest rate differential variable; the terms of trade variable; a proxy for the Balassa–Samuelson effect; fiscal risk premium variable which depends on government income and expenditure; and the net foreign assets (capital inflow) variable. The findings are in agreement

with the theoretical literature in all cases except for the finding that an increase in the net foreign assets results in an equilibrium depreciation of the currency. The paper however notes that although the net foreign assets variable is not in line with *a priori* expectations, the effect is very small (Iimi, 2006:18). There is evidence that in the late 1980s the pula was undervalued whereas in the later years of the study [only went up to 2004], it was overvalued by 5 percent, which had an effect on Botswana's competitiveness in the short and medium term (Iimi, 2006:22).

Korsu and Braima (2009) apply an Engel Granger two step procedure and a VECM to estimate the equilibrium exchange rate in Sierra Leone from 1970 to 2005. The determinants used to estimate the equilibrium exchange rate include the nominal exchange rate, price levels, capital flows, commercial policy, investment to GDP ratio, the real GDP growth rate, government expenditure and the terms of trade. The short-run results reveal that an increase in the nominal exchange rate depreciates the exchange rate in Sierra Leone, while the increase in the price level as well as an increase in capital flows result in an appreciation of the exchange rate. In regard to the effect of the capital flows variable, there is evidence of the Dutch disease in Sierra Leone in the short-run. An increase in commercial policies results in a depreciation of the exchange rate, whereas an increase in the investment to GDP ratio results in an exchange rate appreciation. This implies that investment is taking place more in the non-tradable goods sector. The real GDP growth rate variable causes exchange rate depreciation, which is contrary to the Balassa-Samuelson effect. This result thus implies that in the short-run the growth of real GDP is as a result of growth in the tradable goods sector of Sierra Leone. The government expenditure variables and the terms of trade variables are insignificant in the short-run.

The long-run results reveal that an increase in government expenditure, commercial policies, investment to GDP ratio and real GDP growth rate result in exchange rate appreciation. Thus in the long-run the Balassa-Samuelson holds in Sierra Leone. An increase in capital flows and the terms of trade variable depreciate the currency. This implies that the substitution effect of the terms of trade far outweighs the income effect and in the long-run the Dutch disease does not hold for Sierra Leone. The results also reveal that the RER in Sierra Leone was overvalued for the most part between 1972 and 1998. The RER was however undervalued from 1970 to 1972 and again between 1990 and 2005 (Korsu and Braima, 2009:22).

Loria *et al* (2010) apply the SVAR method for cointegration to examine the determinants of the peso-USD nominal exchange rate in Mexico. The study covers the period between 1994 and 2007. The study provides empirical evidence supporting the validity of the short and long-run versions of the monetary approach of exchange rate determination. The variables believed to have an effect on the nominal exchange rate are the money supply, the interest rate differential and domestic real income. The results reveal that in the short-run an increase in the money supply and the interest rate depreciates the currency, whereas an output structural shock will appreciate the currency. Using the Johansen method, the study shows that these results hold in the long-run as well (Loria *et al*, 2010:551).

2.4.3 LITERATURE FROM GHANA AND NIGERIA

Sackey (2002) develops a model for the equilibrium exchange rate in Ghana with particular focus on the role of net foreign aid inflows. The model applies the Least squares method and covers the period from 1962 to 1996. The long-run determinants of the equilibrium exchange rate are the terms of trade variable; the net foreign aid inflows variable, measured as net official donor aid to Ghana; the government consumption variable; the commercial policy variable[14]; and the technological progress variable[15]. The short-run determinants of the equilibrium exchange include the above mentioned variables excluding the terms of trade and including the nominal devaluations variable. In the long-run model, increases in the external terms of trade and the net foreign aid inflows result in a depreciation of the exchange rate whereas an increase in government consumption, commercial policy and technological progress appreciate the exchange rate. These results are in line with economic theory with the exception of the aid variable which refutes the notion of the Dutch disease where an increase in net foreign aid inflows is expected to appreciate the exchange rate (Sackey, 2002:24). In the short-run, the coefficients of the variables are the same as was the case in the long-run for the aid, government consumption, commercial policy and the technological progress variables. The nominal devaluations variable depreciates the exchange rate in the short-run, which is also as expected in the theoretical literature.

[14] The proxy used for the commercial policy variable is the parallel market premium.

[15] The proxy for the technological progress is the index of agricultural development.

In a study by Youngblood and Apaloo (2006:16) which covers the period from 1965 to 2004, the fundamental determinants of the equilibrium exchange rate include the terms of trade, net capital inflows, and commercial policy (openness). The paper suggests that a decline in the terms of trade depreciates the currency, which is in support of the *a priori* assumptions proposed in the theoretical section. The openness variable exhibits a negative coefficient, which means that an increase in openness will depreciate the currency, which is in line with the theoretical literature. In terms of the capital inflows variable, as capital inflows increase, the currency is expected to appreciate which is also in line with the Montiel (1999) model.

The findings also reveal that in the long-run the exchange rate in Ghana will most likely trend towards the equilibrium. In the short-run, divergences in the Ghana cedi will arise due to cyclical changes in fundamentals and policies that impede convergence.

A study by Aliyu (2007) estimates the exchange rate misalignment for Nigeria from the first quarter of 1986 to the fourth quarter of 2006, using the BEER method, the Permanent Equilibrium Exchange Rate (PEER) method as well as VECM technique. The fundamental determinants in this paper include terms of trade, net foreign assets, index of crude oil price volatility, government fiscal stance, the foreign reserve level relative to GDP, and finally monetary policy. The results reveal that the coefficient of net foreign assets is consistent with theory as a unit increase in the net foreign asset will result in a RER appreciation. A unit increase in the index of crude oil price volatility and monetary policy will result in an appreciation of the RER which is also consistent with literature. The coefficient of the government fiscal stance is positive reflecting a depreciation of the exchange rate and this variable is theoretically consistent if government expenditure is on tradable goods. An increase in terms of trade results in the appreciation of the RER, which is in support of theoretical literature. The reserve level to GDP variable indicates that an increase in the net foreign reserve will depreciate the naira. This is inconsistent with the theoretical expectation, and it suggests that there is no evidence of the Dutch disease in Nigeria.

The results obtained also suggest that the exchange rate was overvalued from the first quarter of 1986 to the second quarter of 1989; from the first quarter of 1992 to the fourth quarter of 1993; from the second quarter of 1995 to the first quarter of 1996; and from the second quarter of 1999 to the third quarter of 2001. Aliyu (2007:26) attributes this to policy changes that occurred during these periods. From the third quarter of 1989 to the fourth quarter of 1991; from the first quarter of 1994

to the first quarter of 1995; from the second quarter of 1996 to the first quarter of 1999; and from the fourth quarter of 2001 to the fourth quarter of 2006, the exchange rate in Nigeria was undervalued. This last period of undervaluation is attributed to good democratic practice, foreign exchange inflows owing to the rise in crude oil prices, and gains from the banking sector consolation experienced in Nigeria at the time.

Iossifov and Loukoianova (2007:7) apply the BEER method as well as the Vector Error Correction Models (VECM) from the first quarter of 1983 to the third quarter of 2006 to estimate the equilibrium RER for Ghana. The variables used to estimate the equilibrium exchange rate in Ghana include the per capita growth rate differential between Ghana and its major trading partners; the real interest rate differential; and the weighted average real world prices of Ghana's four main export commodities. The results reveal that increases in all three variables lead to an exchange rate appreciation. These results are consistent with the *a priori* expectations of the theoretical literature. The error correction estimates reveal that in each quarter fourteen percentage points of any misalignment between actual and equilibrium REER is corrected. Their findings also suggest that after a shock, the REER in Ghana reverts back to equilibrium provided the shocks do not reoccur. In the third quarter of 2006, for example, the actual REER was close to its equilibrium value. This followed the period between 1999 and 2000 when the actual REER was below its equilibrium value (Iossifov and Loukoianova, 2007:13-15).

A review of the empirical literature reveals that although many studies have been done for developed and transition economies, few studies are available for Ghana and Nigeria. This study aims to add to the growing body of literature on real exchange rate misalignment in Ghana and Nigeria. In addition this study will use the Johansen (1995) technique as well as the Vector Error Correction Model to estimate the long-run relationship between the REER and its determinants. This study will employ an array of variables to model the equilibrium exchange rate which will shed more light on the behaviour of real exchange rate behaviour in Ghana and Nigeria. The variables employed in this study will have different proxies to the ones used in the studies reviewed for Ghana and Nigeria. This is important as it will ascertain whether different proxies for the same variable will have an effect on the outcome of the results.

The following subsection will provide a summary of the coefficients of the determinants in the equilibrium exchange rate model from the examined literature.

2.4.4 A SUMMARY OF THE BEHAVIOUR OF THE DETERMINANTS OF THE EQUILIBRIUM RER

Table A-1.1a in the Appendix A-1 summarises the findings in the empirical literature. The fundamental determinants of the long-run equilibrium RER which are recurring in literature are the terms of trade (TOT); exchange controls / openness (OPEN), government expenditure (GVT); the Balassa-Samuelson effect (BAL); net foreign assets / net capital inflow (NFA); the real interest rate differential (RID); ratio of investment to GDP (INV); export prices and general price levels (EXP); income (INC); foreign aid inflow (AID); oil prices / commodity prices (OIL); monetary policy (MS); and finally the nominal exchange rate (NER). It is worth noting that the way in which the RER is calculated in each case will have an effect on the sign of the coefficient of the determinants; for example if the inverse of the RER is used, the results will have the opposite sign. For the sake of this discussion, it is assumed that a positive coefficient is interpreted as an appreciation of the RER and a negative coefficient is interpreted as a depreciation of the RER.

The empirical literature provides strong support of the Balassa-Samuelson effect. The Balassa-Samuelson variables' coefficients have a positive sign with the exception of the exchange rate of China in the Zhang (2001) study. This conflicting result could be because the proxy used for the productivity growth variable in Zhang (2001) does not capture the Balassa-Samuelson effect accurately.

The terms of trade variable generally performs well, as it exhibits both the income and substitution effects of the terms of trade. The evidence in the empirical section however generally supports that an improvement in the terms of trade will result in a currency appreciation. Evidence supporting currency depreciation is found in Ghana (in the long-run); in Poland and Russia; and in Sierra Leone (in the long-run). The coefficient of the openness variable appears to be correctly signed for most of the papers. Generally the papers support that an increase in openness will depreciate the currency, implying that these countries are importing more goods relative to the goods being exported.

As expected the government expenditure variable provides mixed results. Generally, the empirical literature argues that an increase in the government expenditure results in a RER appreciation with the exception of Botswana, Poland (in the long-run) and Nigeria. The results in Botswana, Poland (in the long-run) and Nigeria are likely due to government expenditure being channelled towards the expenditure of tradable goods. The coefficient of the net foreign assets variable exhibits the

expected positive sign except in Botswana, in Sierra Leone (in the long-run) and in Poland (in the short-run). In the long-run, however, the coefficient of net foreign assets variable in Poland becomes positive.

A review of the literature reveals that an expansionary monetary policy will appreciate the currency in all the countries with the exception of Mexico and the transition economies included in De Broek and Slok (2006). The empirical literature generally supports that a currency appreciation can also be due to increases in real income, investment, export prices and the general price level, and the real interest rate differential. An increase in commodity prices generally shows mixed results, whereas an increase in foreign aid inflows and the nominal exchange rate tend to depreciate the currency.

Judging from the performance of the fundamental determinants in the empirical section, this paper aims to employ a set of fundamental determinants to estimate the equilibrium RER for Ghana and for Nigeria. The set of fundamental determinants employed will be limited by the data availability in each of these countries. In addition, the level of exchange rate misalignment will be assessed. The study also aims to apply recent econometrics techniques to improve the validity of the results obtained.

2.5 CONCLUSION

After a thorough assessment of the properties of the alternative measures of the exchange rate, the geometric average REER appears to be the most appropriate exchange rate to employ in this study. This is because of its properties of symmetry and consistency and, most importantly, it is a trade-weighted exchange rate. Once the appropriate measure of REER is established, the next important issue is the appropriate model to employ when modelling the equilibrium real exchange rate. This study will draw from the simple monetary model as well as the Edwards (1989) and the Montiel (1999) models. The determinants of the RER are discussed at length in the chapter and after a review of the empirical literature; it appears that the coefficients of the variables are mostly consistent with the theoretical expectations. The empirical section also reports the real exchange rate misalignment in the situations where it occurred. It is important to note that the differences in the proxies used to measure the same variable can lead to a disparity in the results. In addition, country-specific structural mechanisms put in place by governments can deter the expected outcome. It appears that the differences in methodological approaches used to estimate the equilibrium RER and the RER misalignment do not seem to have an overwhelming impact on the expected result.

APPENDIX A-1: A Summary of the empirical findings

Table A-1. 1a: A summary of previous empirical findings

Study	Country covered	Years covered	Estimation methods	TOT	OPEN	GVT	BAL	NFA	DC/ MS	OIL	NER	RID	INC	EXP	AID	INV
Masters and Ianchovichina (1998)	Zimbabwe	1967 - 1987	Using RER indexes	+	-		+	+	+							
Zhang (2001)	China	1952 - 1997	BEER	+	_	+	_									
Asfaha and Huda (2002)	South Africa	1958 - 2000	Engel Granger and Moving Average methods	+		+	+	+								
Sackey (2002)	Ghana	1962 - 1996	Least squares													
			SHORT-RUN		-	+	+				-				-	
			LONG-RUN	-	-	+	+								-	
Eita and Sichei (2006)	Namibia	1970-2004	Johansen technique	+												+
Iimi(2006)	Botswana	1985 - 2004	BEER	+		-	+	-				+				
DeBroek and Slok (2006)	26 transition economies	1991 to 1998	BEER		-	+	+		-	-						

				TOT	OPEN	GVT	BAL	NFA	DC/ MS	OIL	NER	RID	INC	EXP	AID	INV
Kemme and Roy (2006)	Russia and Poland	1995 to 2001	ARIMA and GARCH						+		-					
		LONG-RUN	Poland	-	-	-	+	+								
			Russia	-	-	+	+	+								
		SHORT-RUN	Poland	-	+	+	+	-								
			Russia		-	+	+	+								
Maeso-Fernandez *et al* (2006)	Transition countries	1990s	BEER Panel cointegration		-	+							+			
Youngblood and Apaloo (2006)	Ghana	1965 to 2004	VECM technique BEER approach	+	-			+								
Aliyu (2007)	Nigeria	1986 to 2006	BEER , PEER and VECM technique	+		-		+	+	+						
Candelon *et al* (2007)	8 EU member states	1993 to 2003	BEER		-		+									
	Baltic's				-		+									
Cheung (2007)	China	1975 to 2004	Pooled OLS			+	+		+							

				TOT	OPEN	GVT	BAL	NFA	DC/ MS	OIL	NER	RID	INC	EXP	AID	INV
Iossifov and Loukoianova (2007)	Ghana	1983 to 2006	BEER VECM				+					+		+		
Yajie *et al* (2007)	China	1980 to 2004	BEER VECM	+			+	+	+							
Korsu and Braima (2009)	Sierra Leone	1970 to 2005	Engel Granger technique VECM													
			SHORT-RUN		+		+	+			-			+		+
			LONG-RUN	-	-	+	+	-								+
Loria *et al* (2010)	Mexico	1994to 2007	SVAR model						-			-	+			
Terra and Valladres (2010)	85 countries	1960 to 1998	BEER Markov Switching model	+	-	+						+				

Where:

TOT = terms of trade variable

OPEN = degree 0f openness / trade liberalisation variable

GVT = government consumption variable

BAL = Balassa-Samuelson effect (productivity) variable

NFA = net foreign assets / capital flows variable

DC/MS = domestic credit / monetary policy variable

OIL = oil/commodity prices variable

NER = nominal exchange rate variable

RID = real interest rate differential variable

INC = real income variable

EXP = export prices

AID = foreign aid

INV = Investment

\- = a depreciation

\+ = an appreciation

CHAPTER 3

AN OVERVIEW OF THE GHANAIAN AND NIGERIAN EXCHANGE RATE POLICIES

3.1 INTRODUCTION

This chapter aims to give a concise description of the evolution of the exchange rate policies adopted in each country. Furthermore, this chapter will briefly analyse the trends of the fundamental determinants in comparison to the real effective exchange rates in both Ghana and Nigeria. This is important to this study, as it may shed some initial light on whether each of these variables has some relationship with the real exchange rate. It is important however to note that there are other factors that affect the REER[16] apart from the variables discussed here. Hence, it is important to observe these trends against the background of the policies put in place in both countries. Section 3.2 will give a brief account of the evolution of the exchange rate policy in Ghana while Section 3.3 provides an analysis of the relationship between the fundamental determinants and the REER in Ghana. Section 3.4 will provide a concise description of the evolution of the exchange rate policy in Nigeria and Section 3.5 will give a description of the relationship between the fundamental determinants and the REER in Nigeria. Section 3.6 will conclude.

3.2 THE EVOLUTION OF THE EXCHANGE RATE POLICY IN GHANA

3.2.1 THE PERIOD FROM 1955 TO 1960

Ghana has an import-constrained economy whose foreign exchange earnings are dependent on the export of a few primary products, especially cocoa, gold and timber. Through the history of the Ghanaian economy the exchange rate, as well as fiscal and monetary policies were often the main contributors to economic performance, particularly between 1960 and 1982, where the economy shrunk at a rate of 1.3 percent (Jebuni *et al*, 1994:1).

Following Ghana's independence from colonial rule, the government embarked on development projects throughout the country which included implementing import-substitution industrialisation. This was funded by cocoa receipts which were experiencing a boom in the 1950s. In addition, the

[16] The real effective exchange rate of the currency is an index with 2000=100. This variable is expressed in foreign currency terms, which implies that an increase in the REER indicates an appreciation of the REER whereas a decrease in the REER indicates depreciation.

development projects were also supported by the Ghanaian exchange rate which was overvalued and fixed during this period. When the price of cocoa began to fall in the 1960s, Ghanaian revenues fell, which compromised the government's development projects. The fall in cocoa prices was followed by Ghana's worst recession since independence which lasted from 1964 to 1968. As a result, in July 1967 the National Liberation Council (NLC) government accepted an IMF/World Bank package, which devalued the cedi for the first time. 1USD was then equal to 1.28 cedi (Jebuni *et al*, 1994:4).

3.2.2 THE PERIOD FROM 1960 TO 1983

In January of 1972, the coup d'état that took place in Ghana resulted in the further devaluation of the cedi. This period was however plagued by high government deficits which then led to an appreciation of the cedi and from 1973 to 1978 the REER appreciated. Furthermore, from 1974 to 1977 the cedi/USD bilateral exchange rate was pegged to the USD at 1.15 cedi. A strong cedi persisted in Ghana and from 1980 to 1982 the cedi/ USD bilateral exchange rate was pegged to the USD at 2.75 cedi (Bank of Ghana, 2004:1).

From 1978 to 1983 the cedi was pegged to the USD and during this period the inflation rate in Ghana was high relative to its partner countries. The REER in Ghana appreciated by 445 percent (Kapar,1991:17). The difference between the parallel and the official rate widened considerably because of imbalances between the supply and demand of foreign exchange in Ghana, and the informal market thus became pivotal in the demand and supply of the foreign exchange. Furthermore, the Ghanaian economy was plagued with a shortage of imports particularly of the inputs required in both the agricultural and industrial sectors. Ghana could not meet its debt obligations and the level of foreign aid was low (Kapar,1991:17-18). Something had to be done to deal with these pertinent economic issues which were plaguing Ghana at the time.

3.2.3 THE PERIOD FROM 1983 TO 1990

In April 1983, the Ghanaian government embarked upon the IMF/ World bank imposed Economic Recovery Programme (ERP)/ Structural Adjustment Program (SAP), and in October of that year all the exchange rates were unified. An exchange rate policy was put in place in 1983 to gradually devalue the cedi. The new policy was to ensure that the weighted average exchange rate moved in accordance with an index which measured the inflation differential between Ghana and its main trading partners. It then became apparent that a pegged exchange rate would not suffice in attaining

an appropriate exchange rate. The exchange rate regime was then changed to a managed float system (Bank of Ghana: 2004:1).

Exchange rate adjustments were implemented in order to counter the overvaluation of the cedi, and the government ensured that the fiscal and monetary policies were in line with these adjustments. The SAP devalued the cedi in October of 1983, and 1 USD was then equal to 30 cedi. The government of the Provisional National Defence Council in 1986 introduced an auction system of determining exchange rates and thereafter the exchange rates were market determined and reflected an equilibrium exchange rate which was determined by fundamentals. By the end of December 1986, the real effective exchange rate had been devalued by 94 percent since March of 1983. Apart from devaluing the cedi, the auction system was aimed to decrease the spread between the parallel and official exchange rates (Kapar, 1991:19).

Ghana also implemented the liberalisation of the trade industry and this included the removal of exchange controls on importable goods into Ghana. The policy on trade was effective to the point where the exchange rate continued to depreciate. Although the exchange rate continued to depreciate up to 1988, the parallel market still thrived in Ghana. To cope with the issue of the large parallel market, the first bureau de change was established in 1988 and this further liberalised the foreign exchange market. Between 1988 and 1990, the rates attained in the bureau de change and the auction system converged (Kapar, 1991:19).

3.2.4 THE PERIOD FROM 1990 TO 2009

In order to further liberalise the exchange rate system, the retail auction system was removed and it gave way to the wholesale auction system in 1990. This move further unified the rates at the bureau de change and the auction system in Ghana. From 1999 to 2000, Ghana experienced the collapse of the cedi in nominal terms and this depreciated the REER sharply. Furthermore, in 2002, Ghana experienced large negative terms of trade shocks which further devalued the REER.

In July 2007 the Ghanaian cedi (GHC) was redenominated. The new Ghana cedi was set to equal to 10,000 old Ghanaian cedis. The old currency was in circulation alongside the new one until December 2007 (Bank of Ghana, 2007:1).

Table 3.1 provides a summary of the policy changes that took place in Ghana.

Table 3.1: A summary of the exchange rate policy and parity in Ghana

Period	Exchange rate policy and the value of the cedi
1950	The exchange rate was fixed and overvalued in the 1950s. This period was characterised by the cocoa boom in Ghana. The revenues from cocoa helped to sponsor import-substitution industrialisation which was implemented in a bid to develop the economy.
1960	From 1964 to 1968, Ghana experienced a recession mainly due to a fall in the cocoa prices.
1967	IMF/World bank package devalues the cedi, 1USD =1.28 cedi.
1973-1978	High government deficits and high inflation drive the REER appreciation until 1978. From 1974 to 1977 the cedi/USD was pegged to the USD at 1.15 cedi.
1980-1982	A strong cedi persisted and the cedi/USD was pegged to the USD at 2.75 cedi.
1983	Implementation of the Structural Adjustment Program. The cedi was devalued to 1 USD equal to 30 cedi.
1986	Introduction of the retail auction system to ensure the exchange rate is market determined and to decrease the spread between the parallel and market rates.
1988	First bureau de change was established
1990	Introduction of the wholesale auction system.
1999-2000	Large deterioration of the terms of trade and the collapse of the cedi in nominal terms, depreciates the REER.
2007	Introduction of the new Ghana cedi (GHS) which is equal to 10,000 old Ghanaian cedis.

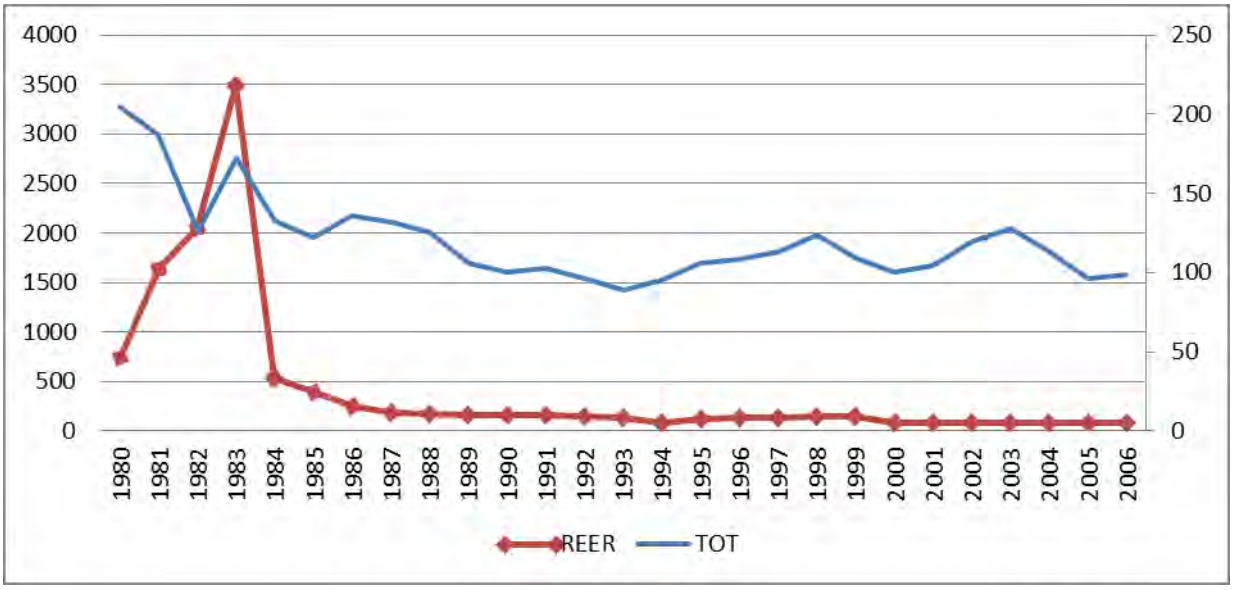
Source: Compiled by author based on different literature.

3.3 THE TRENDS OF THE FUNDAMENTAL DETERMINANTS OF THE EXCHANGE RATE IN GHANA

In this section the variables which will be discussed in relation to the REER are the terms of trade index, the nominal effective exchange rate, the government consumption expenditure as a percentage of GDP, the foreign aid inflow as a percentage of GDP, the openness to trade, the domestic credit as a percentage of GDP, the net foreign assets as a percentage of GDP, the GDP

growth rate, and finally the world cocoa prices. These variables are the potential determinants of the REER in Ghana. For both Ghana and Nigeria, the choice of variables draws from the models discussed in Chapter 2 as well as the macroeconomic and policy trends in each of the countries. Furthermore, the choice of variables is motivated by data availability within each of the countries. This section aims to provide a visual analysis of the relationship between each of the determinants and the REER through time[17]. This is achieved by graphically observing each of these determinants in relation to the REER. The data for all the variables is accessed from the World Bank databank (2010) and the IMF International Financial Statistics (2010). The REER is shown on the left axis of all the graphs and the variable being considered is shown on the right axis.

Figure 3.1: The terms of trade index in Ghana and the REER



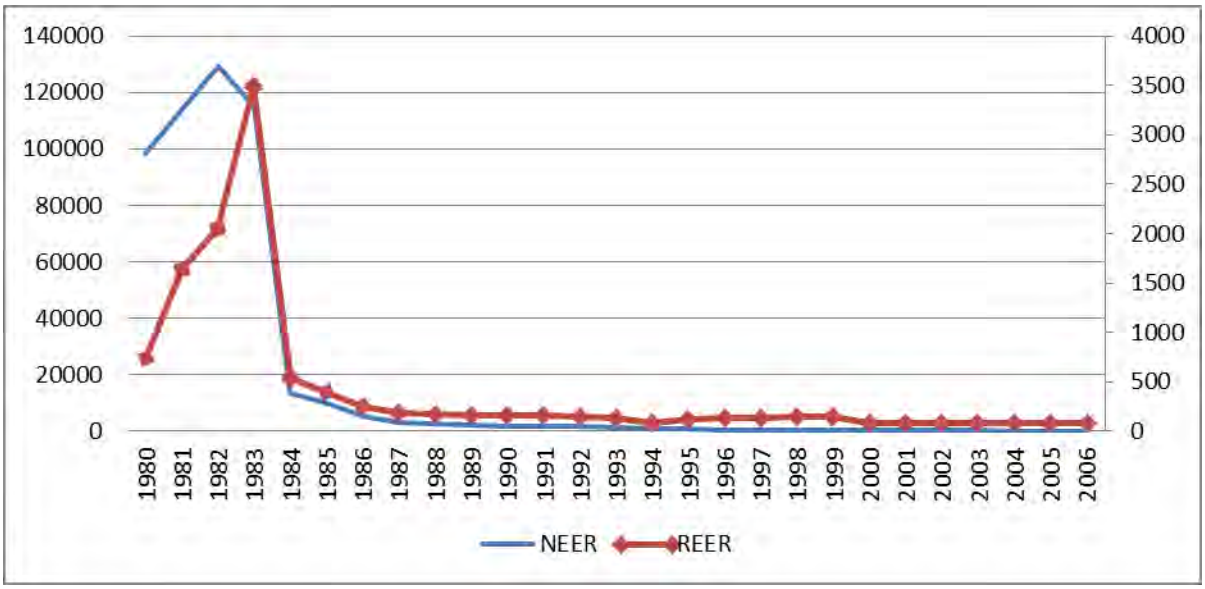
From a visual inspection of the terms of trade index in Figure 3.1, it appears that prior to 1985 the terms of trade experienced a downward trend albeit with fluctuations. As the terms of trade gradually deteriorated, particularly between 1983 and 1984, the REER also experienced a sharp depreciation. It is also evident that after 1985 the terms of trade as well as the REER exhibited a mean reverting pattern. The two plots in Figure 3.1 suggest that the terms of trade index and the

[17] It is important to note that an upward movement in the REER is translated as an appreciation of the REER. A downward movement in the REER on the other hand, indicates the depreciation of the REER.

REER exhibit a long-term relationship. It can thus be deduced from the plots that the terms of trade appear to be positively[18] related to the REER.

In Figure 3.2 it seems from the plots that the REER and the nominal effective exchange rate in Ghana follow a similar trend throughout the period observed. The plots suggest that the REER and the NEER are closely related over time and the two variables peaked in 1982 and 1983 respectively. Thereafter both the REER and the NEER experienced sharp devaluations. After 1983 both the NEER and the REER fluctuated steadily up until 2006. From this it can be concluded that the NEER and the REER are positively related.

Figure 3.2: The NEER in Ghana and the REER



In Figure 3.3 it is evident that the REER peaked in 1983, which was also the period in which the government consumption expenditure was lowest. The period of low government consumption expenditure was therefore accompanied by an appreciating cedi exchange rate. The government consumption expenditure gradually increased as a share of GDP over the years whereas the REER generally depreciated. This observation is important because it suggests that the government consumption expenditure and the REER in Ghana are negatively related in the long-run.

[18] A positive relationship between a variable and the REER means that an increase in the variable in question will cause the REER to appreciate. A negative relation to the REER on the other hand would suggest that an increase in the variable in question will cause the REER to depreciate.

Figure 3.3: The government consumption expenditure (% of GDP) in Ghana and the REER

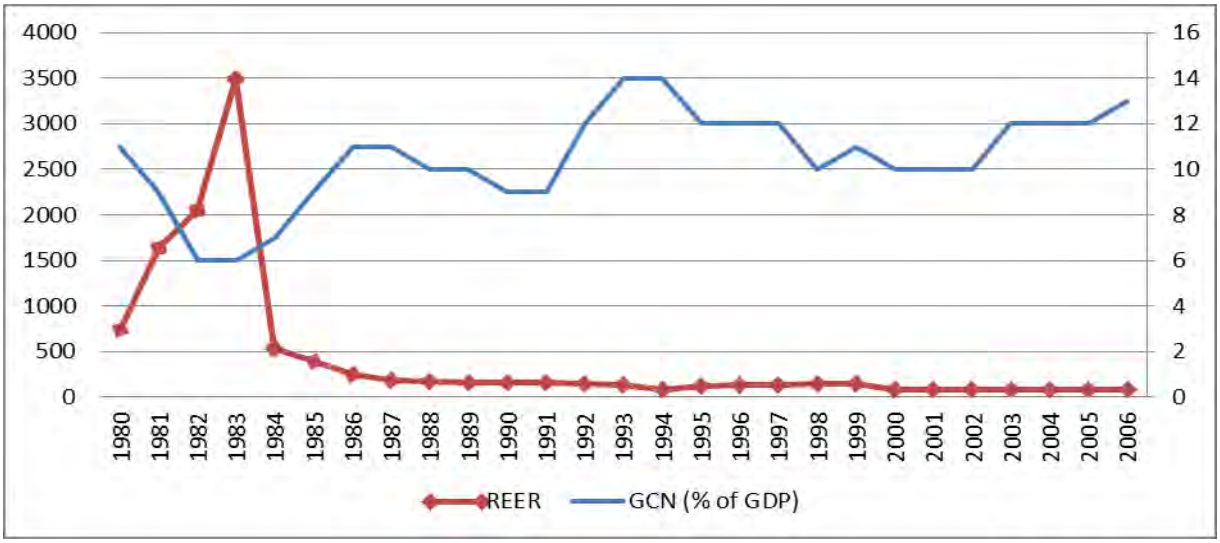
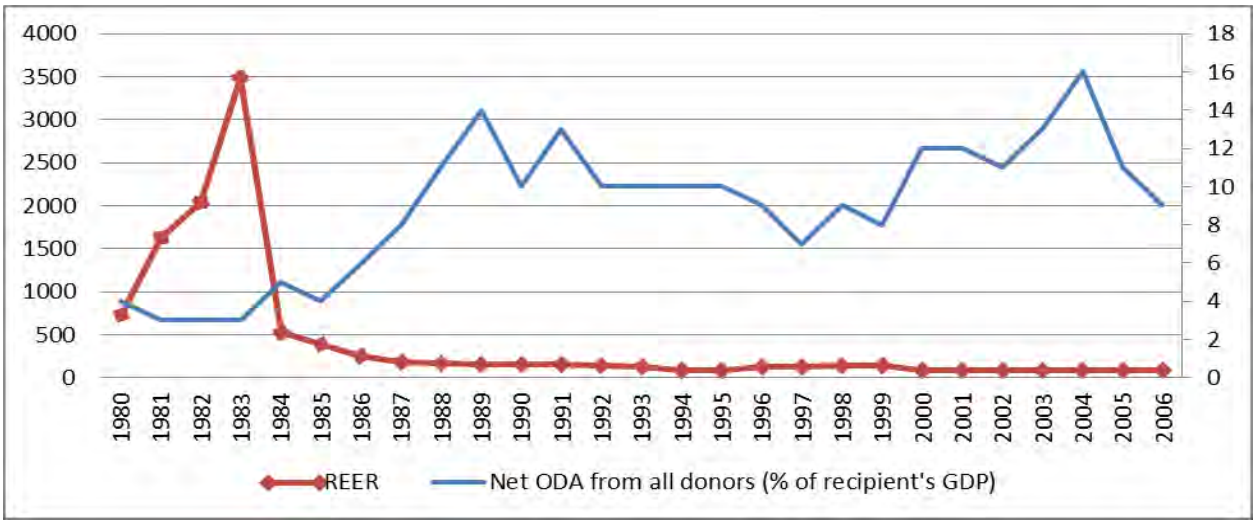


Figure 3.4: The net foreign aid inflow (% of GDP) in Ghana and the REER

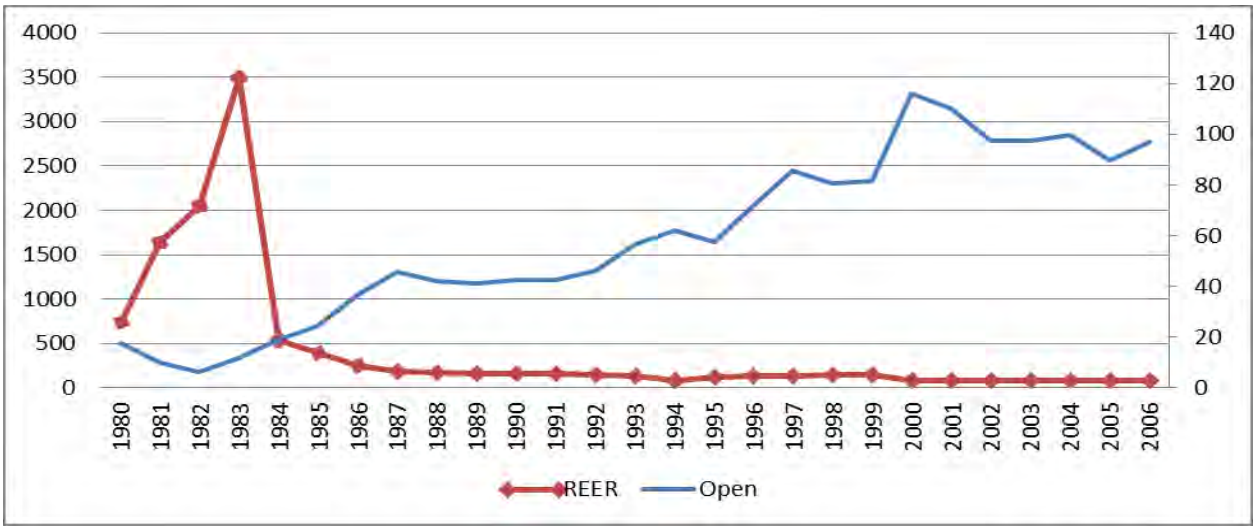


From a visual inspection of the plots in Figure 3.4 and Figure 3.5 it appears that the net foreign aid inflow and the openness to trade generally increased in the period observed whereas the REER generally decreased, albeit with fluctuations. It is also interesting to note that from 1980 to 1983 when the net foreign aid inflows and openness to trade were at their lowest, the REER generally increased, reaching its peak in 1983.

This relationship suggests that an increase in the net foreign aid inflows as well as an increase in the openness to trade will most likely depreciate the REER in Ghana. The relationship between the net

foreign aid inflows and the REER suggests that there may be no evidence of the Dutch disease problem in Ghana. The relationship between the openness of trade and REER is in support of the theoretical expectations.

Figure 3.5: The openness of trade in Ghana and the REER



The visual analysis of the plot of the extension of domestic credit in Figure 3.6 shows that in Ghana, domestic credit gradually increased as a percent of GDP from 1980 through to 2006, albeit with fluctuations. Where the greatest fluctuations occurred, for instance from 1986 to 1988, and from 1998 to 2001, there is little evidence to suggest that they had an influence on the REER.

Figure 3.6: Domestic credit (% of GDP) in Ghana and the REER

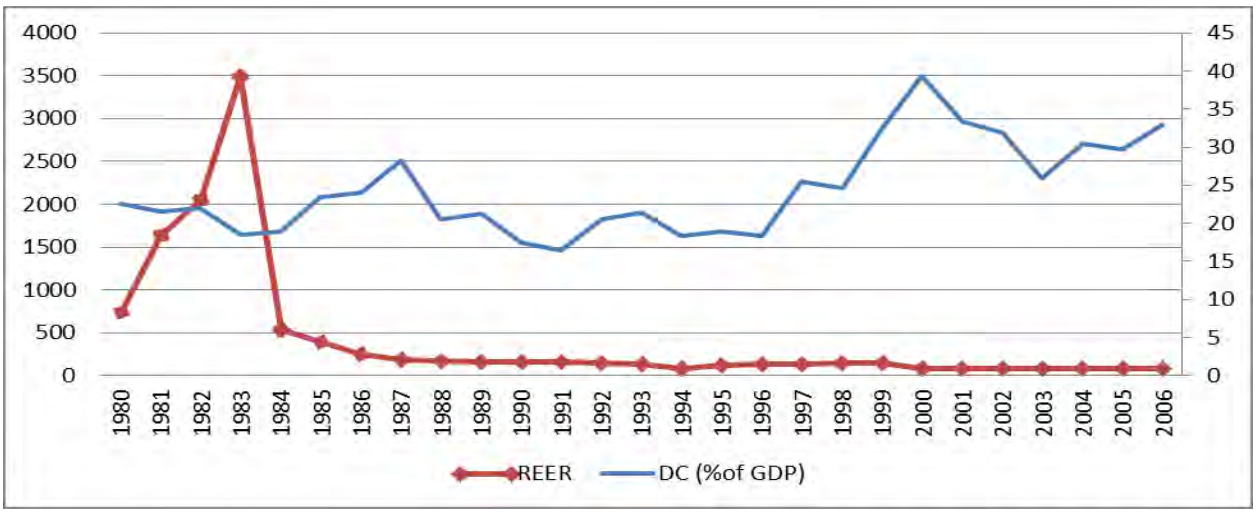
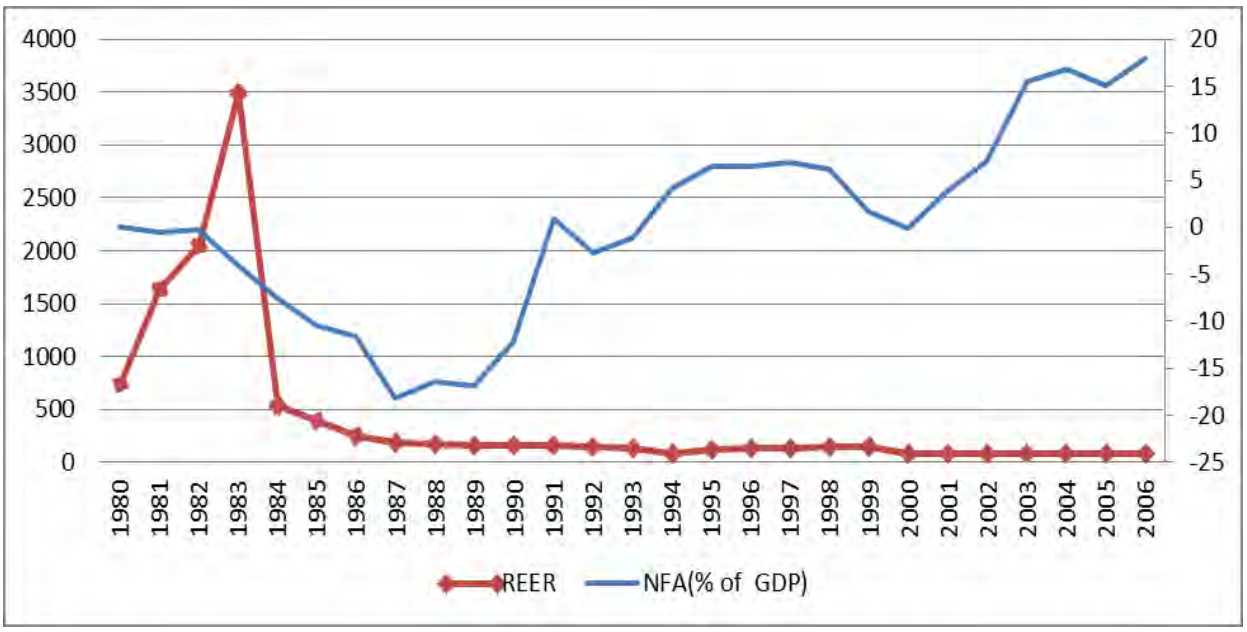


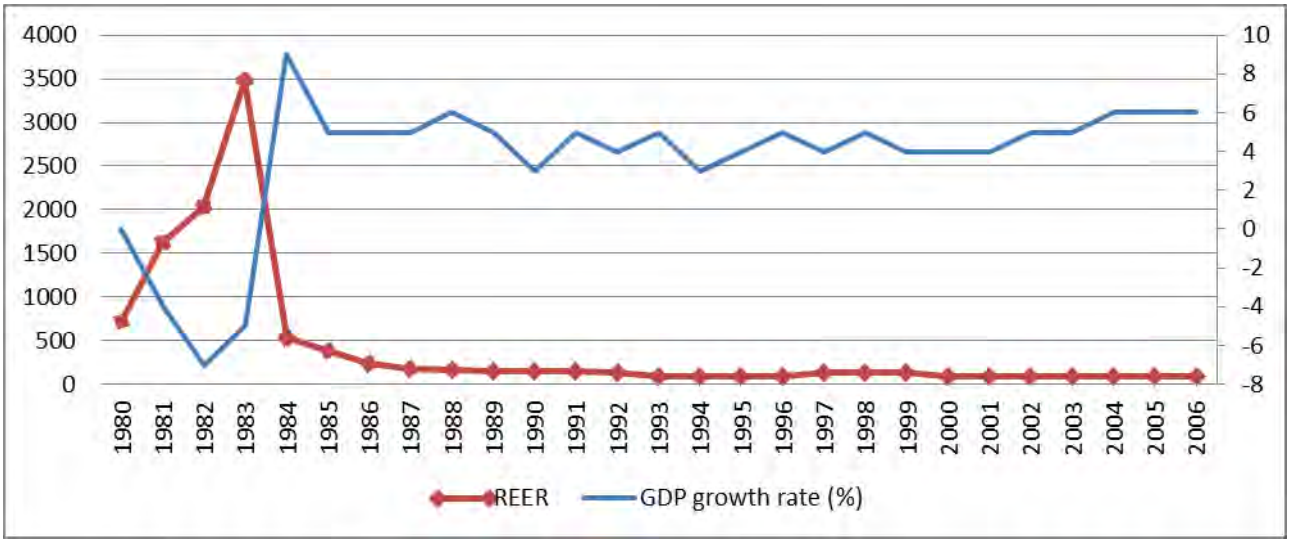
Figure 3.7 shows that from 1980 to 1989, more capital was flowing out of rather than into Ghana. The situation generally improved from 1989 to 2006. From the visual analysis of the plots from 1983 to 1990 when the net foreign assets can be argued to have been at its lowest, the REER experienced patterns of depreciation. From this it can be deduced that there seems to be a positive relationship between the capitals flows and the REER in Ghana.

Figure 3.7: The net foreign assets (% of GDP) in Ghana and the REER



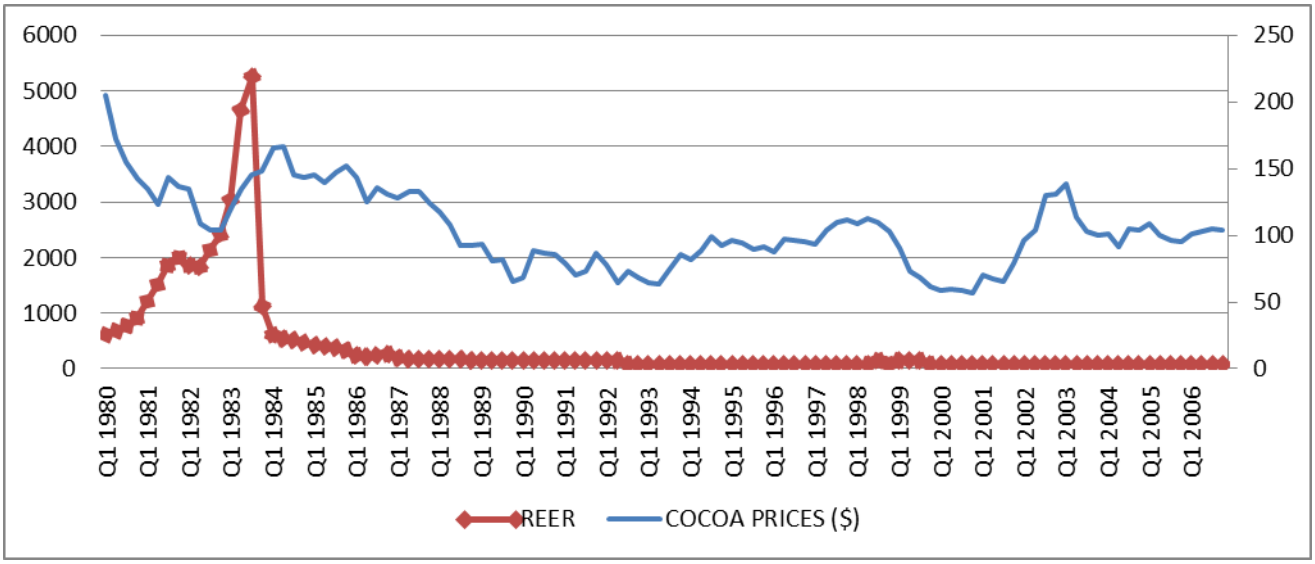
The visual plots in Figure 3.8 highlight that between 1983 and 1984, both the GDP growth rate and the REER peaked, thereafter they both declined and experienced steady fluctuations for the rest of the period covered. This analysis suggests that the GDP growth rate in Ghana is positively related to the REER. An increase in the GDP annual growth rate is thus expected to cause the REER to appreciate. The findings from the analysis of the plots are thus in support of the Balassa-Samuelson effect in Ghana.

Figure 3.8: The GDP growth rate (%) in Ghana and the REER



Cocoa is one of Ghana's chief exports, and an increase in the world cocoa price is expected to cause a REER appreciation. The plots in Figure 3.9 show that, although world cocoa prices were volatile, they generally decreased from 1980 to 2006, while the REER generally also declined albeit with fluctuations. This relationship suggests that a fall in cocoa prices is likely to decrease the REER, and this is in line with the theoretical expectations articulated in Chapter 2.

Figure 3.9: The world cocoa prices (USD) and the REER



The next section will discuss the exchange rate policy in Nigeria.

3.4 AN OVERVIEW OF THE EXCHANGE RATE AND THE EXCHANGE RATE POLICY IN NIGERIA

3.4.1 THE PERIOD FROM 1960 TO 1983

From 1967 to 1970 Nigeria experienced a civil war. This adversely affected the function of the fixed exchange rate regime which was in place at the time. The fixed exchange rate regime was accompanied by strict controls and regulations which ultimately resulted in the overvaluation of the exchange rate. This had negative implications for the economy as it encouraged the importation of finished goods which created more competition for the domestic producers. Furthermore the balance of payments position and the country's external reserves level were both compromised by the overvalued exchange rate (Sanusi, 2004:2).

Following the civil war, Nigeria began to experience a positive economic growth which was due to the oil boom experienced from 1970 to 1980. As a result, throughout the 1970s the naira exchange rate appreciated, with the exceptions of 1976 and 1977. The oil boom also resulted in large capital inflows into Nigeria from 1974 to 1978. The central bank of Nigeria thus implemented a system of gradually appreciating the naira against the USD and the British pound sterling, in a bid to have a naira exchange rate which reflected the Nigerian balance of payments position (Oyejide, 1986:26).

3.4.2 THE PERIOD FROM 1983 TO 1990

In 1980 Nigeria was an oil-exporting country faced with high capital inflows which resulted in the appreciation of the naira. The oil boom came to an end by 1983 and the prevailing currency appreciation impeded the growth of the economy particularly in the agricultural sector. It was clear by 1986 that the now overvalued currency would have adverse effects on the economy as a whole, since the agricultural sector contributed 60 percent of non-oil exports and sustained more than 70 percent of the population (Anthony, 2010:1-6).

In 1986, Nigeria implemented the IMF/ World bank imposed Structural Adjustment Program which emphasised a market oriented approach to exchange rate determination. This decision was informed by the compromised balance of payments position as well as the nation's ailing external reserves level. Both the nominal and the RERs were depreciated so as to align them to their equilibrium levels (Obadan, 1994:2). Agriculture was boosted by increased tariffs on agricultural imports, the

subsidisation of fertiliser, reversing the previous position where by 1982, all export crops with the exception of cotton and all food crops were highly protected (Hino, 2003:94).

The institutional framework in place in 1986 was the second-tier foreign exchange market (SFEM). The objective of the SFEM was to attain a realistic exchange rate through a series of exchange rate devaluations. SFEM implemented a dual exchange rate system and in 1987 the two rates merged at the rate of 3.74 naira for 1 USD. A Dutch Auction System (DAS) was introduced in 1987 in order to improve the level of professionalism in the bidding system. The SFEM and DAS were then replaced by the Foreign Exchange Market (FEM) in 1987, in a bid to reduce the multiplicity of the exchange rates, as well as ensure a the depreciation of the currency. In 1989, the Bureau de change and the Inter-bank Foreign Exchange Market (IFEM) were introduced to the market, in order to cater for the needs of small end-users. In 1990, the IFEM was altered to accommodate the reintroduction of the DAS (ODUBOGUN, 1995:13).

3.4.3 THE PERIOD FROM 1990 TO 2006

From 1992 to 1993 the exchange rate system in Nigeria was deregulated and this was further enhanced by realigning the official exchange rate with the exchange rate in the parallel market. In 1994 the Autonomous Foreign Exchange Market (AFEM) replaced the IFEM. The AFEM was established to ensure that foreign exchange rate was sold at a market determined price, by authorised dealers. The exchange rate was further depreciated and at the close of 1995, 1 USD was equal to 82 naira in the autonomous part of the market. This however widened the gap between the parallel and official exchange rate. The further devaluation of the naira in 1998 fostered a market-oriented exchange rate arrangement which led to a fall in the premiums being captured in the parallel market and therefore narrowed the gap between the official and parallel market exchange rates.

In 1999 the IFEM was reintroduced in order to improve inter-bank activities in the market. The exchange rate continued to depreciate and in 2001, 1 USD was equal to 111 naira. This period was also marked by large oil revenues as well as an improvement in the macroeconomic performance of the economy due to the banking sector reform (Central Bank of Nigeria, 2010: 1).

In 2005 the monetary and fiscal policy stance of the government as well as large capital inflows caused the naira to appreciate significantly. In order to cope with the demand pressure on the foreign exchange rate as well as the falling external reserves, the Central Bank of Nigeria

reintroduced the DAS which replaced the IFEM in 2006. It is reported that for the first time the official and parallel market rates in Nigeria merged. The exchange rate however continued to appreciate throughout 2006 owing to the high revenues from the high crude oil prices internationally (Aliyu, 2007:10).

Table 3.2: A summary of the exchange rate policy and parity in Nigeria

Period	Exchange rate policy and the value of the cedi
1960-1967	The exchange rate was overvalued due to high control regulation practiced during the civil war.
1970	Due to the oil boom, the Central bank of Nigeria adopted a strategy of the gradual appreciation of the naira against the USD and the British pound sterling. Throughout the 1970s the naira exchange rate appreciated, with the exception of 1976 and 1977.
1986-1987	The implementation of Structural Adjustment Program. SFEM and DAS are introduced. In 1987 the FEM replaces the prevailing institutional setup (SFEM and DAS).
1989	The IFEM replaced the FEM in 1989 and in the later in the year it is altered to accommodate the reintroduction of the DAS. The Bureau de change system was established.
1994	The AFEM replaced the IFEM and the exchange rate depreciated. The exchange rate continued to depreciate and in 1995, 1USD was equal to 82 naira.
1999-2004	The IFEM is reintroduced to ensure the depreciation of the naira. In 2001, 1USD was equal to 111 naira. High oil revenues and banking sector reforms, improved the macroeconomic performance of the country.
2005	The naira began to appreciate due to the government's fiscal and monetary policy stance.
2006	The DAS replaced the IFEM and for the first time the official and parallel market rates merged. The exchange rate continues to appreciate due to the crude oil revenues.

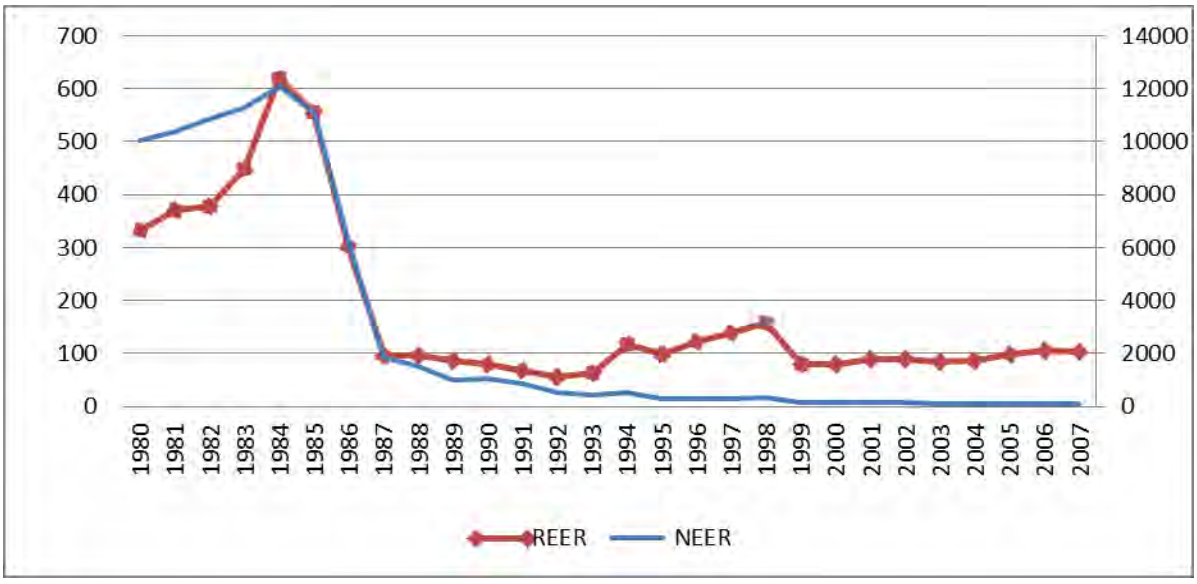
Source: Compiled by author based on different literature.

3.5 THE TRENDS OF THE FUNDAMENTAL DETERMINANTS OF THE EXCHANGE RATE IN NIGERIA

The variables which will be analysed in relation to the REER include the nominal effective exchange rate, the net foreign aid inflows as a percentage of GDP, the openness to trade, the government consumption expenditure as a percentage of GDP, the net foreign assets as a percentage of GDP, the extension of domestic credit as a percentage of GDP, the world oil prices and finally the GDP growth rate. Drawing from the models of exchange rate discussed in Chapter 2, as well as the data availability in Nigeria, these variables are expected to be the determinants of the equilibrium REER in Nigeria. REER is shown on the left axis of all figures and the variable being examined is on the right axis.

From a visual inspection of the NEER and the REER in Nigeria, it appears that throughout the period observed with the exception of the period from 1993 to 1999, they move very close together, as was the case in Ghana. This suggests that the two have a long-run relationship.

Figure 3.10: The NEER in Nigeria and the REER



From Figure 3.11, between 1980 and 1987 and between 1999 and 2003, Nigeria did not have any foreign aid inflows into the country. During the period when the foreign aid inflow was at its highest, the REER experienced both appreciations and depreciations. The visual inspection of the

two variables thus shows that there is little evidence to suggest that foreign aid inflows have a bearing on the REER in Nigeria.

Figure 3.11: The foreign aid inflow (% of recipient's GDP) in Nigeria and the REER

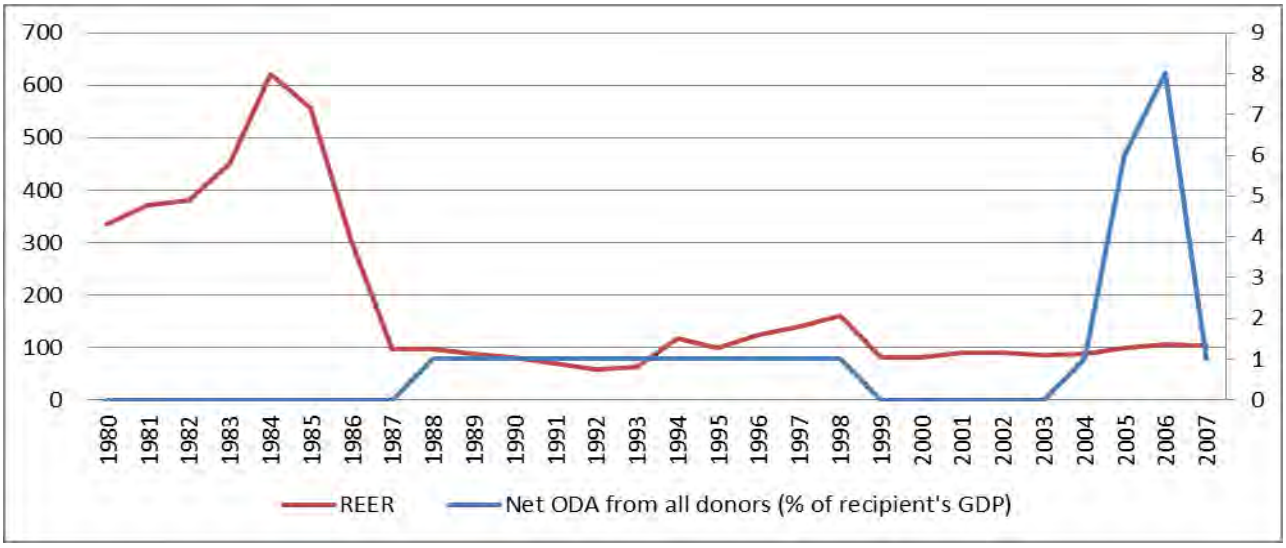
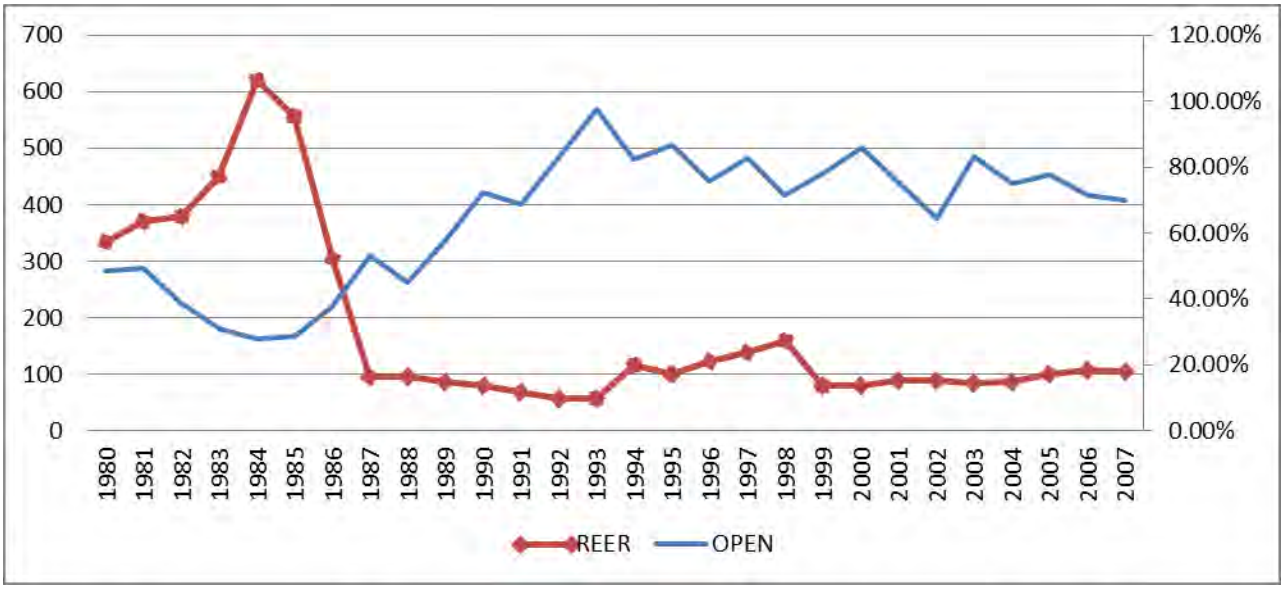


Figure 3.12: The openness to trade in Nigeria and the REER

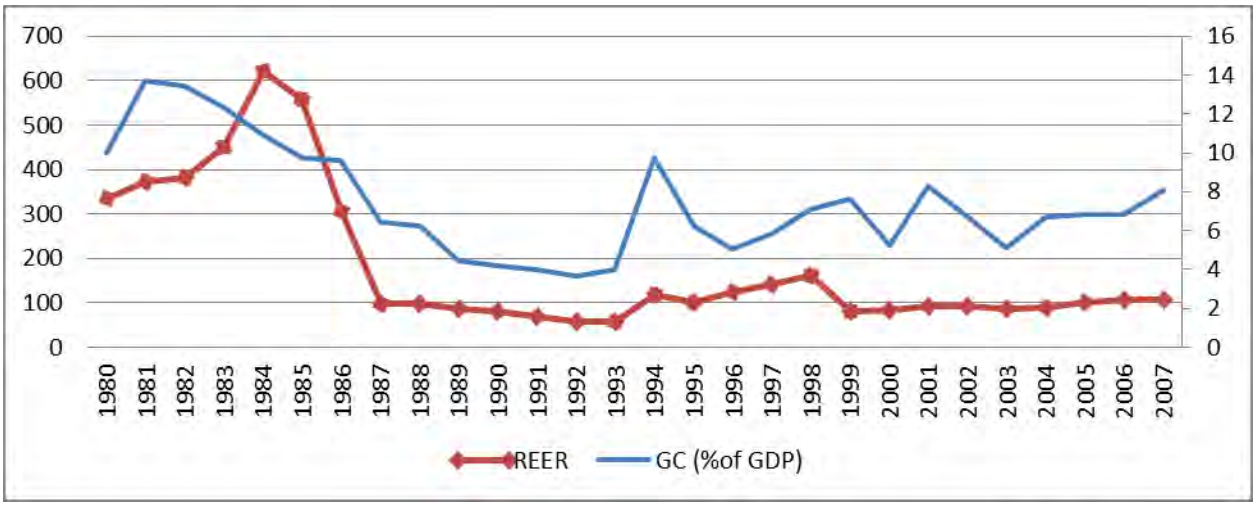


It appears that within the period covered, when the openness of trade is at its lowest the REER is at its peak. After 1986 the openness to trade tends to increase whereas the REER tends to decrease albeit with fluctuations. This visual assessment of the variables suggests that the openness to trade is

negatively related to the REER. This means that as the openness to trade increases the REER depreciates. This is in line with the theoretical expectations of the Edwards (1989) model.

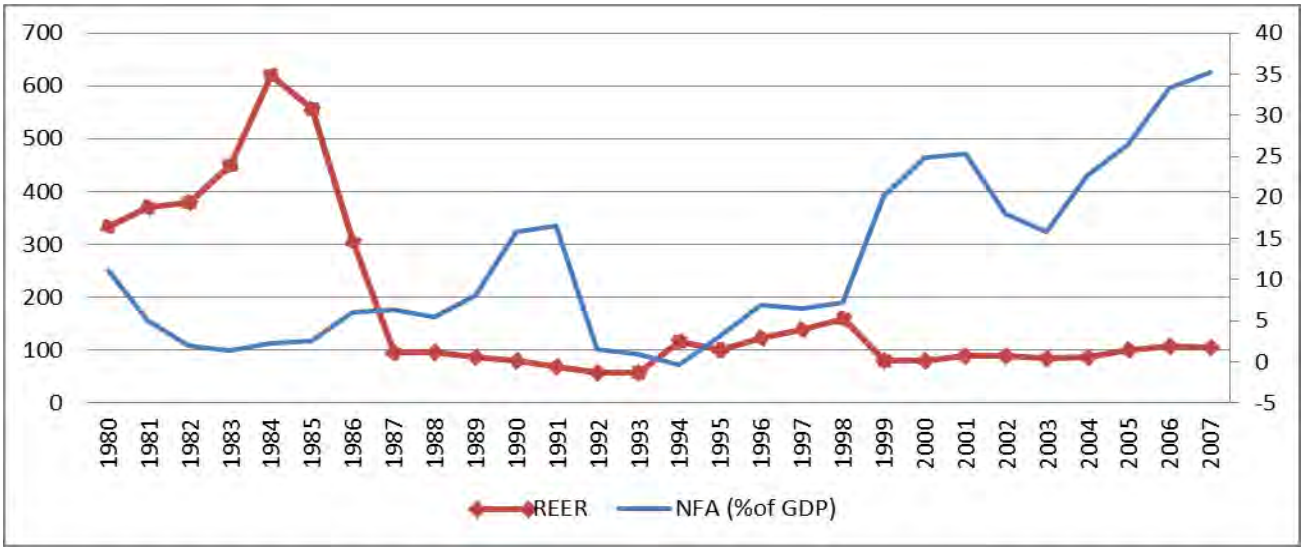
In Figure 3.13 it is evident that after 1986 as the government consumption expenditure decreased, the REER also decreased after a lag and as the government consumption increased the REER also increased after a lag up until 2000. This pattern is particularly prominent from 1993 to 1995 and from 1997 to 2000. This suggests that an increase in government consumption has an appreciating effect on the REER with a slight time lag.

Figure 3.13: The government consumption expenditure (% of GDP) in Nigeria and the REER



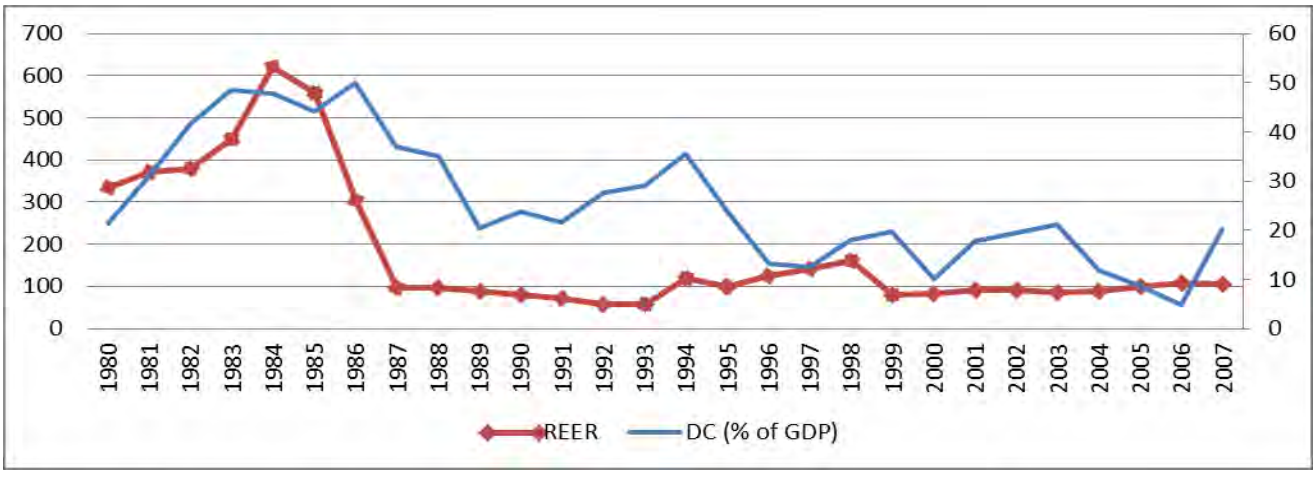
From 1986, the net foreign assets plotted in Figure 3.14 trends upwards albeit with fluctuations, whereas the REER generally fluctuates in a downward trend. Furthermore, between 1980 and 1986 and from 1992 to 1996 when the net foreign assets dip, the REER increases. This implies that a fall in net foreign assets will cause the REER to experience episodes of appreciation. This finding suggests that there is no evidence of the Dutch disease in Nigeria.

Figure 3.14: The Net foreign assets (% of GDP) in Nigeria and the REER



The visual plots in Figure 3.15 suggest that the domestic credit and the REER move together over time, albeit with fluctuations. This is particularly notable from 1986 to 1989 and from 1993 to 1999. This implies that an extension of the money supply into the economy of Nigeria appreciates the REER. This is not in line with the *a priori* expectations since an extension of money supply in the economy is expected to depreciate the currency.

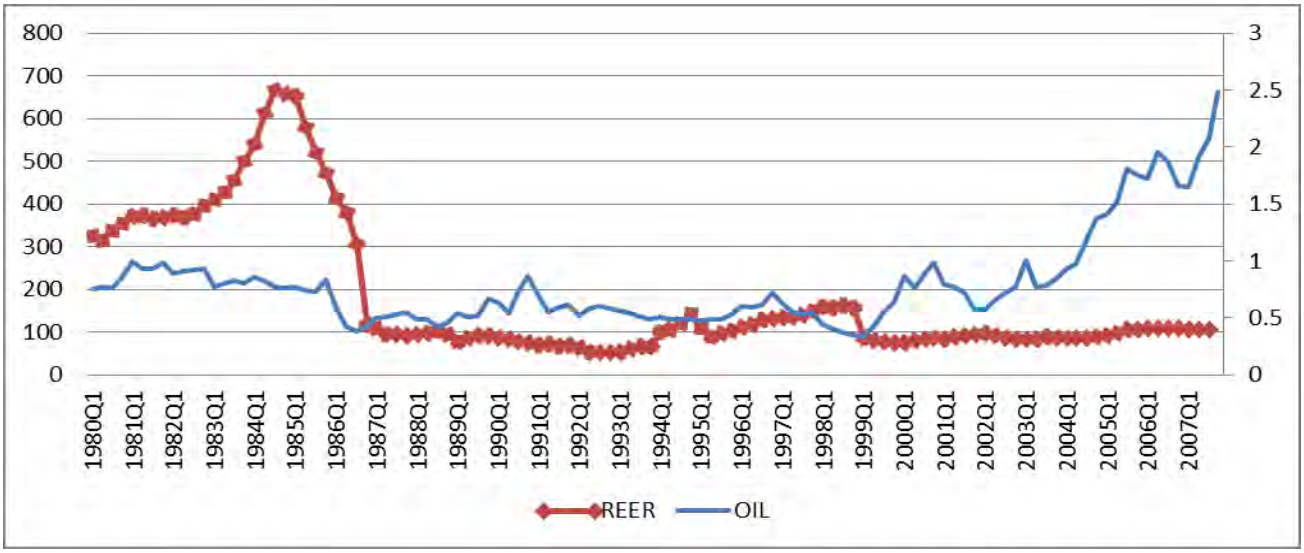
Figure 3.15: The extension of domestic credit (% of GDP) in Nigeria and the REER



Countries with oil reserves such as Nigeria are expected to experience an exchange rate appreciation, as the price of oil increases (MacDonald, 1998:123). Since 1980 the oil prices fluctuated gradually however they increased considerably over time. The visual analysis suggests that between 1980 and

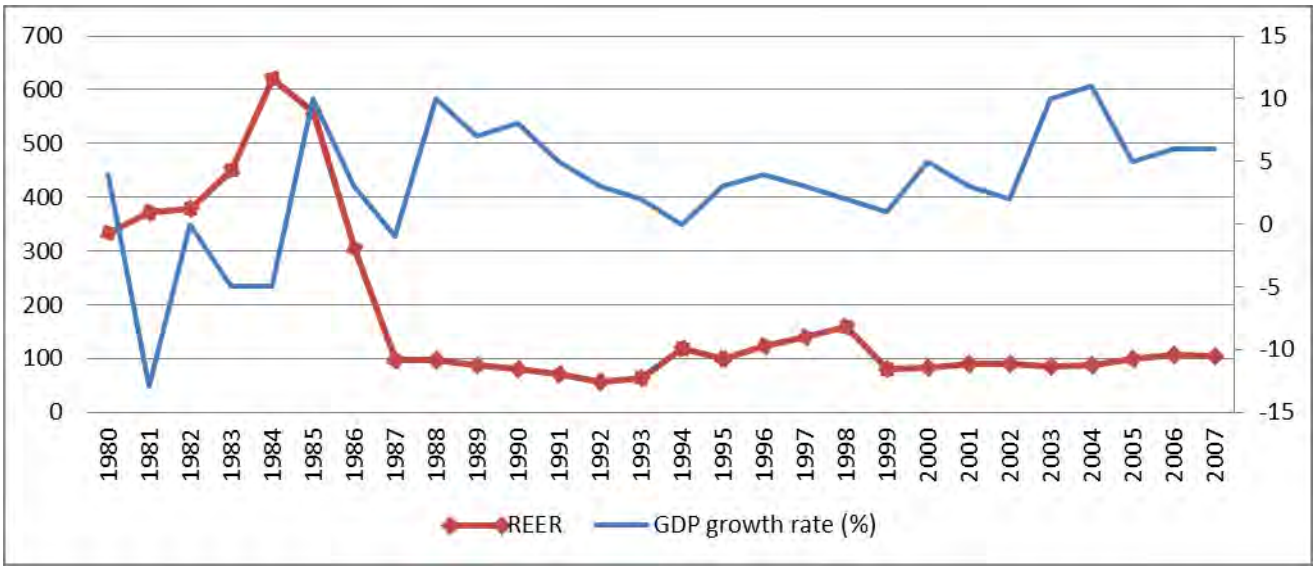
1999 the oil prices fluctuated steadily whereas the REER fluctuated a great deal at first then moderately after 1986. Furthermore it appears that when the oil prices rose considerably from 1999 the REER experienced a series of positive relationships. The visual analysis in Figure 3.16 thus makes difficult to observe a conclusive relationship between oil prices and the REER.

Figure 3.16: World oil prices (USD) and the REER



In Figure 3.17, the GDP annual growth rate in Nigeria fluctuated steadily in the period covered and from the visual analysis of the plots there is no clear evidence of a relationship between the GDP growth and the REER in Nigeria.

Figure 3.17: The GDP annual growth rate (%) in Nigeria and the REER



It is evident that the REER is influenced by a combination of variables. This makes it difficult to make conclusive inferences about the effect of each variable on the exchange rate. Thus it is important to estimate the long-run relationship between the REER and its fundamental variables. The next chapter will articulate the cointegration techniques which will be used to estimate this long-run relationship.

3.6 CONCLUSION

Both Ghana and Nigeria employed the SAP in 1983 and 1986 respectively which encouraged a market determined exchange rate which would be close to its long-run equilibrium value and would be beneficial to the economy as a whole. It would thus be useful to assess whether the policy changes were successful in both countries. To do so this paper aims to model the RER for each country based on its determinants. This chapter provides a summary of the relationship between the REER and it determinants in both Ghana and Nigeria. This provides some insight into the expected relationship between the determinants and the RER.

Observing the trends of the determinants through time does not provide conclusive evidence to suggest that they have a long-term relationship with RER. The observations made in both Ghana and Nigeria about the effects of the fundamental determinants on the exchange rate are uncertain and require formal testing. This will be addressed in the chapter to come.

CHAPTER 4

ANALYTICAL FRAMEWORK

4.1 INTRODUCTION

The literature review (Chapter 2) discusses the various models for the determination of the equilibrium exchange rate while Chapter 3 gave an account of the evolution of the exchange rate in Ghana and in Nigeria. Chapter 3 also analyses the trends of the fundamental variables relative to the REER in both countries. Against this background, this chapter will provide the analytical framework which is used in this study. Section 4.2 will develop the model which links the RER with its fundamental determinants and Section 4.3 will define the variables which enter the model. The estimation techniques which will be employed in the study will be discussed in Section 4.4, and Section 4.5 will discuss the estimation technique used to compute the real exchange rate misalignment. Section 4.6 will conclude.

4.2 MODEL SPECIFICATION

The discussion in the theoretical section of Chapter 2 reveals that the real exchange rate is determined by both the nominal and the real variables. These variables include the exchange controls, domestic interest rates, foreign aid, income levels, money supply, world inflation, productivity growth, fiscal deficit, world interest rates, capital controls and terms of trade. This study will thus estimate the following model,

$$LREER_t = \beta_0 + \beta_1 L(TOT)_t + \beta_2 L(GCN)_t + \beta_3 NFA_t + \beta_4 L(OPEN)_t + \beta_5 TECHPRO_t + \beta_6 ODA_t + \beta_7 L(NEER)_t + \beta_8 L(LDC)_t + \beta_9 L(COCOA)_t + \beta_{10} L(OIL)_t + \mu_t \quad 4.1$$

where:

LREER = natural log of the real effective exchange rate;

LTOT = natural log of the external terms of trade (P_x^*/ P_M^*);

LGCN = natural log of government consumption (fiscal policy);

NFA = a measure of extent of controls over capital flows;

LOPEN = natural log of the index of the lowering of trade restrictions and exchange controls;

TECHPRO = measure of productivity, a proxy for the Balassa-Samuelson effect;

ODA = measure net foreign aid inflow;

LNEER = natural log of the nominal effective exchange rate;

LDC = natural log of domestic credit, a proxy for the money supply;

LCOCOA = natural log of world cocoa prices;

LOIL = natural log of world oil prices;

μ = the error term.

4.3 DEFINITION OF THE VARIABLES AND DATA SOURCES

In Ghana and Nigeria data are mostly available in their annual frequency however for the purpose of the model employed in this study the data has to be in quarterly frequency. To overcome this problem the series available in annual form are converted to the quarterly form using interpolation techniques which are available in Eviews 6 (2007). A careful examination of the variables being interpolated is carried out to ensure the appropriate interpolation method is used. For the series in rates, the quadratic match average method is applied and for flow variables, the cubic match last method is used. Finally the cubic match sum method for interpolating data is used for stock variables (Aziakpono, 2005:163).

The variables in Equation 4.1 are in logarithm terms with the exceptions of NFA, ODA and TECHPRO. The variables have been converted to logarithms in order to minimise the effects of outliers. Some of the variables in Equation 4.1 do not have data which is readily available so they were omitted from the model or alternative proxies for them are used. The construction of the proxies is based on quarterly data from the first quarter of 1980 to the first quarter of 2006 for Ghana and from the first quarter of 1980 to the last quarter of 2007 for Nigeria.

The expected effect of each variable on the equilibrium REER in Equation 4.1 was discussed at length in Chapter 2. This section will also briefly summarise the expected signs of the coefficients of the variables, in order to define Equation 4.1.

LREER: The real effective exchange rate of the currency is an index with 2000=100. This variable is expressed in foreign currency terms, which implies that an increase in the REER indicates an appreciation of the REER whereas a decrease in the REER indicates depreciation. The variable is in its natural log form.

LTOT: The external terms of trade is defined as the ratio of the world price of Ghana/Nigeria's exports to the world price of imports. To capture this variable the terms of trade index (2000=100) for both countries is applied. The terms of trade index is based upon the national accounts exports price index divided by the imports price index, with the index for 2000 equalling 100. This data is accessed from the World Bank databank. This variable is in its natural log form.

The impact of the terms of trade on the RER is not directly observable, as it is contingent on the relative strength of the income and substitution effects. Thus the expected sign of the terms of trade coefficient is either positive or negative.

LGCN: The ratio of the government consumption expenditure to Gross Domestic Product (GDP) is used as a proxy for government consumption variable in Ghana. This is computed using the general government final consumption expenditure (formerly general government consumption) which includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditure on national defence and security, but excludes government military expenditures that are part of government capital formation. The source of this data is the World Bank national accounts data, and OECD National Accounts data files.

In Nigeria, the ratio of government consumption as a percentage of GDP is used to proxy the GCN variable. The variable is computed by dividing the government consumption (at current prices) by the GDP (at current prices) and the data is available in the IFS CD-ROM. For both Ghana and Nigeria, the variables are in their natural log form. This proxy is employed in Edwards (1989:136) because there is no data available on government consumption of non-tradables. Edwards (1989) however warns that this is not a very good proxy and the results ought to be interpreted with care.

The effect of government consumption is ambiguous, as it can also lead to either a real appreciation or depreciation. If government consumption is channelled towards the non-tradable goods sector, there will be a RER appreciation and the expected sign of the coefficient is positive. The opposite is true if government consumption is channelled towards the tradable goods sector.

NFA: The measure of extent of controls over capital flow is not available in time series hence the ratio of net capital flows to GDP is used as a proxy. The capital flows to GDP is computed by finding the ratio of net foreign assets to GDP. The net foreign assets which are used to compute this variable are the sum of foreign assets held by monetary authorities and deposit money banks, less their foreign liabilities. This data is accessed from the World Bank databank.

The expected sign for the coefficient of the controls over capital inflows is positive. This is because a relaxation of capital controls will increase capital inflows resulting in an increase in the supply of foreign currency. This results in an increase in the demand for non-tradable goods which puts inflationary pressure on non-tradables resulting in a RER appreciation.

LOPEN: The openness variable is captured by the ratio of the sum of exports and imports to GDP. This computation of openness is recurring in literature (see Zhang (2001) Kemme and Roy (2006), Maeso-Fernandez *et al* (2006)). For both Ghana and Nigeria, the data is accessed from the IMF's Direction of Trade Statistics and the variable is in the natural log form.

An increase in openness is expected to depreciate or appreciate the real exchange rate and for this reason the expected sign of the coefficient of the openness variable is either negative or positive.

TECHPRO: the measure of technological progress (Balassa-Samuelson effect), is measured by the real GDP growth rate differential between Ghana and its major trading partners as well as Nigeria and its major trading partners. The weighted average of the foreign real GDP growth rates (2000=100) of the major trading partners[19] is constructed using weights estimated from exports and imports data available in the IMF Direction of Trade Statistics. The weights assigned to Ghana's major trading partners are as follows: Germany as proxy for the European Union, 63 percent; USA, 16 percent; Nigeria, 12 percent; South Africa 4 percent, and Japan, 3 percent. The weights assigned

[19] The major trading partners are determined by calculating the countries with the largest imports and exports into and out of the country in question, for the period covered in the study. The exports and imports data is obtained from the Direction of Trade Statistics (DOTS).

to Nigeria's major trading partners include: USA, 41 percent; Germany as proxy for the European Union, 27 percent; Brazil, 14 percent; India, 14 percent; Canada, 2 percent. The TECHPRO variable is thus the difference between the real GDP growth rate of Ghana/Nigeria and the weighted average of real GDP growth rate of the major trading partners.

The expected sign for the coefficient of technological progress is positive. This is because technological progress is expected to increase productivity in the tradable goods sector relative to the non-tradable goods sector. Thus the price of goods in the non-tradable goods sector rises, resulting in a RER appreciation.

ODA: The foreign aid inflows variable is measured as the net Official Donor Assistance (ODA) as a percentage of the recipient's GDP. The net ODA constitutes the actual international transfers by the donor of financial resources or of goods or services valued at the cost to the donor, less any repayments of loan principal during the same period. The data is available from the World Bank databank.

Foreign aid is expected to be channelled to the non-tradables goods sector of an economy hence it will result in a RER appreciation. The coefficient of the foreign aid variable is thus expected to be positive.

LDC: The domestic credit variable is computed as the ratio of domestic credit to GDP, expressed as a percentage. Domestic credit is defined as the sum of net credit to the non-financial public sector, credit to the private sector, and other accounts. The data is available from the World Bank databank. The variable is also expressed in its natural log form.

The rise in domestic credit represents an expansionary monetary policy. This is expected to cause an equilibrium real depreciation hence the expected sign for the domestic credit variable is negative.

LNEER: This variable is the natural log of the nominal effective exchange rate index (2000=100), and it is expressed in foreign currency terms. This data is sourced from the IMF's International Financial Statistics.

An increase in the nominal exchange rate is expected to appreciate the REER, hence the expected sign of the coefficient of LNEER is positive.

LCOCOA: Cocoa is one of the chief exports in Ghana hence it is important to include it in the exchange rate model in this study. The data for the world cocoa prices is available on Thompson DataStream and it is in its natural log form.

LOIL: The oil price is proxied by the world crude oil prices. This data is obtained on the Dow Jones Energy Source which is available on the Thompson DataStream. The variable is in its natural log form.

The expected sign of the coefficient of commodity prices (the cocoa prices in Ghana and crude oil prices in Nigeria) is positive because a rise in the cocoa prices and crude oil price will result in a RER appreciation in Ghana and Nigeria respectively (Edwards, 1989:37-43).

Once the determinants of the model have been specified, the next step is to estimate the parameters of the specified model. This will be discussed in the following section.

4.4 A REVIEW OF THE ESTIMATION TECHNIQUES FOR THE DETERMINATION OF THE REAL EXCHANGE RATE

The parameters in Equation 4.1 can be tested using simple regression methods which assume that all the variables in the Equation 4.1 are stationary. Most variables in Equation 4.1 are however integrated of order one I(1), that is, they have to be differenced once in order for them to be stationary. The ability to difference series once in order to make them stationary means that cointegration is likely to exist among the variables.

This study applies the Johansen (1995) cointegration test. The Johansen approach not only tests cointegration but also allows the estimation of an error correction specification. The Johansen (1995) approach accounts for the shortcomings of the Engel Granger approach, an alternative method that can be used to test for cointegration. The Engel Granger approach is static and does not account for the dynamic interrelationship of the variables. The Johansen method however provides the estimates of all the cointegrating relationships in a vector of non-stationary or a mixture of stationary and non-stationary variables.

The Johansen technique estimates both the long-run and the short-run dynamics in the RER model defined in Equation 4.1. The first step in this approach is to establish the order of integration of all the variables (stationarity tests) in Equation 4.1. The next section will briefly describe the methods

employed in this study namely the Augmented Dickey-Fuller tests (ADF); and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test. The second step is to run the cointegration test in order to identify the long-run relationship in the variables. If there is evidence of one or more cointegrating relationships, then a short-run error correction model is estimated. The final step is to perform residual diagnostic checks, impulse response and variance decomposition analysis.

To estimate the extent of real exchange rate misalignment, the study will use the Hodrick-Prescott filter to obtain the permanent values of the explanatory variables which enter the exchange rate model. This along with the parameters estimated from the long-run model is used to compute the permanent REER (PEER). The extent of real exchange rate misalignment is thus the difference between the actual REER and the PEER. Thereafter the percentage misalignment is computed.

4.4.1 STATIONARITY AND UNIT ROOT TESTING

An important condition for the existence of the relationship between the REER and its fundamental determinants is that the fundamental determinants should be stationary at first difference. Only then will Equation 4.1 be a candidate for the cointegrating relationship. A stationary series can be defined as one with a constant mean, constant variance and constant auto covariance for each given lag. A stationary series is thus said to be integrated of order zero I(0). Most financial data have to be differenced once in order to be stationary, making them integrated of order one I(1) (Lütkepohl, 2005:242). It is important to observe the stationarity of a series as it can strongly influence the series' behaviour and properties. In addition the use of non-stationary data can lead to spurious regressions. It is noteworthy to refer to Brooks (2008:36) who argues that if individual time series are non-stationary in level terms, a linear combination of their time series may be stationary. For example, a linear combination of I(0) and I(1) variables is I(0), if the two variables are cointegrated.

Prior to testing for stationarity in the time series, it is important to identify any existence of the drift parameter (α) and the linear trend parameter (β) in the series. This study tests the conditional hypothesis using the three symmetric critical τ_{ij} provided in the Dickey –Fuller test. Given the ADF model as follows:

$$\Delta X_t = \alpha + \beta_t + \delta X_{t-1} + \sum_{j=2}^{q} \delta_j \Delta X_{t-j+1} + \varepsilon_t \qquad 4.2$$

where:

Δ = the difference operator

α = the constant term or drift

β = the linear deterministic trend

ε = the white noise error term

A series is said to be stationary when the coefficient of the linear deterministic trend is equal to zero, $\beta = 0$ using τ (tau) statistics. The test for conditional hypothesis thus tests the α and/or the β conditional upon $\delta = 0$. Given that $\tau_{\alpha u}$ tests for drift only, $\tau_{\alpha T}$ tests for stochastic trend and $\tau_{\beta T}$ tests the deterministic trend, the conditional hypotheses are as follows:

(1) When Dickey-Fuller regression equation of the form 4.2 are used

H_o: $\alpha = 0$, given that $\delta=0$, if $|t| < |\tau_{\alpha T}|$

H_a: $\alpha \neq 0$, given that $\delta=0$, if $|t| > |\tau_{\alpha T}|$

(2) When Dickey-Fuller regression equation of the form 4.2 are used

H_o: $\beta = 0$, given that $\delta=0$, if $|t| < |\tau_{\beta T}|$

H_a: $\beta \neq 0$, given that $\delta=0$, if $|t| > |\tau_{\beta T}|$

(3) When the regression equation of the form 4.2 are used without the difference terms and linear trend terms

H_o: $\alpha = 0$, given that $\delta=0$, if $|t| < |\tau_{\alpha u}|$

H_a: $\alpha \neq 0$, given that $\delta=0$, if $|t| > |\tau_{\alpha u}|$

The τ statistics are provided in Sedhighi *et al* (2000:272). Upon detecting whether there is a drift or a trend component, the tests for stationarity can be estimated.

The unit root tests employed in this paper include the Augmented-Dickey Fuller (ADF) test and the Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test. The ADF test is argued to be weak at detecting a false null hypothesis, which implies that in certain instances the Dickey-Fuller test fails to

detect stationarity, and this usually occurs with small samples (Thomas, 1997:410). In order to overcome this issue, this study employs the KPSS test to improve the robustness of the results.

The main difference between the ADF and the KPSS tests is the null hypothesis. The null hypothesis in the ADF tests is that the series being tested is non-stationary. When the observed ADF test statistic is greater than the critical values, it implies that the result is significant hence the null hypothesis is rejected and it can be concluded that the series is stationary. The opposite is true if the observed ADF test statistic is less than the critical values.

The KPSS test has the null hypothesis that the series being tested in stationary. When the computed LM statistic is less than the KPSS critical values, the results are insignificant therefore we fail to reject the null hypothesis and conclude that the series is stationary. The opposite is true if the LM statistic is greater than the critical values. Both the ADF and KPSS tests are carried out at levels and a first difference.

4.4.2 COINTEGRATION AND THE VECM

The test for cointegration of the variable in Equation 4.1 suggests that they move away from some equilibrium value in the short-run, and they return to this value in the long-run. Furthermore, the cointegration analyses reveals the variables which affect the REER in the long-run, thus specifying the determinants of the real exchange rate model in Ghana and in Nigeria.

The Johansen technique is a maximum likelihood estimation on a vector autoregressive (VAR) system. The Johansen method is a preferred test for cointegration to the Engel Granger approach because the Engel Granger approach suffers some limitations when estimating a multivariate model. The Engel Granger technique forces researchers to treat variables asymmetrically and to specify one dependent variable and the others as independent variables (Enders, 2003:322). The Johansen method on the other hand tests the hypothesis for the weakly exogenous variable, in order to identify the endogenous variable in the model. An additional limitation in the Engel Granger technique is that it only estimates one cointegrating relationship between the variables. The Johansen method however takes into account that all the linear combinations of the cointegrating vectors are also cointegrating; hence it can detect more than one cointegrating relationship (Enders, 2003:354).

The Johansen method allows for the testing of the hypothesis about the actual cointegrating vector, and it allows for hypothesis tests on the cointegrating relationship itself unlike the Engel Granger approach. For these reason the Johansen test is argued to be superior to the Engel Granger approach.

Prior to testing for cointegration it is important to select an appropriate lag length. A VAR model which uses different lag lengths for each equation is generally considered to be a restricted VAR, however Brooks (2008:232) argues that a VAR model should be as unrestricted as possible. The method used in practice when selecting an appropriate lag length is the information criteria.

There are three commonly used information criteria, the Akaike (AIC), the Bayesian information criterion (SBIC) and the Hannan-Quin criterion (HQIC). All three as well as the LR test statistic, the Schwarz (SIC) and the Final prediction error are used in this study when selecting the appropriate lag length for the cointegration test. Because this study will use fine information criteria, it is important to outline how to go about selecting the appropriate lag length in the event that there are conflicting results among the information criteria. This method involves sequentially increasing the lags from the smallest to the largest lag selected by the information criteria and using the lag-length that eliminates serial correlation in the residuals (Aziakpono, 2008:182).

The approach includes performing the cointegration test with the lowest selected VAR lag order, and then sequentially increasing the lag length, until the point where there is evidence of cointegration with serially uncorrelated error terms; or until the highest selected lag length is reached, at which point one concludes that there is no cointegration.

The next step is to test for cointegration. A critical step in the Johansen test for cointegration is the choice of the deterministic trend to employ in the estimation. The deterministic trends assumptions are identified in E-views 6 (2008:735). There are five possible assumptions, and the first assumes that there is no deterministic trend in the data and no intercept or trend in the VAR and in the cointegrating equation. The first assumption is hardly used in empirical literature. The second assumption is that there is no deterministic trend in the data but there is an intercept in the cointegrating equation and no intercept in the VAR. This assumption is highly applicable to series which do not show any trends in visual plots and in the unit root tests. The third assumption is that there is a linear deterministic trend in the data and an intercept in the cointegrating equation and the VAR. This assumption is particularly useful if the series exhibit stochastic trends.

The fourth assumption is that there is a linear deterministic trend in the data, intercept and trend in the cointegrating equation and no trend in the VAR. E-views 6 (2010) suggests that this assumption is particularly useful when the series are trend stationary. Finally, assumption 5 allows for a quadratic deterministic trend in the data, intercept and trend in the cointegrating equation and a linear trend in the VAR. As in the case with the first assumption, the fifth is hardly used in practice. This study will thus employ the suitable assumption influenced by the results from the conditional hypothesis, the inspection of the graphs of the relevant series as well as the economic *a priori* assumptions of the behaviour of the variables in the cointegration test.

In the Johansen Maximum Likelihood procedure, there are two test statistics: the Trace statistic and the Maximum Eigenvalue test. The two tests determine the number of cointegrating vectors in an equation. The Trace statistic is a joint test of the null hypothesis that the number of cointegrating vectors is less than or equal to r (the rank of Π which determines the number of cointegrating vectors) against the alternative hypothesis that the cointegrating vectors are more than r, that is

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{g}\ln\left(1-\lambda_i^{'}\right) \qquad 4.3$$

where

r = the number of cointegrating vectors under the null hypothesis

$\lambda_i^{'}$ = the estimated value of the *i*th ordered Eigenvalue form the Π matrix

It is clear from Equation 4.3 that the larger the $\lambda_i^{'}$, the larger and more negative will be the $\ln(1-\lambda_i^{'})$ and therefore the greater the test statistic. A significantly non-zero Eigenvalue is translated as a significant cointegrating vector (Enders, 2003:353-4).

The Maximum Eigenvalue test performs separate tests on each Eigenvalue. The null hypothesis is that there are r cointegrating vectors present and the alternative is that there are $(r+1)$ cointegrating vectors present.

$$\lambda_{\max}(r, r+1) = -T\ln(1-\lambda_{r+1}^{'}) \qquad 4.4$$

From the Johansen tables, if the test statistic is greater than its critical value, we reject the null hypothesis that there are *r* cointegrating vectors, therefore choosing the alternative hypothesis that $(r+1)$ cointegrating vectors exist for the trace statistic test and or more than r cointegrating vectors exist for the Maximum Eigenvalue test. Once the model had identified the number of cointegrating equations the next step is to estimate a VECM.

After selecting an appropriate lag length, consider a VAR model with k lags and with a set of n variables which are integrated of order 1.

$$y_t = \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_k y_{t-k} + \mu_t \qquad 4.5$$

The VAR in Equation 4.5 is specified as a VECM model in the following form

$$\Delta y_t = \prod y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \ldots + \Gamma_{k-1} \Delta y_{t-(k-1)} + \mu_t \qquad 4.6$$

In the Johansen technique *r* is the rank of the matrix, and it cannot be full rank (*r* = *n*) because this would imply that the original y_t is stationary. If Π has zero rank $(r=0)$, this would imply that although Δy_t may depend on Δy_{t-j}, it does not depend on Δy_{t-1}, thus showing that there is no long-run relationship and that no cointegration exists. This therefore means that for cointegration to exist, the rank of $\Pi(r)$ has to be between 1 and n, where there are *r* cointegrating vectors (Enders, 2003:354).

Π is the product of two matrices β' and α with two dimensions, $(n \times r)$ and $(r \times n)$,

$$\prod = \alpha\beta' \qquad 4.7$$

Where the matrix β' is a matrix of the cointegrating vectors (the long-run coefficients) and α represents the adjustment parameter (Lütkepohl, 2005:247). The VECM is only applicable once it has been established that cointegration exists.

The error correction (speed of adjustment) coefficient α shows how long it will take for a variable to return to its equilibrium value after a shock in the short-run. The error correction coefficient also captures the short-run effects or the temporary shocks of the macroeconomic fundamentals on the

REER (Kemme and Roy, 2006: 212). The speed of adjustment coefficient must always be negative (and significant) because it implies an adjustment back to equilibrium.

4.4.3 DIAGNOSTICS CHECKS

The aim of diagnostics checks is to test the stochastic properties of the model. Diagnostic checks are thus put in place in order to confirm that the model is 'well behaved'. This study applies diagnostics tests to check for the presence of serial autocorrelation, and this will be discussed in the following subsection.

Autocorrelation LM tests

Serial correlation is a common issue which often arises when estimating a test statistic. The presence of serial correlation implies that the error terms from different time periods are correlated. Serial correlation does not affect the biasness or the consistency of the parameter estimates, but it does however affect their efficiency. Positive serial correlation of the estimates of the standard error for instance will be smaller than their true value, which will lead to the conclusion that the parameter estimates are more accurate than they really are. The test employed in this study for serial correlation is the Lagrange Multiplier test and the null hypothesis is that there is no serial autocorrelation while the alternative is that auto correlated residuals exist (Eviews, 2007:350).

Weak exogeneity test

According to Enders (2003:368), "In a cointegrated system, if a variable does not respond to the discrepancy from the long-run equilibrium relationship, it is weakly exogenous". The study will carry out the weakly exogenous test to verify whether the REER for both countries is endogenous to each of the respective models. To do so, a zero restriction is placed on the α parameter in Equation 4.7. If the α parameter is equal to zero, the variable in question is weakly exogenous. If the REER is weakly exogenous, it can no longer be used to model the equilibrium RER of a country. This is because it is not endogenous; hence it is not determined by the other variables in the model.

4.4.4 VARIANCE DECOMPOSITION AND IMPULSE RESPONSE

Block F-tests would be useful in analysing the causality in a VAR with cointegrating variables since they reveal which of the variables in the system would have a significant impact on the future value of each of the variables in the system. The F-test is however limited as it fails to show whether a

shock of the variables has a positive or negative impact on the other variables in the system. The F-test also fails to provide insight into how long it will take for the shock to work through the system (Brooks, 2008:299). The variance decomposition and impulse response analysis overcome these limitations and will be employed in this study.

Impulse response takes into account how the dependent variables in a VAR system respond to the shocks of each of the explanatory variables. If there are n variables in the system, then n^2 impulse responses can be generated. This is achieved by expressing the VAR model as a vector moving average and if the system is stable the shock should generally die out. An impulse response does not die out to zero, however it approaches some non-zero value which reflects the non-stationarity of the system where an impulse can have a permanent effect (Lütkepohl, 2005:264).

Variance decomposition on the other hand reveals the proportion of the movements in the dependent variables that are due to their own shocks versus the shocks of the exogenous variables. With the variance decomposition analysis it is generally observed that own series shocks explain most of the error variance of the series in the VAR. Generally variance decomposition and impulse response analyses provide similar information (Brooks, 2008:300).

Once the long-run model for the real exchange rate has been estimated, the next step is to determine the extent of the real exchange rate misalignment. This will be discussed in the following section.

4.5 THE HODRICK-PRESCOTT FILTER AND EXCHANGE RATE MISALIGNMENT

The Hodrick-Prescott (H-P) filter is a smoothing technique which is used to obtain the long-run (permanent) trend component of a series. The H-P filter is a linear two-sided filter that computes the smoothed series s of y, by minimising the variance of y around s, subject to penalty that constrains the second difference of s (Eviews, 207:360). The H-P filter thus chooses the s to minimise:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} \left[(s_{t+1} - s_t) - (s_t - s_{t-1}) \right]^2 \qquad 4.8$$

The penalty parameter λ controls the smoothness of the series σ. The larger the penalty parameter, the smoother the σ. The default penalty parameter used is λ = 1600 for quarterly data.

The H-P filter is used to smooth the explanatory variables in the long-run model. The permanent (smoothed) series of the explanatory variables along with the long-run coefficients from the VECM are used to compute the permanent equilibrium exchange rate (PEER). Exchange rate misalignment is thus the difference between the actual REER and the PEER. To compute the percentage exchange rate misalignment we apply the method used in Dufrenot and Yehoue (2005:17) and Aliyu (2007:22) where

$$RERmisalignment = [(actualREER - PEER) / PEER] \times 100 \qquad 4.9$$

4.6 CONCLUSION

Against the theoretical background of the determination of the equilibrium exchange rate, the equilibrium exchange rate model is defined as the relationship between the REER and its determinants. This chapter provides the definitions of the determinants as well as a brief discussion of their effects on the REER. The next step would be to test for cointegration among the variables. An important condition for this test is that the variables should be non-stationary; hence this chapter provides a brief description of the ADF and KPSS tests for unit root and stationarity respectively.

The Johansen method tests for the number of cointegrating equations using the Trace test and the maximum Eigenvalue test. This is carried out after selecting an appropriate lag using the information criteria. If there is evidence of a cointegrating equation the VECM is estimated in order to gain the long- and short-run coefficients of the exchange rate model. If a model performs well in the diagnostic checks, impulse response and variance decomposition analyses will be applied in order to assess the magnitude and effect of shocks of the explanatory variables on the REER.

The H-P filter is used to smooth out the explanatory variables in the long-run model, in order to obtain their permanent values. Along with the estimated long-run coefficients, the PEER is computed. Exchange rate misalignment is thus the difference between the actual REER and the PEER. The next chapter will apply these techniques to quarterly data from Ghana and Nigeria in order to assess the extent of RER misalignment in these countries over the study periods.

CHAPTER 5

EMPIRICAL ANALYSIS AND FINDINGS

5.1 INTRODUCTION

Chapter 4 provides the analytical framework which reviews the estimation techniques which will be used to model the equilibrium exchange rates as well as to find the degree of possible real exchange rate misalignment. This chapter applies these proposed analytical techniques on quarterly data from Ghana and Nigeria from 1980 to 2006 and from 1980 to 2007 respectively. The findings in this chapter provide the answers to the questions which were posed at the onset of this study such as: which variables are the short- and long-run determinants of the equilibrium REER in Ghana and in Nigeria? Is the REER endogenous to the model? Based on these findings, is there exchange rate misalignment in Ghana and in Nigeria and if there is, to what extent? The Johansen (1995) approach, the Vector Error Correction model as well as orthogonalised impulse response and variance decomposition analyses are applied to answer the first two questions, while the Hodrick-Prescott filter is applied to answer the remaining question. Section 5.2 presents the empirical findings and Section 5.3 will conclude.

5.2 EMPRICAL FINDINGS

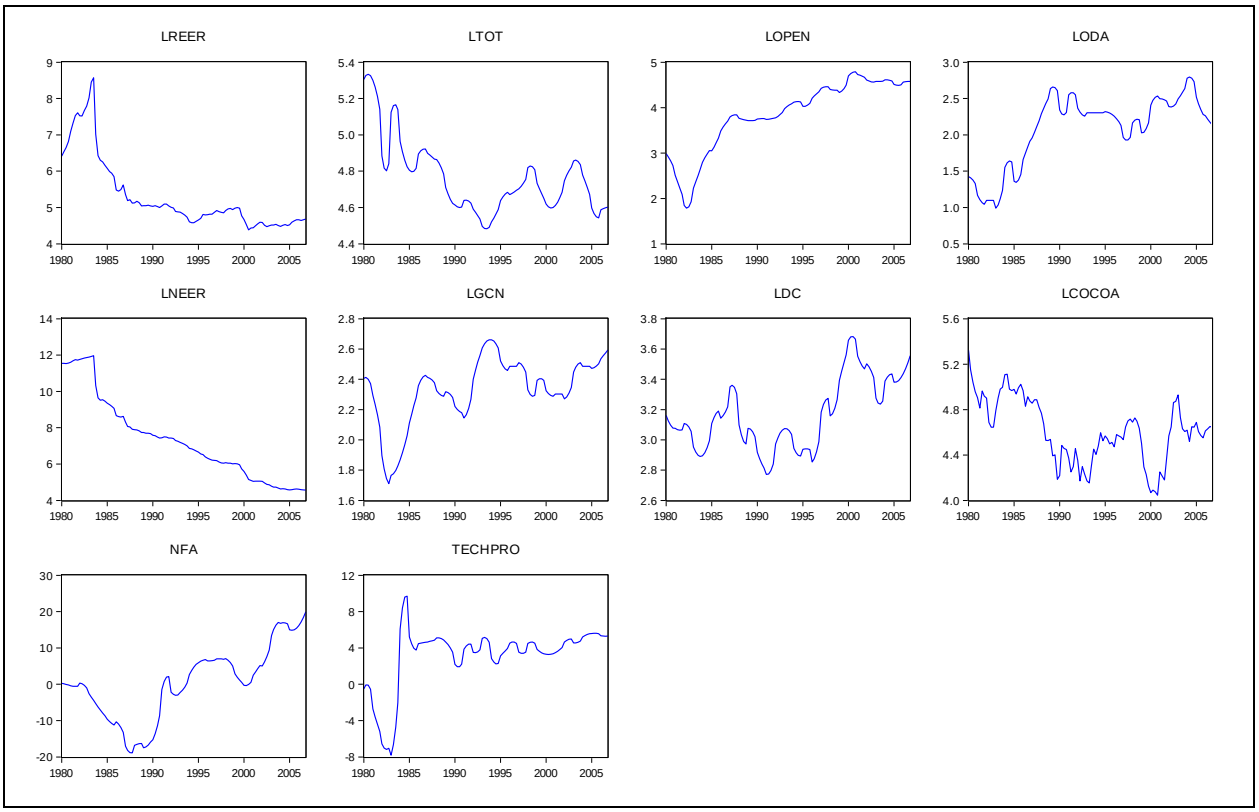
This section is divided into four subsections. The results from the unit root test are presented first, followed by the cointegration test results. In addition to the cointegration results, subsection 5.2.2 will discuss the long-run parameters of the VECM. Subsection 5.2.3 will discuss the short-run parameters of the VECM along with the diagnostic checks results, as well as the variance decomposition results and the impulse response results. The last sub-section 5.2.4 will discuss the identified exchange rate misalignment in Ghana and Nigeria.

5.2.1. STATIONARITY/UNIT ROOT TEST RESULTS

The study employs both the formal and the informal unit root tests. The informal test involves a visual plot of the series whereas the formal tests include the ADF and the KPSS tests. The informal test which is usually applied is the graphical analysis of the time series. The visual plot of the series is usually done prior to performing any of the formal tests. The inspection of the visual plots is also useful as it will indicate the presence of any data capturing errors or any structural breaks in the data.

In addition it provides an idea of the trends and stationarity of the data. The first graphical analysis results are for the time series data in Ghana.

Figure 5.1: The REER and the potential determinants for Ghana from 1980-2006



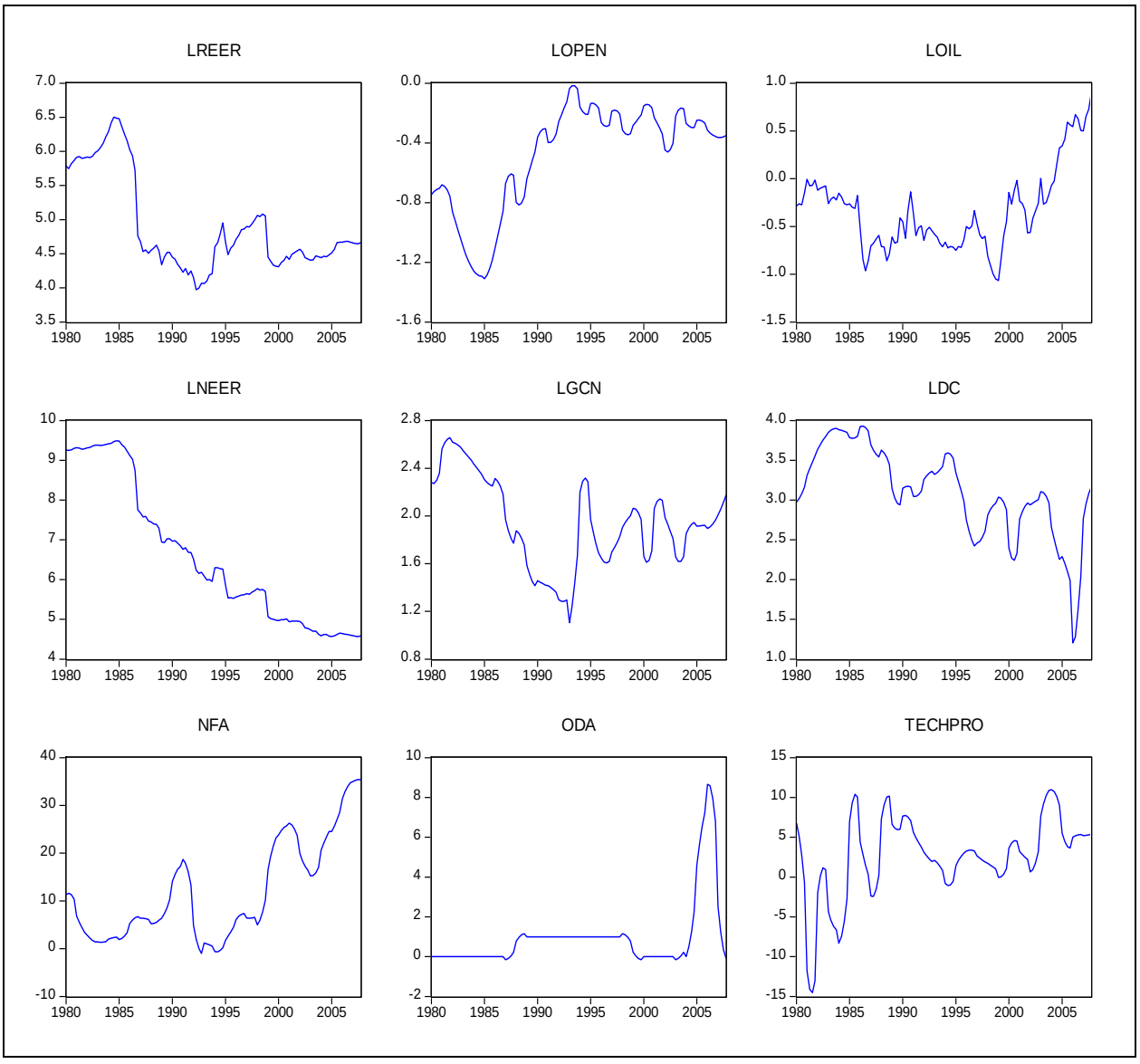
Source: Computed based on data from IMF International Financial Statistics

In Figure 5.1, it appears that the LREER and the LNEER variables are trending downwards and the LOPEN and NFA variables are trending upwards, albeit with fluctuations. The remaining four variables, (LGCN, LTOT, ODA, LCOCOA, LDC and TECHPRO) do not show any trend although they exhibit large fluctuations over time with the exception of LCOCOA. All the variables in Figure 5.1 with the exception of LCOCOA have a time variant mean and variance which suggest that they are likely to be non-stationary at levels. The first impression of LCOCOA suggests that it is hovering around the mean however the variance is clearly not constant over time.

From the first impression of the plots for Nigeria in Figure 5.2, the REER and the NEER variables are both trending downwards, whereas NFA, LOPEN and LOIL are trending upwards, albeit with fluctuations. The remaining variables (LGCN, ODA, LDC and TECHPRO) do not appear to show

a trend although they fluctuate over time. All the variables in Figure 6.2 have a time variant mean and variance which suggest that they are non-stationary at levels.

Figure 5.2: The REER and the potential determinants for Nigeria from 1980-2007



Source: Computed based on data from IMF International Financial Statistics

To conclude, the stationarity of the variables based on a visual inspection of Figures 5.1 and 5.2 would simply not suffice. It would be useful to perform formal testing procedures, the results of which will be discussed next.

As already mentioned, the formal tests employed to test for the unit root are the ADF and KPSS test which were discussed in Chapter 5. Prior to estimating the ADF and the KPSS tests, it is important to test whether intercept or trend assumption are important in this analysis. To test the conditional hypothesis the study follows the Sedhighi (2000) process described in Chapter 4. The test is performed at levels. Table 5.1 provides conditional hypothesis results for Ghana and Nigeria.

Table 5.1: Conditional hypothesis results

	Variable	Stochastic trend	Determ -inistic trend	Intercept only	Decision rule
Ghana	LCO	2.23	-0.03	2.71[a]	Intercept
	LDC	2.63	2.30	1.53	None
	LGC	3.63[b]	2.50[b]	2.61[b]	Trend and Intercept
	LNE	1.59	-1.49	0.67	None
	ODA	2.77[b]	0.36	2.88[b]	Intercept
	LOP	1.50	2.70[a]	5.54[a]	Trend and Intercept
	LRE	1.76	-1.03	1.28	None
	LTO	-2.83[a]	-0.82	1.60	Intercept
	NFA	2.83[a]	3.13[b]	0.64	Trend and Intercept
	TEC	6.97[c]	0.60	9.02[c]	Intercept
Nigeria	LOI	-1.31	1.87	0.55	None
	LDC	4.27[a]	-3.55	2.40	Trend and Intercept
	LGC	1.03	0.84	2.06	None
	LNE	1.27	-1.21	0.39	None
	ODA	-0.27	1.53	1.40	None
	LOP	-1.41	1.12	-1.08	None
	LRE	1.42	-0.59	1.50	None
	NFA	-0.78	2.53	1.35	None
	TEC	0.36	1.03	2.24[a]	Intercept

Note: a, b, c denotes intercept or trend at 10, 5 and 1 % respectively. LCO: LOCOCA, LOI: LOIL, LGC: LGCN, LNE: LNEER, LOP: LOPEN, LRE: LREER, TEC: TECHPRO, LTO: LTOT

Source: Computed by author

The ADF test and the KPSS tests were performed on the variables in both countries based on the conditional hypothesis results. The results are provided in Table 5.2 for both Ghana and Nigeria. It is important to note that for the ADF test the null hypothesis is that the series has a unit root whereas the KPSS test has the null hypothesis that the series is stationary. Hence stationarity for the ADF test implies rejecting the null hypothesis which is the case when the test statistic is greater than the critical values. Stationarity for the KPSS test however implies failing to reject the null hypothesis which is the case when the test statistic is smaller than the critical values.

Table 5.2: Unit root/Stationarity test results

		ADF			KPSS		Decision
		Level	1st diff	2nd diff	Level	1st diff	
Ghana	LGC	-3.56[b]	-3.28[b]	-7.04[c]	0.10[b]	0.06	1st difference
	LCO	-2.75[a]	-8.76[c]	-	0.52[b]	0.15	1st difference
	LOP	-4.61[c]	-	-	0.18[b]	0.06	1st difference
	LRE	-1.11	-7.16[c]	-	0.82[b]	0.09	1st difference
	LTO	-1.62	-3.42[b]	-8.73c	0.71[b]	0.14	1st difference
	LNE	-2.86[c]	-	-	1.09[c]	0.18	1st difference
	ODA	-2.78[a]	-2.47	-6.64[c]	0.71[b]	0.15	1st difference
	NFA	-2.95	-2.51	-6.47[c]	0.16[b]	0.07	1st difference
	TEC	-8.56[c]	-	-	0.47[b]	0.03	1st difference
	LDC	0.55	-2.54[b]	-6.45[c]	0.65[b]	0.10	1st difference
Nigeria	LDC	-4.37[c]	-	-	0.06[c]	-	Level
	LGC	-0.72	-3.41[c]	-	0.40[a]	0.09	1st difference
	LNE	-2.55[b]	-7.51[c]	-	1.14[c]	0.15	1st difference
	LOI	-0.73	-8.95[c]	-	0.42[a]	0.29	1st difference
	LOP	-1.53	-2.51[b]	-7.51[c]	0.75[c]	0.11	1st difference
	LRE	-0.78	-7.94[c]	-	0.62[b]	0.11	1st difference
	NFA	0.09	-3.58[c]	-	0.81[c]	0.20	1st difference
	ODA	0.16	-1.04	-6.22[c]	0.40[a]	0.04	1st difference

TEC	-2.71[a]	-3.18[b]	-13.28	0.46[b]	0.08	1st difference

Note: a, b, c denotes significance at 10, 5 and 1 % respectively. Source: Computed by author.

As discussed in Chapter 4, the KPSS test tends to perform better than the ADF test (Harris, 1995:80). Therefore where ADF results differ from the KPSS results, for example LTOT in Ghana and LDC in Nigeria, the decision is based on the KPSS results. For Ghana, all the variables are stationary at first difference and in Nigeria, all the variables are stationary at first difference with the exception of LDC which is stationary at levels.

It can be concluded that all the variables are either level stationary or stationary at first difference for both Ghana and Nigeria. If the variables in the series are I(0) and I(1), the variables can enter the model for the cointegration test.

5.2.2 COINTEGRATION TESTS

The cointegration test is performed using the Johansen method. The aim of the test is to estimate whether there is a long-run relationship between REER and its proposed determinants. Testing for cointegration using all the proposed variables presents the problem of having too many cointegrating equations. The issue with having many cointegrating equations is that they become very difficult to interpret (Mkenda, 2001:31). Using all the proposed variables, and attempting alternative specifications, it appears that the cointegration results will have up to 6 cointegrating equations.

Faced with the issue of many cointegrating equations the next step would be to simplify the model. Care must be taken when removing some of the variables from the equation to avoid producing a misspecified model. The criteria for selecting the variables which will enter the model should emphasize that the model should produce meaningful results. Furthermore the model should include as many variables suggested in theory as possible in order to avoid producing a misspecified model (Aron *et al* 1997:20). Finally the REER in the model should be endogenous. To test that the REER is endogenous the weakly exogenous test as well as the variance decomposition are carried out. The weakly exogenous test is carried out with the assumption that the REER is weakly exogenous. The results of the weakly exogenous test are presented in Table 5.3. Alpha restrictions are placed on the LREER variable to perform the weakly exogenous test. It is important to highlight that the null hypothesis for the test is that the variable in question is weakly exogenous to the model.

A sufficiently large Chi-square statistic as well as a significant p-value would thus imply that the variable in question is endogenous to the model.

Table 5.3 Weakly exogenous test results

	Chi-squared statistic (χ^2)	P-value	Decision Rule
Ghana	43.07	0.00	Endogenous
Nigeria	2.60	0.10	Endogenous

Source: Computed by author

The results reveal that in the case for Ghana, the Chi-square statistic is sufficiently large and the p-value is significant, hence we reject the null hypothesis and conclude that the real exchange rate is endogenous in both models. The RER in the Nigeria model is however less endogenous than the REER in the Ghana RER model. The results of the variance decomposition will be discussed in subsequent sections.

Against this background the RER model for Ghana includes the following variables: LREER, LNEER, LGCN, LTOT, LOPEN, ODA and LCOCOA. The RER model for Nigeria includes the following variables: LREER, LNEER, LOIL, LOPEN, NFA and LGCN.

The lag order is chosen using the information criteria as well as the theoretical underpinnings of the model. The selection is drawn from a maximum of 8 lags since the series are quarterly. Furthermore using 8 lags will allow for adjustment in the model and for the attainment of well-behaved residuals. Table 5.4 summarizes the lag lengths selected by each of the models.

Table 5.4: VAR lag order selection criteria

	LR	FP	AIC	SIC	HQ
Ghana	6	6	8	2	6
Nigeria	6	6	6	2	2

Note: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion. Source: Computed by author

In the Ghana RER model the LR test statistic, the Final prediction error and the Hannan-Quinn information criterion suggest 6 lags, meanwhile the Akaike information criterion, and the Schwarz information criterion, suggest 8 and 2 lags respectively. In the Nigeria RER model the LR test

statistic, the Final prediction error and the Akaike information criterion suggest 6 lags whereas the Schwarz information criterion and the Hannan-Quinn information criterion suggest 2 lags. The information criteria provide conflicting results which could be as a result of small sample bias. In order to reach a meaningful conclusion, diagnostic checks are performed from the minimum lag selected to the maximum lag selected, and the model selects the lag order with the best diagnostics checks results.

Specifically, the Autocorrelation LM test is conducted from the minimum lag to the maximum lag to test for serial autocorrelation. The null hypothesis is that there is no serial autocorrelation. Failing to reject the null hypothesis (an insignificant p-value) would thus indicate no serial autocorrelation in the series. Both models provide evidence that there is no serial autocorrelation in lag 2.

Table 5.5: Johansen cointegration rank results for Ghana

	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
Trace Test	None *	0.46	173.38	125.61	0.00
	At most 1 *	0.41	107.91	95.75	0.00
	At most 2	0.18	51.66	69.81	0.56
	At most 3	0.13	30.17	47.85	0.70
	At most 4	0.07	14.64	29.79	0.80
	At most 5	0.04	6.35	15.49	0.65
	At most 6	0.01	1.06	3.84	0.30
Max-eigenvalue test	None *	0.46	65.47	46.23	0.00
	At most 1 *	0.41	56.25	40.07	0.00
	At most 2	0.18	21.48	33.87	0.64
	At most 3	0.13	15.53	27.58	0.70
	At most 4	0.07	8.28	21.13	0.88
	At most 5	0.04	5.29	14.26	0.70
	At most 6	0.01	1.06	3.84	0.30

Note: Trace and Max-eigenvalue and tests indicate 2 cointegrating equations at the 0.05 percent level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values. Source: Compiled by author from the Eviews work file available in the Appendix.

Having established that lag 2 is the optimum lag in the RER model for Ghana and using the deterministic trend assumption that there is a linear deterministic trend in the data, intercept and trend in the cointegrating equation and no trend in the VAR, the Trace test and the Maximum Eigenvalue test suggest that there are 2 cointegrating equations in the model.

Table 5.6: Johansen cointegration rank results for Nigeria

	Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
Trace Test	None *	0.36	116.99	95.75	0.00
	At most 1	0.24	67.71	69.81	0.07
	At most 2	0.16	37.60	47.85	0.31
	At most 3	0.09	17.86	29.79	0.57
	At most 4	0.04	6.79	15.49	0.60
	At most 5	0.02	2.26	3.84	0.13
Max-eigenvalue test	None *	0.36	49.28	40.07	0.00
	At most 1	0.24	30.10	33.87	0.13
	At most 2	0.16	19.73	27.58	0.35
	At most 3	0.09	11.07	21.13	0.64
	At most 4	0.04	4.53	14.26	0.79
	At most 5	0.02	2.26	3.84	0.13

Note: Trace and Max-eigenvalue and tests indicate 1 cointegrating equation at the 0.05 percent level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values. Source:

Compiled by author from the Eviews work file available in the Appendix.

In the RER model for Nigeria, 2 lags is also the optimum lag and the deterministic trend assumption that there is a linear deterministic trend in the data, intercept and trend in the cointegrating equation and no trend in the VAR is used to test for cointegration. The Trace test and the Maximum Eigenvalue test suggest that there is one cointegrating equation in the model.

The Johansen test results confirm that in Ghana and Nigeria RER models there is evidence of cointegration. The models are normalised on the REER since it is endogenous in both models method. Table 5.7 provides results of the VECM test for Ghana whereas Table 5.8 provides the VECM test results for Nigeria.

Table 5.7: The coefficients of the long-run determinants (β) for Ghana

LRE	LGC	LTO	LOP	ODA	LCO	C
1.00	1.44 [5.82]	1.46 [3.70]	0.43 [5.14]	0.68 [7.73]	-0.66 [-2.95]	-15.72

Note: The figures within the [ ] are t-ratios for the significance of the dynamic terms.

Source: Compiled by author

Table 5.8: The coefficients of the long-run determinants (β) for Nigeria

LRE	LGC	LNE	LOP	NFA	LOI	C
1.00	-1.17 [-6.25]	0.06 [0.86]	0.20 [0.62]	0.05 [5.15]	-0.73 [-3.85]	-3.82

Note: The figures within the [ ] are t-ratios for the significance of the dynamic terms.

Source: Compiled by author

Care must be taken when interpreting the coefficients long-run model when using the Johansen approach when estimated using Eviews routine. Specifically, the signs of the parameters must be interpreted as opposite of the Eviews output. Hence, from the results in Table 5.7, the long-run equation for Ghana's RER model can be written as follows:

$$LREER = 15.72 - 1.44LGCN - 1.46LTOT - 0.43LOPEN - 0.68ODA + 0.66LCOCOA \quad 5.1$$

As shown in Equation 5.1 LGCN, LTOT, LOPEN and ODA are negatively related to LREER meaning that an increase in the government consumption expenditure, the terms of trade, openness and the foreign aid variables will lead to a decrease in the real exchange rate, meaning a depreciation of the domestic currency. The LCOCOA variable has a positive relationship with LREER, such that an increase in international cocoa prices will lead to appreciation of the real exchange rate in Ghana. This is as expected since Ghana is a cocoa-rich country and if the world prices of cocoa increase we would expect the exchange rate to appreciate as was the case during the cocoa boom of the 1950s. The LNEER variable is insignificant and is thus excluded from the long-run results.

The result of the coefficient of the ODA variable is of particular interest because it implies that an increase in the net foreign aid inflow will depreciate the currency. This finding suggests that the Dutch disease, which is the case where the inflow of capital gradually appreciates the currency, does not apply to Ghana. This result is in line with the finding in Sackey (2002) and it also supports the inferences about the plots of the relationship between the net foreign aid inflow and the REER made in Chapter 3 which suggest that as foreign aid into Ghana increased, the REER generally decreased.

The result for LGCN is in line with the theoretical expectations and it implies that the government consumption expenditure in Ghana is greater in the tradable goods sector. This supports the findings in Chapter 3 which concluded that in Ghana, as the government consumption increased,

the REER generally decreased. These results are consistent with the results from Sackey (2002) and Youngblood and Apaloo (2006) who found that in Ghana the government consumption expenditure variable has a depreciating effect on the currency. With regard to the terms of trade, it is apparent that the substitution effect far outweighs the income effect which would imply that an improvement in the terms of trade will make the consumers in Ghana shift from the consumption of exportable goods to the consumption of importable goods, resulting in exchange rate depreciation. The result of the LOPEN variable conforms to the theoretical expectations because as trade restrictions are lifted the exchange rate depreciates. This result confirms the findings in Chapter 3 which suggest that an increase in the openness to trade in Ghana, generally depreciated the real exchange rate. This is usually the case when imports increase as result of trade openness.

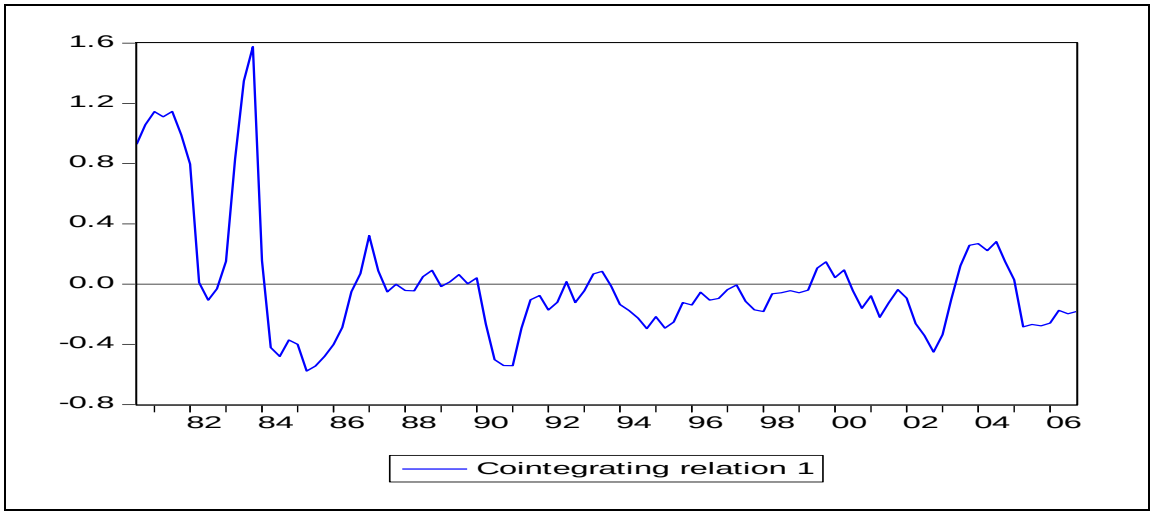
The long-run equation for Nigeria can be written as follows:

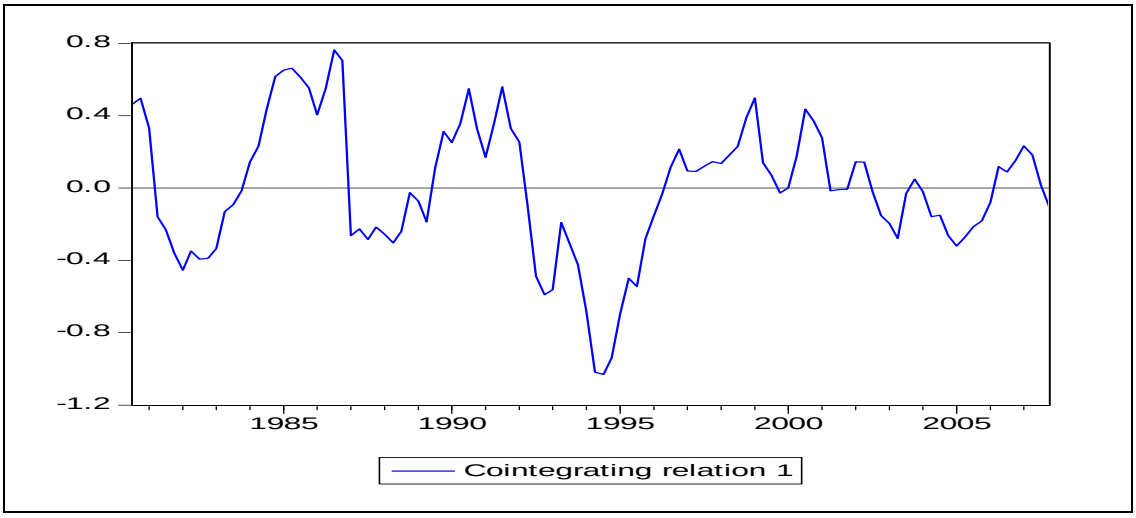
$$LREER = 3.59 + 0.73LOIL - 0.05NFA + 1.17LGCN \qquad 5.3$$

The long-run results suggest that the LOIL and the LGCN variables have a positive relationship with LREER whereas the NFA variable has a negative relationship with LREER. This suggests that an increase in the world oil prices and the government consumption expenditure variable and a decrease in the net foreign assets will appreciate the real exchange rate in Nigeria. The LNEER and the LOPEN variables are omitted from the model because their t-ratios show that the variables are insignificant. An increase in the net foreign assets entering Nigeria will depreciate the currency which implies that Nigeria is not plagued with the Dutch disease. This finding supports the findings in Chapter 3 which suggest that there is a negative relationship between the net foreign assets and the REER in Nigeria. The results from the coefficient of the government consumption expenditure variable suggest that in Nigeria, the bulk of government expenditure is in the non-tradable goods sector. This results in an appreciation of the RER in Nigeria. The coefficient of the LOIL variable is as expected since Nigeria is an oil exporting country, and an increase in world oil prices ought to appreciate the currency. The result of the effect of oil prices on the real exchange rate is similar to the finding in Aliyu (2007) however the findings of the effect of government spending and net foreign assets on the real exchange rate contrast to the findings in Aliyu (2007). This could be owing to the different proxies used by the studies for the variables. In addition the Aliyu (2007) study covers a shorter period (1986 to 2006) compared to the period covered in this study.

The plots of the cointegration graphs of the two models for Ghana and the model for Nigeria provide evidence that the real exchange rate equations confirm a stationary relationship. Figures 5.3 plots the cointegration graphs for the model in Ghana and the model in Nigeria respectively. The plots show that the first vector is in the cointegrating space which appears to be stationary.

Figure 5.3: Cointegration graphs for the REER equations





5.2.3 THE SPEED OF ADJUSTMENT

The short-run dynamic of the real exchange rate are captured in the VECM. Table 5.9 and Table 5.10 report the coefficients of the short-run variables.

Table 5.9: The coefficients of the Error Correction Term for Ghana

LRE	LGC	LNE	LTO	LOP	ODA	LCO
-0.62[-9.03]	-0.00 [0.54]	-0.60 [-8.90]	-0.03 [-1.76]	-0.02 [-0.91]	0.01 [0.24]	-0.02 [-0.47]

Note: The figures within the [ ] are t-ratios for the significance of the dynamic terms.

Source: Compiled by author

Table 5.10: The coefficients of the Error Correction Term for Nigeria

LRE	LNE	LOI	LOP	NFA	LGC
-0.12 [-3.01]	-0.08 [-2.09]	-0.02 [-0.66]	0.01 [1.20]	-0.43 [-1.06]	0.05 [1.71]

Note: The figures within the [ ] are t-ratios for the significance of the dynamic terms.

Source: Compiled by author

Key parameters to interpret in the VECM model are the coefficients of the speed of adjustment for the LREER variable. The parameter measures the speed of adjustment of the actual exchange rate back to its equilibrium value, following a shock in the system. Based on this coefficient in the RER model for Ghana, about 62 percent of the gap between the actual real exchange rate and its equilibrium value is eliminated every quarter in Ghana. This result implies that the gap between the actual real exchange rate and its equilibrium value is corrected within 5 months if no other shocks occur. Similarly about 11 percent of the gap between the actual real exchange rate and its equilibrium value is eliminated every quarter in Nigeria. This result implies that the gap between the actual and the equilibrium exchange rate will be corrected within 2,5 years provided no other shocks occur.

Variance decomposition is performed to confirm whether the REER is endogenous in both Ghana and Nigeria. Tables 5.11 and 5.12 report the variance decomposition for Ghana and Nigeria respectively, over 10 periods (2,5 years). The variance decomposition reveals the proportion of the movements in the dependent variables that are due to their own shocks versus the shocks of the exogenous variables.

Table 5.11: Variance decomposition results for Ghana

Period	LRE	LNE	LGC	LTO	LOP	LOD	LCO
1	100.0	0.00	0.00	0.00	0.00	0.00	0.00
2	82.27	8.87	0.43	1.38	3.10	2.15	1.77
3	57.73	14.14	2.18	2.74	12.24	5.60	5.33
4	42.30	12.25	4.54	2.20	24.92	6.75	7.01
5	32.80	9.03	6.35	1.51	37.41	6.13	6.74
6	26.81	6.59	7.31	1.18	47.25	5.04	5.79
7	23.10	4.99	7.70	1.01	54.23	4.07	4.87
8	20.82	3.94	7.82	0.88	59.04	3.32	4.15
9	19.33	3.22	7.85	0.76	62.41	2.78	3.61
10	18.27	2.72	7.86	0.65	64.85	2.38	3.22

Source: Based on estimated model by author

In Ghana, after approximately 2,5 years only 18 percent of the variance of REER was explained by itself. The results show that in the model, the real exchange rate is explained mostly by other variables after 2,5 years and thus it is endogenous in the model. The openness to trade in the model for Ghana contributes the most to the real exchange rate and this result is consistent with parameters of the long-run model.

Table 5.12: Variance decomposition results for Nigeria

Period	LRE	LNE	LGC	LOP	LOI	NFA
1	100.0	0.00	0.00	0.00	0.00	0.00
2	96.59	0.09	0.51	1.91	0.86	0.01
3	90.88	0.21	1.85	4.91	2.00	0.12
4	84.44	0.28	3.88	7.79	3.13	0.44
5	78.17	0.29	6.25	10.14	4.13	1.00
6	72.54	0.26	8.62	11.87	4.93	1.76
7	67.74	0.22	10.76	13.09	5.51	2.64
8	63.80	0.18	12.58	13.92	5.92	3.56
9	60.61	0.16	14.07	14.48	6.19	4.46

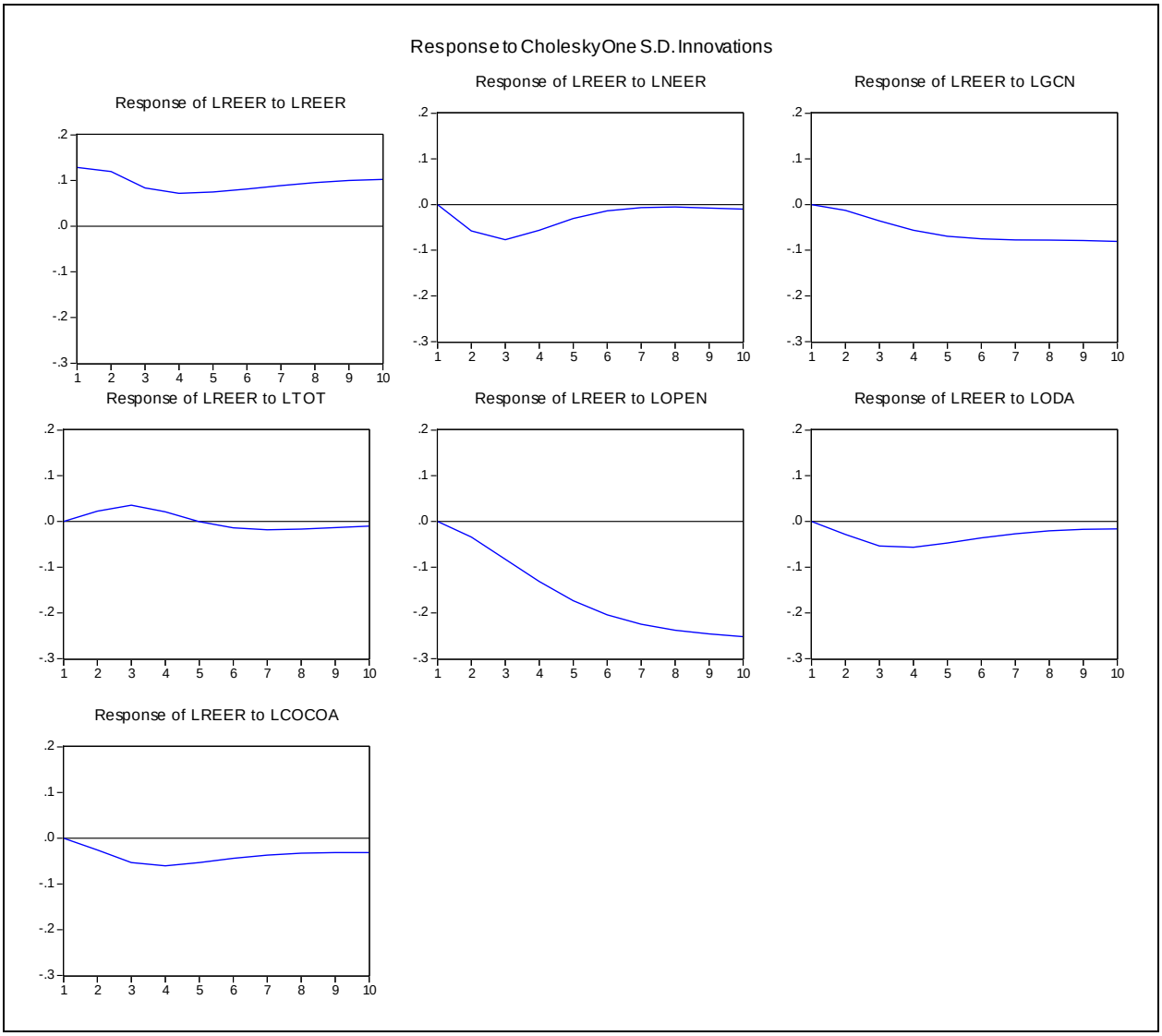
10	58.07	0.14	15.25	14.86	6.36	5.29

Source: Based on estimated model by author

In Nigeria, 58 percent of the variance of the REER be explained by itself after ten periods and the remaining 42% explained by the other variables. The results for Nigeria imply that the REER is less endogenous compared to Ghana. In Nigeria, the variable which contributes the most to the real exchange rate is the government consumption expenditure closely followed by the openness variable.

The impulse response shows the dynamic response of the real exchange rate to shocks in each variable over 10 periods. Figures 5.4 and 5.5 plot the impulse response for Ghana and Nigeria respectively.

Figure 5.4: Impulse response plots, Ghana

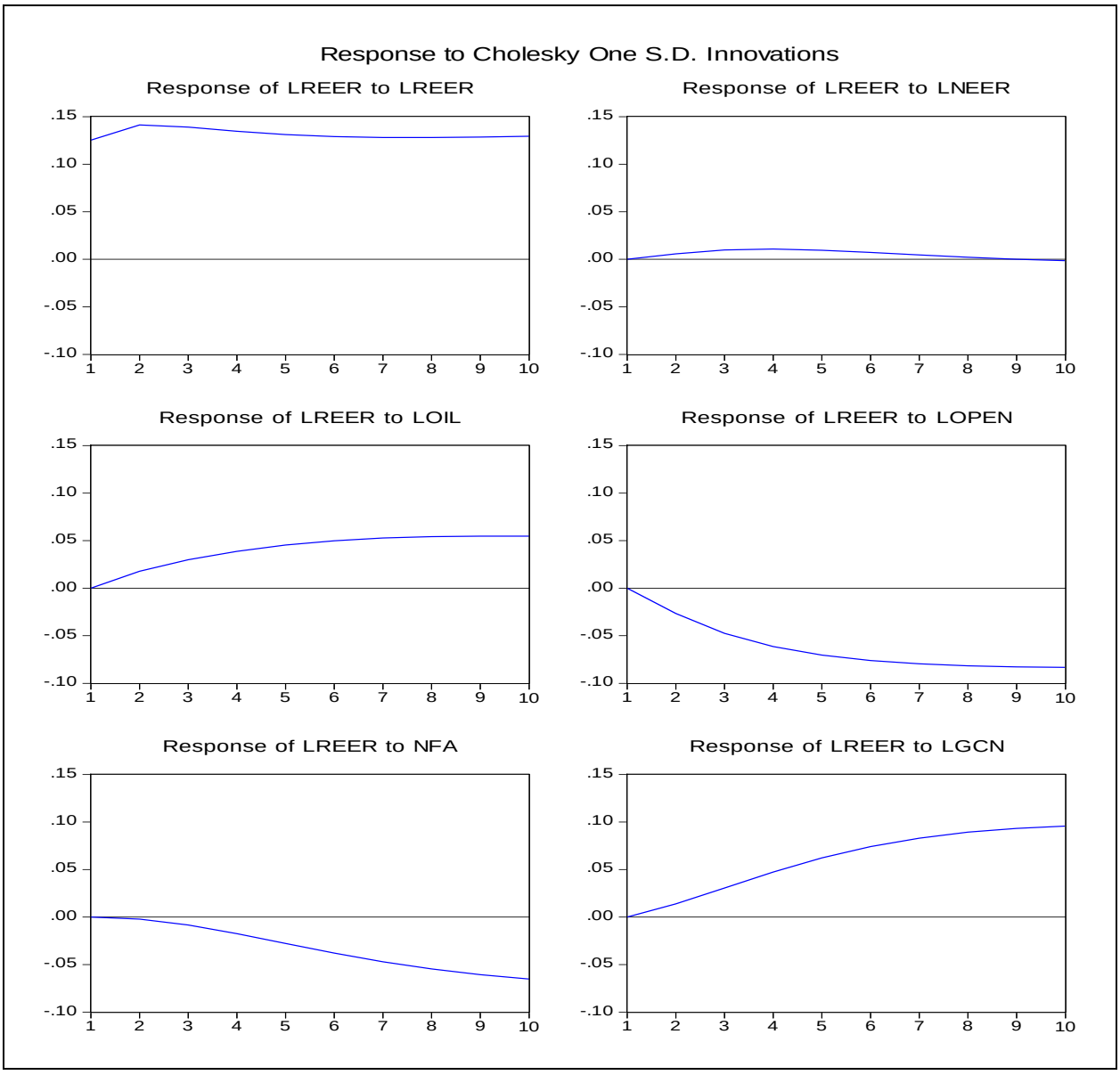


Source: Compiled by author from an Eviews output

The impulse response shocks for the Ghana RER model generally support the findings in the long-run model with the exception of cocoa prices. In the long-run (after 2,5 years) the plots confirm that an increase in government consumption expenditure, the terms of trade, openness and net foreign aid inflow will lead to a depreciation of the real exchange rate; however the effect is only marginal with the net foreign aid inflow. In contrast to the findings in the long-run model, the cocoa prices appear to depreciate the real exchange rate. This is theoretically not plausible, hence we relied on the long-run parameter for this variable.

Figure 5.5: Impulse response plots,

Nigeria



Source: Compiled by author from an Eviews output

For Nigeria, the plots show that the LOIL and LGCN variable have a positive relationship with the LREER whereas the NFA variable has a negative relationship with LREER. This confirms the findings in the long-run model for Nigeria. The impulse response also shows that the effects of the oil prices, government consumption expenditure and the net foreign assets variables on the real exchange rate progressively increase until the 5th period where the effect becomes constant.

5.2.4 EXCHANGE RATE MISALIGNMENT

The variables in the long-run equation are put through the H-P filter in order to attain their permanent, noncyclical values. These permanent values of the determinants and the coefficients of the determinants from the long-run model are then used to construct the permanent REER, the PEER. The deviation of actual REER from its permanent value is thus the level of exchange rate misalignment. The percentage misalignment is calculated as: (actual REER-PEER/PEER) *100. When the misalignment is close to zero, this implies that the actual exchange rate is close to its equilibrium value. When the percentage misalignment is above zero, this implies an overvalued currency, whereas when the percentage misalignment is below zero it implies an undervalued currency. Table 5.13 provides the summary of the conclusion for exchange rate misalignment estimation and whereas Figures 5.7 and 5.8 illustrate the plots of the difference between the actual REER and its equilibrium value.

Table 5.13: Exchange rate misalignment

	Period	Misalignment
Ghana	1980Q1 to 1983Q4	Overvalued
	1984Q1 to 1991Q1	Undervalued
	1991Q2 to 1991Q4	Overvalued
	1992Q1 to 1997Q4	Undervalued
	1998Q1 to 1999Q3	Overvalued
	1999Q3 to 2006Q4	Undervalued
Nigeria	1980Q1 to 1984Q1	Undervalued
	1984Q2 to 1986Q3	Overvalued
	1986Q4 to 1997Q4	Undervalued
	1998Q1 to1998Q4	Overvalued
	1999Q1 to 2007Q4	Undervalued

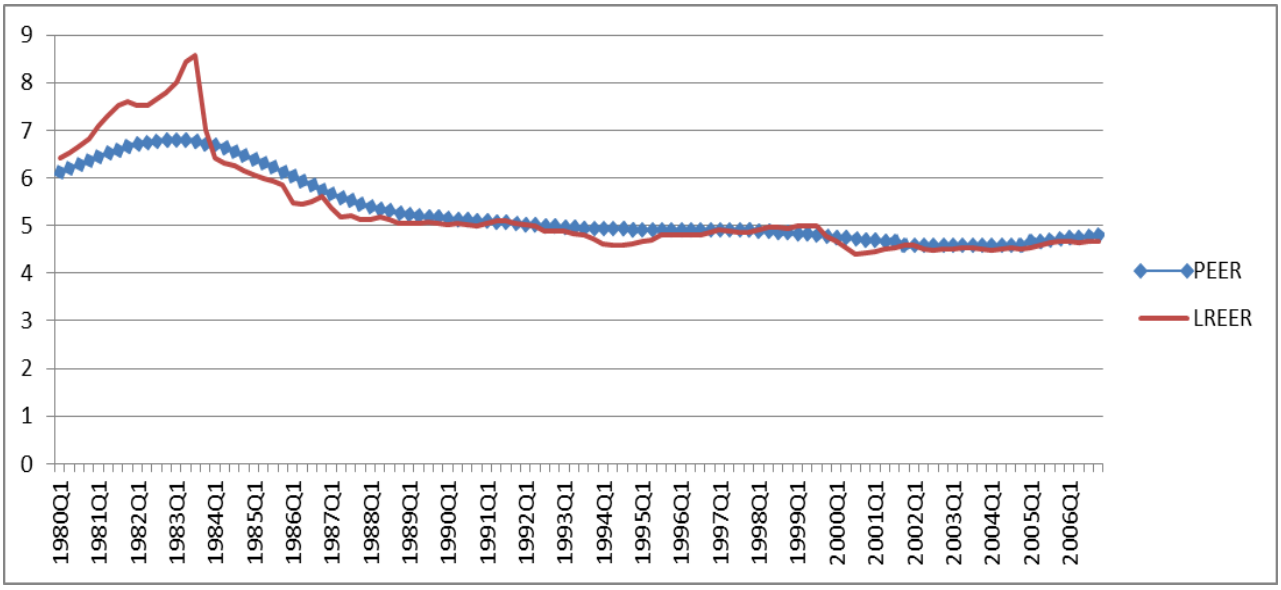
Source: Compiled by author

Ghana experienced episodes of exchange rate overvaluation from the first quarter of 1980 to the last quarter 1983, from the second quarter of 1991 to the last quarter of 1991, and from the first quarter of 1998 to the third quarter of 1999. Evidence of exchange rate undervaluation was found from the

first quarter of 1984 to the first quarter of 1991, from the first quarter of 1992 to the last quarter of 1997, and from the third quarter of 1999 to the last quarter of 2006.

It is evident that over the period covered the exchange rate has generally been undervalued particularly after the implementation of the Structural Adjustment Program in 1983. Thereafter few episodes of overvaluation occur. The plot also reveals that the extent of misalignment from 1983 is marginal because the LREER and PEER move closely together. The Structural Adjustment Program was thus successful in bringing the real exchange rate in Ghana close to its equilibrium value. The findings in G1 are similar to the findings in Iossifov and Loukoianova (2007) and Youngblood and Apaloo (2006) where the actual REER was close to its equilibrium value towards 2006.

Figure 5.6: Real exchange rate misalignment in Ghana

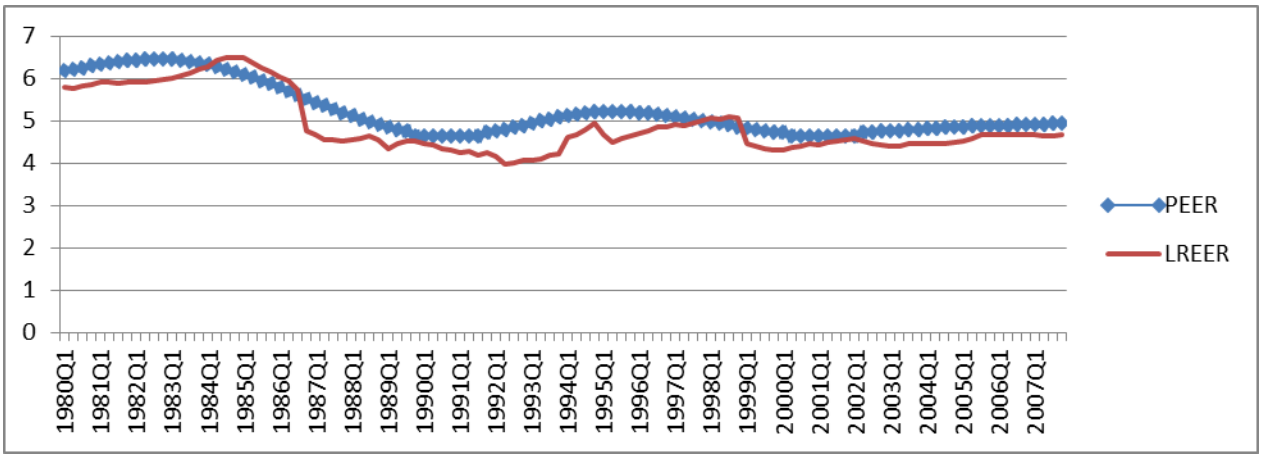


Source: Compiled by author

The evidence in Ghana RER model strongly correlates with the events which took place in Ghana. The cedi was pegged to the USD in the early 1980s and hence it is not surprising that the REER was overvalued at this period as indicated in the model. Furthermore, from 1999 the Ghanaian economy experienced a sharp deterioration of the terms of trade and a collapse of the nominal exchange rate and hence the finding that the REER was undervalued during this period is not surprising.

Nigeria experiences episodes of overvaluation from the second quarter of 1984 to the third quarter of 1986, and from the first quarter of 1998 to the fourth quarter of 1998. Evidence of undervaluation on the other hand is found from the first quarter of 1980 to the first quarter of 1984, from the fourth quarter of 1986 to the last quarter of 1997 and from the first quarter of 1999 to the last quarter of 2007. From an inspection of Figure 5.9, it appears that the actual REER in Nigeria follows closely to the PEER. Although the extent of misalignment in Nigeria is limited, it is nonetheless still apparent. The liberalization of the exchange rate market in Nigeria which started with the implementation of the Structural adjustment Program in 1986 did not appear to decrease the extent of real exchange rate misalignment; in fact the exchange rate was generally undervalued thereafter.

Figure 5.7: Real exchange rate misalignment in Nigeria



Source: Compiled by author

5.3 CONCLUSION

This chapter set out to estimate the exchange rate models for Ghana and Nigeria. In order to do so the Johansen cointegration technique was used. The first step was to test for stationarity and the variables in both countries were found mostly to be I(1), which provided evidence that cointegration may exist. Upon selecting the variables which are used for each model, the model was estimated for each of Ghana and Nigeria. The Johansen technique provided evidence of 2 cointegrating equations for the Ghana RER model and 1 cointegrating equation in the model for Nigeria. These results allowed for the estimation of the VECM, which provided the parameters of the short and long-run relationships.

In the real exchange rate model for Ghana, an increase in government consumption expenditure, the terms of trade, net foreign aid inflow and openness result in a depreciation of the currency. On the other hand, an increase in world cocoa prices tends to appreciate the exchange rate. The speed of adjustment coefficient suggests that 62 percent of the gap between the actual exchange rate and its equilibrium value will be corrected in one quarter. In the real exchange rate model for Nigeria, an increase in world oil prices and government consumption expenditure appreciate the exchange rate, whereas an increase in net foreign assets will depreciate the exchange rate. The speed of adjustment coefficient suggests that 11 percent of the gap between the actual exchange rate the equilibrium value is corrected after one quarter.

Generally, the variance decomposition results support the evidence provided in the VECM weak exogeniety test. The real exchange rate is found to be endogenous in both real exchange rate models for Ghana and Nigeria. The impulse response results for both countries support the findings of the VECM long-run models. There is evidence of exchange rate misalignment in Ghana. The real exchange rate model for Ghana shows that the real exchange rate experienced periods of overvaluation and undervaluation; however, the periods of marginal undervaluation persist particularly after 1983. The results in Nigeria suggest that there is real exchange rate misalignment in Nigeria, but the extent to which it occurs is small. The real exchange rate in Nigeria went through several periods of undervaluation and overvaluation and the undervaluation persisted particularly after 1986, with it tending towards equilibrium.

CHAPTER 6

CONCLUSIONS, POLICY RECOMMENDATIONS AND LIMITATIONS

6.1 SUMMARY OF THE FINDINGS AND CONCLUSIONS

The study analysed the relationship between the real exchange rate and its determinants in Ghana and Nigeria. After specifying the models, it was then possible to compute the real exchange rate misalignment in both countries. After a review of the literature and empirical studies, it was concluded that the variables that enter the exchange rate model are trade restrictions, domestic interest rates, net foreign aid, domestic income, money supply, world inflation, government consumption expenditure, productivity growth in the non-tradable goods sector, capital restrictions and the terms of trade, cocoa prices (in Ghana) and oil prices (in Nigeria).

The study applies the Johansen approach and the VECM to estimate the long-run determinants of the exchange rate in Ghana and Nigeria. Prior to carrying out the Johansen test, unit root and stationarity test results show that the variables are largely I(1) for both countries, thus making it possible to test for cointegration. For Ghana, the Johansen cointegration and VECM results reveal that, in the long-run, an increase in government consumption expenditure, terms of trade, the level of openness, and net foreign aid inflow will result in real exchange rate depreciation. On the other hand, an increase in international cocoa prices will cause an appreciation of the real exchange rate. The speed of adjustment coefficient in the real exchange rate model for Ghana suggests that about 62 percent of the gap between the actual real exchange rate and its equilibrium is eliminated every quarter.

In the real exchange rate model for Nigeria, an increase in world oil prices and government consumption expenditure and a decrease in net foreign assets will appreciate the real exchange rate. In Nigeria, about 11 percent of the gap between the actual real exchange rate and its equilibrium value is eliminated in every quarter.

The results from the variance decomposition support the findings from the weakly exogenous test suggesting that the REER in all the models is endogenous. The impulse response results support the findings of the long-run models for the real exchange rate models for Ghana and for Nigeria.

The real exchange rate model for Ghana suggests that the REER experienced significant misalignment throughout the entire period covered. The most misalignment occured from the first quarter of 1980 to the last quarter of 1983 when the exchange rate was overvalued and from the first quarter of 1984 to the first quarter of 1991 when the real exchange rate was undervalued. The findings however reveal that following the Structural Adjustment Program in 1983, the extent of real exchange rate misalignment was limited. Nigeria also experienced slightly higher real exchange rate misalignment throughout the period covered than Ghana, more so from the second quarter of 1984 to the third quarter of 1986 when the real exchange rate was overvalued and from the last quarter of 1986 to the last quarter of 1997 when the real exchange rate was undervalued.

6.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

The results of this study have a number of policy implications:

1. The evidence of a long-run relationship between the real exchange rate and its determinants, as well as the endogenous characteristic of the real exchange rate in all the models, implies that policy makers in both Ghana and Nigeria can control the behaviour of the real exchange by influencing one of the exogenous variables.

   By adjusting one of the variables which influences the real exchange rate, policy makers can affect the path of the real exchange rate. The results for Ghana reveal that the openness to trade variable has the greatest effect on the real exchange rate. This therefore means that policy makers can influence trade in order to affect the level of real exchange rate in Ghana.
2. The results also suggest that the real exchange is affected by other shocks in the system outside the control of the policy makers, such as the terms of trade shocks experienced in Ghana around 1999 and the world oil price hikes at the turn of the century which resulted in high oil price in Nigeria.
3. The results from the real exchange rate model for Ghana and the real exchange rate model for Nigeria highlight that since the implementation of Structural Adjustment Programs in both Ghana and Nigeria the real exchange rates in both countries have generally been undervalued. It would thus be useful for policy makers to target those variables that cause an appreciation of the exchange rate in both countries in order to align the real exchange rate closer to its equilibrium value.

In Ghana for instance, it would be useful to reduce government consumption expenditure and alter the composition of trade openness, by stimulating exports growth in order to drive the equilibrium close to the equilibrium. In Nigeria, an increase in government consumption expenditure would appreciate the real exchange rate, which would help to limit the extent of real exchange rate misalignment.

6.3 LIMITATONS OF THE STUDY AND AREAS OF FURTHER RESEARCH

The issue that many researchers are confronted with when modelling exchange rates for developing countries is the unavailability of data. This means that some variables have to be omitted from the models albeit with the risk of omitted variable bias. Alternatively, proxies for the variables without data can be created. However, the problem with using proxies is that they may not correctly represent the true value of the variable. It would be useful for further research to look into finding proxies for the explanatory variables which better represent the determinants and improve the performance of the model.

A pertinent issue in the estimation of the real exchange rate models for both Ghana and Nigeria is that the data for most of the variables is in its annual frequency. The annual data must be converted to quarterly data using the data frequency conversion method of interpolation. The risk of using interpolated data is that although the interpolated series may be accurate and precise it is not the actual value of the quarterly data, hence there is room for error.

Appendix A-2: Johansen Cointegration test results

Table A-2.1a: Johansen Cointegration test results for Ghana

Sample (adjusted): 1980Q4 2006Q4
Included observations: 105 after adjustments
Trend assumption: Linear deterministic trend
Series: LREER LNEER LGCN LTOT LOPEN LODA LCOCOA
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.463961	173.3898	125.6154	0.0000
At most 1 *	0.414760	107.9171	95.75366	0.0056
At most 2	0.185061	51.66520	69.81889	0.5643
At most 3	0.137532	30.17775	47.85613	0.7099
At most 4	0.075873	14.64223	29.79707	0.8027
At most 5	0.049140	6.357168	15.49471	0.6533
At most 6	0.010105	1.066391	3.841466	0.3018

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.463961	65.47265	46.23142	0.0002
At most 1 *	0.414760	56.25193	40.07757	0.0004
At most 2	0.185061	21.48745	33.87687	0.6472
At most 3	0.137532	15.53553	27.58434	0.7048
At most 4	0.075873	8.285057	21.13162	0.8854
At most 5	0.049140	5.290777	14.26460	0.7048
At most 6	0.010105	1.066391	3.841466	0.3018

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table A-2.1b: Johansen Cointegration test results for Nigeria

Sample (adjusted): 1980Q4 2007Q4
Included observations: 109 after adjustments
Trend assumption: Linear deterministic trend
Series: LREER LNEER LOIL LOPEN NFA LGCN

Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.363723	116.9918	95.75366	0.0008
At most 1	0.241343	67.71068	69.81889	0.0728
At most 2	0.165627	37.60422	47.85613	0.3196
At most 3	0.096602	17.86702	29.79707	0.5760
At most 4	0.040713	6.793438	15.49471	0.6018
At most 5	0.020546	2.262825	3.841466	0.1325

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.363723	49.28114	40.07757	0.0035
At most 1	0.241343	30.10646	33.87687	0.1321
At most 2	0.165627	19.73720	27.58434	0.3596
At most 3	0.096602	11.07359	21.13162	0.6400
At most 4	0.040713	4.530612	14.26460	0.7995
At most 5	0.020546	2.262825	3.841466	0.1325

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix A-3: VECM test results

Table A-3.1a: VECM test results for Ghana

Vector Error Correction Estimates
Sample (adjusted): 1980Q3 2006Q4
Included observations: 106 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1
B(2,2)=1
B(2,6)=0
B(2,1)=0
B(1,2)=0
Convergence achieved after 38 iterations.
Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 2):
Chi-square(1) 0.894479
Probability 0.344266

Cointegrating Eq:	CointEq1	CointEq2
LREER(-1)	1.000000	0.000000
LNEER(-1)	0.000000	1.000000
LGCN(-1)	1.448606	-3.825616
	(0.24872)	(0.72438)
	[5.82414]	[-5.28126]
LTOT(-1)	1.462808	-9.619194
	(0.39506)	(1.14228)
	[3.70278]	[-8.42106]
LOPEN(-1)	0.438777	3.477466
	(0.08528)	(0.22780)
	[5.14510]	[15.2653]
LODA(-1)	0.688773	0.000000
	(0.08900)	
	[7.73901]	
LCOCOA(-1)	-0.662637	4.361501
	(0.22426)	(0.64667)
	[-2.95477]	[6.74451]
C	-15.72415	13.93332

Error Correction:	D(LREER)	D(LNEER)	D(LGCN)	D(LTOT)	D(LOPEN)	D(LODA)	D(LCOCOA)
CointEq1	-0.622611	-0.609318	-0.009252	-0.037475	-0.024121	0.010443	-0.022272
	(0.06894)	(0.06846)	(0.01710)	(0.02118)	(0.02634)	(0.04198)	(0.04683)
	[-9.03075]	[-8.90039]	[-0.54110]	[-1.76907]	[-0.91579]	[0.24875]	[-0.47556]
CointEq2	-0.187652	-0.166122	0.005143	0.006672	0.001854	-0.000349	-0.016427
	(0.02637)	(0.02619)	(0.00654)	(0.00810)	(0.01007)	(0.01606)	(0.01791)
	[-7.11604]	[-6.34410]	[0.78641]	[0.82344]	[0.18400]	[-0.02176]	[-0.91700]

Table A-3.1a: VECM test results for Nigeria

Vector Error Correction Estimates
Date: 11/03/10 Time: 12:50
Sample (adjusted): 1980Q3 2007Q4
Included observations: 110 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1
Convergence achieved after 1 iterations.
Restrictions identify all cointegrating vectors
Restrictions are not binding (LR test not available)

Cointegrating Eq:	CointEq1
LREER(-1)	1.000000
LNEER(-1)	0.066106 (0.07615) [0.86814]
LOIL(-1)	-0.736064 (0.19105) [-3.85281]
LOPEN(-1)	0.202647 (0.32215) [0.62905]
NFA(-1)	0.052957 (0.01027) [5.15506]
LGCN(-1)	-1.175926 (0.18787) [-6.25918]
C	-3.826310

Error Correction:	D(LREER)	D(LNEER)	D(LOIL)	D(LOPEN)	D(NFA)	D(LGCN)
CointEq1	-0.122925 (0.04078) [-3.01441]	-0.088563 (0.04222) [-2.09756]	-0.027496 (0.04143) [-0.66373]	0.018751 (0.01555) [1.20572]	-0.435744 (0.40869) [-1.06619]	0.050370 (0.02933) [1.71737]

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