KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF ART AND SOCIAL SCIENCES

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

DETERMINANTS OF REAL EXCHANGE RATE IN GHANA

A THESIS SUBMITTED TO THE DEPARTMENT OF ECONOMICS, KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHYLOSOPHY IN ECONOMICS.

BY

ABDUL, HAMID HAMDU

APRIL, 2013

DECLARATION

I declare that this thesis submitted herein is the result of original research I have personally undertaken under supervision, except reference to other people's work, which has been duly acknowledged in the text.

…… …… ……

ABDUL, HAMID HAMDU DATE

(STUDENT)

I declare that I have supervised the above student in undertaking the study submitted herein and confirm that he has my permission to present it for assessment.

…….. ……

DR. OSEI - FOSU ANTHONY KOFI DATE
(SUPERVISOR)

DEDICATION

To my mother, TALHATU MOHAMMED, my Lovely wife, ABUBAKARI NAJIHA, my son, ZAKIR ANAMZOYA and ABDUL-MUMIN MOHAMMED, my Big Brother.

ACKNOWLEDGEMENT

My greatest thanks and praise go to the Almighty ALLAH for giving me the direction, strength, wisdom and encouragement to finish this work successfully.

I also wish to express my sincere thanks and gratitude to my Supervisor, DR. Osei- Fosu Anthony Kofi whose constructive criticisms, comments, suggestions and guidance have made this thesis a success.

Special thanks to my Lovely Mother, Talhatu Mohammed, who has been an inspiration to my life in all aspects. I will also like to thank my lovely wife, Abubakari Najiha for being supportive of me in my life.

This section cannot be completed without mention of Mr. Frank Adu who spent his precious time in helping me to run the various econometric regressions of the work. I say God richly bless you all.

I am also grateful to the following people for their support and encouragement: Mr. Henry Minnow (Chief Budget Analyst-EJMA) Mr. Mohammed Abdul-Razak (SARI), Hajia. Gyami Abdul-Wahabi(WFP), Dr. Sr. Eugenia Amporfu (Dept of Economics, KNUST),

Mrs. Grace Ofori-Abebrese(Dept of Economics, KNUST),Dr.Hadrat M.Yussif(Dept. of Economics, KNUST), Alhaji Sule, Alhaji Iddi, Alhaji Ahmed Suleiman(Chief Director-AG's Dept),Mr. Enoch Cobbinah(Chief Director MOE),Mr., Amadu Rauf, Mr.Rasheed Alolo(Tamale Poly), Esi Eshun, Alhaji Abubakari Mualim, Fusieni Amdiya, Mr. Abdul Hussein A.Rasheed and all those who in diverse ways have influenced my life and also contributed their time and effort in making this study a success.

Though I received a lot of guidance and support from my supervisor and colleagues I claim sole responsibility for any errors, omissions or misrepresentation that may be found in this work.

ABSTRACT

The paper analysed the determinants of real exchange rate in Ghana (1980-2010).The problem statement of the study was that, maintenance of a stable value for the Ghanaian cedi against the US doller continued to pose serious challenges to policy makers in Ghana, for instance the real exchange rate depreciated against the USD by 4.5% in 2003 , 2.2% in 2004, 0.9% in 2005, 1.1% in 2006 and 4.8% in 2007 (Bawumia, 2010) and the Ghanaian cedi experiencing a ‘free fall’’ recently, it became very important for a study to be conducted to re-examine what really goes in to the real exchange rate determination in Ghana. The study adopted a typical developing country model develop by Edwards (1989) as well as time series analysis and employed Autoregressive Distributed Lag (ARDL) approach to estimate the model specified for the study. The empirical results of the study suggested that in the long-run real exchange rate determinants were; terms of trade, openness, and the rate of growth. All these variables maintained their sign as good determinants of real exchange rate except OPENNESS that was not consistent in the short run. Investment as percentage of GDP was not significant in the long run but was significant in the short run whilst Election year (POL) had a depreciation effect on Real exchange rate but wasn’t significant determinant. Finally improvement in terms of trade had a depreciation effect on real exchange for both long run and short run. The recommended that, export promotion should be highly encouraged as part of the trade liberalization policy. In addition, there should also be diversification of our exports. This can be done by adding value to our exports so that they attract competitive prices on the world market. Domestic consumers should also be encouraged to use domestic goods and services. This can be achieved through the organization of rural trade fairs and exhibitions at the district level to showcase made in Ghana goods and this would help reduce domestic expenditure on imported goods so as to ensure favourable balance of trade, thereby, resulting to an appreciation of the real exchange rate in Ghana.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

Table **page**

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

The agreement in policy circles in developing nations is that, the main objective of exchange rate policy should be to reduce persistence in misalignment, which is a common issue in most developing countries. However, in order to manage misalignments, it is relevant to successfully identify what determines the real exchange rate (Afari et al, 2004).

When the real exchange rate is seen to have become excessively misaligned, the expectation is that it will adjust toward its equilibrium level in the future. To the extent that this adjustment is expected to take place through an appreciation or depreciation in the nominal exchange rate, this will discourage domestic agents from holding assets denominated in the domestic currency, which is a potential source exchange rate crisis (Montiel, 2003). Importers, exporters, investors and the monetary authorities are all concerned with the behaviour of the exchange rate, as it directly or indirectly affects them. The behaviour of the exchange rate is, therefore, a useful indicator of economic performance that needs to be understood. The real exchange rate, which is the nominal exchange rate adjusted for changes in the price level differential between the domestic economy and the rest of the world is more important than the nominal exchange rate (Takaendesa, 2006) and is particularly good for developing economies where traded goods are a significant share of gross domestic product (Edwards and Savastano, 1999 also cited in Takaendesa, 2006).

1.2 Overview of Exchange Rate Policies in Ghana

In the 1960s Ghana adopted the fixed exchange system, shortly after independence, of which the Bretton Woods system supported. In particular the Ghanaian currency was pegged at two Cedi to the pound. Adjustments were made only to supposed to occur when

there were fundamental balanced of payments problem. The choice of a fixed exchange regime in Ghana was therefore consistent with the thinking of the time. Due to the inheritance of huge foreign exchange reserves from the colonial era, Ghana exercised practically no control over the foreign exchange markets, which were in the hands of a few commercial banks.

With the launching of the Economic Recovery Programme (ERP), the government made a series of devaluation of the Cedi between 1983 and 1986. In particular, the Cedi was devalued in stages from ¢2.75: US$1.00 in 1983 to ¢90.00: US$1.00 by the third quarter of 1986 (Appiah and Adetunde, 2011).

In Ghana, exchange rate changes have gone through four phases in the last twenty years. These are: PHASE I (The Pre-2000 era): The era of high exchange rate fluctuation, during which the cedi lost more than half of its value against its major trading partners.

PHASE II (The pre-redenomination era): The cedi remained resolute against the US Dollar and other international currencies.

PHASE III (The post-election 2008 era): Here, the global financial crisis, among other factors, pushed the cedi marginally down.

PHASE IV (The post-2010 Christmas era): After several months of stability and intermittent exchange rate appreciation, the cedi begun to show signs of fragility, showing fears of significant loss in value similar to what was experienced many years ago. In each of these periods, significant attention was focused on the cedi's value and extensive public discourse centered on the subject (Nana, 2012). Unfortunately these fears that were

anticipated has become a reality with the Ghana Cedi depreciating by 17.3% in 2010 (CEPA, 2012).

One of the most important issues in Ghana's policy arena over the past years has been that of exchange rate stabilisation as exhibited by successive budget and policy statements. However, maintenance of a stable value for these currency vis -á -vis major international currencies like the US doller has continued to pose serious challenges to policy makers, for instance the real exchange rate depreciated vis- á- vis the USD by 4.5 percent over the year 2003 and 2.2 percent for the year 2004, 0.9 percent in 2005, 1.1 percent in 2006 and 4.8 percent in 2007. Between 2004 and 2007 the cedi depreciated by an average of 2.25 percent against the US dollar (Bawumia, 2010).

In the year 2000, the cedi was described variously as being in a *'free fall'*. At the same time, parallel market operations had re-emerged just a decade after foreign exchange was liberalised. The natural question which follows is: *what are the forces behind the movement of the cedi on the foreign exchange market? (*Zakari and afriyie, 2004).

1.3 Statement of the Problem

Exchange rate determination as an area of international finance has seen a major research interest in the Post- Bretton Woods Era. Surprisingly, the interest in this area of research is still very intense, and experts do not see this interest waning in the foreseeable future. Many researchers attribute interest in exchange rate determination to the fact that it is empirically difficult to predict future exchange rate values (Killian and Taylor, 2001).

However, given the importance and the unpredictable nature of the real exchange rate which has elicited a lot of studies in other countries, it is surprising to note that not much studies have been done on Ghana on the Determinants of real exchange rate.

The Ghanaian cedi has been unstable for some years and experiencing a 'free fall'' recently and maintenance of a stable value for the Ghanaian cedi against the US doller had continued to pose serious challenges to policy makers, for instance the real exchange rate depreciated against the USD by 4.5% in 2003 , 2.2% in 2004, 0.9% in 2005, 1.1% in 2006 and 4.8% in 2007 (Bawumia, 2010) it became very important for a study to be conducted to re-examine what really goes in to the real exchange rate determination in Ghana.

The study therefore adopted a typical developing country model develop by Edwards (1989) which to the best of our knowledge had never been used by any study on Ghana alone before. This study covered the period 1980-2010 which had not been covered by previous studies. Thus, this work was to fill the information gap by providing relevant answers to the questions about real exchange rate determination in other to inform policy direction in Ghana. It should be noted that, this work aimed in improving previous studies that had been done.

1.4 Objectives

The general objective of the study was to find out the determinants of the Real Exchange Rate in Ghana. Specifically;

1. To examine the impact of other key macroeconomic and policy variables on Real exchange rate in Ghana.

2. Whether Election year is a significant determinant of Real exchange rate in Ghana.

3. To draw policy implications from the findings for macroeconomic management.

1.5 Study Hypothesis

The study seeks to test and validate the following empirical theory;

H_0: Real exchange rate is not influenced by TOT, OPENNESS, YG, IGDP and ELECTION YEAR.

H_1: Real exchange rate is influenced by TOT, OPENNESS, YG, IGDP and ELECTION YEAR.

1.6 Significance of the Study

A number of researchers have pointed out the importance of the real exchange rate in the economy and why it is important to understand its fundamental determinants (see, for example, Baffes *et al*., 1999: 408; Khan and Montiel, 1996: 15; Mkenda, 2001; and Aron *et al*., 1997). However, most of the studies on this relationship have placed particular emphasis on analyzing industrialised, Asian countries and some few African countries.

Some researchers have argued that real exchange rates are crucial not only for attaining sustained general economic performance and international competitiveness, but have a strong impact on resource allocation amongst different sectors of the economy, foreign trade flows and balance of payments, employment, structure of production and consumption and external debt crisis (Edwards, 1989: 5, Aron *et al*., 1997: 25 and Edwards and Savastano, 1999: 3).

So analyzing the determinants of real exchange rate in a developing country like Ghana is adequately justified for a number of reasons;

In the first place, the issue of real exchange rate determinants on Ghana needs to be researched since in the wake of trade liberalization and high growth the Ghanaian cedi is

depreciating (CEPA, 2012) this phenomenon is therefore a worrying concern for every successive government in Ghana and therefore there is the need to research on this.

Secondly, in view of conflicting results of past empirical studies both cross-country and country specific, on what really is the determinants of real exchange rate, it is only proper that empirical study of this nature is conducted using data on Ghana to establish the exact determinants of the real exchange rate in order to guide policy formulation. Thirdly to examine whether political variable (election) helps in predicting real exchange rate movements, we assume that economic fundamentals follow a random walk. In general, election here is a political variable, which proxies the opportunistic manipulation of the economy due to up-coming elections (Blomberg and Hess, 1997). The intuition for incorporating election period effects, into our empirical model is that, exchange rates are based on the 'rational opportunistic political business cycle' model of Rogoff and Sibert (1988). Here, the assumption is that just before an election, the incumbent government manipulates the economy in a way as to appear more competitive. For instance, salary increases and a rash to begin certain developmental projects such as extension of electricity to rural areas that do not contribute to output at least in the short term. Although voters have to rationally infer the incumbent's true competency from its performance, such actions temporarily drive up government's budget deficits, which cause the exchange rate to rise.

As it were, the first multiparty elections under Ghana's new constitution were held in 1992. In the run-up to the election, the incumbent government abandoned its fiscal targets and a budgeted surplus of 1.6 per cent of GDP turned into a deficit of nearly 9 per cent. The pattern was repeated prior to the 1996 election and, to a lesser extent, in 2000 (IMF Country report, July 2004).

Finally this study upon its completion will help us know how the real exchange rate responds to terms of trade, openness, Investment as percentage of GDP, and other factors and hence inform in prescribing effective economic policies.

1.7 Scope of the study

The study is confined to the analysis of long and short run determinants of real exchange rate in Ghana from 1980 to 2010. The choice of the time and variables is greatly informed by the availability of data (Explained in detail in chapter 3).

1.8 Organisation of the Study

The study is divided into five chapters. Chapter one opens the study with the introduction and background of the study. Chapter two reviews both the theoretical and empirical literatures on the determinants of Real exchange rate in Ghana. Chapter three presents the methodology of the study. This includes the model specification, estimation techniques and data descriptions. The model estimation, discussion and presentation of results as well as diagnostic tests are also reported and analyzed in chapter four. Chapter five closes the study with conclusions and policy recommendations based on the findings.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter is divided into three sections; the first section takes up the definitional and measurement issues in detail, with the second part dealing with the theoretical review and the third part dealing with the empirical review.

2.2 Theoretical Review

2.1 Definition of Concepts and How the real Exchange Rate Market Works

In estimating the long run equilibrium real exchange rate the first step is the measurement of the actual real exchange rate. Unfortunately, there are both conceptual and empirical challenges in the measurement of the real exchange rate. There are several definitions of both the nominal and real exchange rate, which are based on different analytical frameworks and used for different purposes. These multiple conceptual definitions are often misunderstood and have difficult analysis of exchange rate issues.

The real exchange rate is determined in the exchange rate market. That is through the exchange rate market one countries currency is converted to the other for trade to take place. The issue now is what the exchange rate is and how it is measured.

The exchange rate is the price of one currency in terms of another currency. In other words, it is the rate at which currencies are exchanged, for example the units of cedis needed to buy a unit of a dollar. There are two major types of exchange rates. The predominant one, called the spot exchange rate, is the exchange rate for immediate (two-day) exchange of bank deposits or currencies. The second is called the forward exchange rate, which is the rate for the exchange of bank deposits at some specified future date (forward transaction). When a

currency falls in value in relation to another, it is said to be depreciating. Conversely, when a currency increases in value in relation to other currencies, it is referred to as appreciation (Takaendesa, 2006).

Also exchange rates could be Nominal, Real, Bilateral and Multilateral Exchange rates. These concepts are briefly discussed below:

The Nominal Exchange Rate is simply the price of one currency interms of the other. According to Takaendesa (2006), the nominal exchange rate can be expressed in two forms namely the indirect European quotation and the direct American quotation. Hence the indirect European quotation is the price of a unit of foreign currency in terms of the units of local currency and in the direct American quotation is the price of the local currency in terms of units of foreign currency.

With regards to the real exchange rate, literature has shown that, there has not been a general agreement among economist on its measurement. This is because economists use different types of macroeconomic models for different purposes, a series of analytical RER definitions tend to be used. Theory has shown that the definition of the real exchange rate can be grouped in to internal and external real exchange rate where the internal real exchange rate is the ratio of the domestic price of tradable to non-tradable goods within a single economy whilst the external exchange rate is the nominal exchange rate adjusted for price level differences among countries.

The internal real exchange rate is an indicator of domestic resource allocation incentives in the home country, as it is defined as the internal relative price incentive for producing or consuming tradable goods as opposed to non-tradable goods. Different expressions of the

internal RER can be derived depending on whether we are looking at two or multi-good models. The most used definition of the internal RER derives from the Salter-Swan non-traded goods model (Black, 1994). The RER in this case is expressed as the ratio of the price of tradable to non-tradable goods as follows:

$RER = G\frac{Pt}{pn}$.....equation 2.1

Where Pt is the world price of traded goods, Pn is the domestic price of non traded goods and *G* is the NER. In this case, therefore, an increase in RER means depreciation, while a decrease means an appreciation. The RER stated in equation 2.1 above can be stated indirectly which will then mean that, an increase in *RER* implies an appreciation of the domestic currency, while a decrease implies its depreciation.

The external RER starts from the purchasing power parity (PPP) theory, which compares two countries and the relative prices of baskets of goods produced or consumed. In this case, the RER is defined as the ratio of the price of foreign to that of domestic goods, expressed in domestic currency (Montiel, 2003). The RER is calculated by beginning with the NER – the home country price of foreign exchange – then dividing by a home country price index for the class of goods in question and finally multiplying by the corresponding foreign price index (Takaendesa, 2006).

That is we take the Ghanaian price of the US dollar denoted by *Ft* and multiply it by $\boldsymbol{P_t^*}$ **/P$_t$** where ***P**** and **P$_t$** represent consumer price indexes for United States and Ghana, respectively. These steps give the RER (*qt*) for period *t* as:

$RER_t = F_t P_t^* / P_t$ .....equation 2.2

The former is applied where the calculation of the real exchange rate involves only two countries, while the multilateral is used when the calculation of the real exchange rate involves the currency of the country in question and usually those of its major trading partners.

There are also concepts of nominal effective exchange rates (NEER) and real effective exchange rates (REER). Historically, the concept of NEER was introduced by Hirsch and Higgins (1970). The NEER index is a multilateral rather than bilateral and can also be defined as a weighted average of a basket of currencies over time, deriving from nominal exchange rate movements. It shows the effects of exchange rate movements relative to a selected basket of currencies in a given base period. The concept of real effective exchange rate (REER) goes beyond finding the weighted average of currencies to include differences in inflation rates between countries. In other words, it incorporates both the concepts of NEER changes and inflation differentials, with the main aim of deflating the exchange rate indices by corresponding indices of relative prices. Deflating the NEER has a silent benefit under conditions of worldwide inflation at nationally different rates. The REER is thus the NEER of a currency adjusted for inflation differentials between the home country and other nations to be included in calculating the index. As is the case with the NEER, the REER is multilateral, the exchange rate of a currency in relation to a basket of other currencies, rather than bilateral (Takaendesa, 2006).

Most studies that have looked at the real exchange rate have used the notion of real effective (multilateral) rather than real effective bilateral exchange rate Korsu and Braimah (2005).

The real effective exchange rate therefore can be computed as follows:

REER= $\sum_{i=1}^{i=n} Si\ (\frac{ei\ CPIi*}{CPI})$..... equation 2.3

Where:

REER = real effective exchange rate

i = number of major export partners of Ghana

*S*i = the weight of country i in the total export of Ghana

CPI*i = the consumer price index of country *i*

CPI= Consumer price index in Ghana

There are also other various measures of the real effective exchange rate.

2.2.2 The Purchasing Power Parity (PPP)

According to Korsu and Braimah (2005) a strand of the literature on real exchange rate is the case of the developed economies. This strand uses the purchasing power parity (PPP) or the macroeconomic balance approach to determine the equilibrium real exchange rate and hence the degree of real exchange rate misalignment without paying attention to the determinants of the real exchange rate. Hence, the focus of this strand is mainly the determination of the degree of misalignment of the real exchange rate rather than the determinants of the real exchange rate. Another strand in the literature is the case of developing countries. This was pioneered by Edwards (1988, 1989) and later by Rodriquez (1989), Elbadawi (1994) and Montiel (1997).

Thus there are two research agendas dealing with the analysis of the real exchange rate, its determinants, and the effects of its misalignment. The first is based on the purchasing power

parity or PPP hypothesis, while the second focuses on behavioral and fundamental models and connecting the RER to a set of determining variables or fundamentals (Elbadawi (1994). Let us now take a brief look at some of these models and theories.

Being the first approach in the literature, it was formulated for the first time by Cassel (1918) who defined the theoretical nominal exchange rate as a report between national and foreign prices: $E^{PPP} = P/P^*$. But the market value of the exchange rate could present deviations from the former value, deviations which are considered as over-or under valuations of the national currency. By this, the real exchange rate according to the PPP theory is the report between the market and theoretical value of the national currency expressed in other currency: $Q = E/E^{PPP}$. Therefore, a real exchange rate higher than one reflects the under-valuation of the national currency, while it is less than one it can be said that the national currency is over-valued. Formulating the theory of PPP, Cassel (1918) used a number of hypotheses which should be fulfilled in order that the theory could be valid.

This theory is based on the law of one price which supposes that a given good costs the same in two different countries when the price is expressed in the same currency. Thus, the international arbitrage mechanism should work, perfect competition must prevail both in home and foreign markets, capital movements and trade should be free without any barrier (taxes) or restriction. Taking into account the above mentioned hypothesis, there are a number of reasons why the PPP might be wrong and misleading indicator for equilibrium exchange rate, especially in developing economies. First of all, there are significant differences between the compositions of the price basket because of the fact that consumers' preferences and the structure of the manufacture production differ from one country to another. Secondly, if the perfect competition is not working (the costs of transportation are different), the LOOP does not hold. This problem is present especially in the case of

developing countries where governments control the level of regulated prices, subsidies certain categories of services, like public transportation, telecommunication and others. Consequently, the price of non-tradable goods in developing countries will be lower than that in developed countries (Cassel (1918)).

The PPP hypothesis shows that in equilibrium foreign and domestic currencies should have the same purchasing power. Given a basket of goods, this definition gives an easy-to-calculate benchmark for the equilibrium RER. The empirical evidence, however, ends up rejecting PPP-based models in both developed and developing economies because they fail to explain continues deviations of the real exchange rate from the PPP benchmark (Mussa, 1986) and/or because the rate of convergence to equilibrium is too slow to be compatible with the PPP hypothesis, even if one is to allow for plausible nominal rigidities (Rogoff, 1996). However, even if one is willing to use such long-horizon benchmark, it should be acknowledged that PPP-based models are unlikely to provide an adequate description neither of the causes of the RER fluctuations nor of its fluctuations (Elbadawi, 1994).

2.2.3 The Balassa Samuelson Approach or Effect

Balassa (1964) and Samuelson (1964) were the first who proved that the PPP approach is not compulsory in practice. They considered economy split into two sectors tradable and non-tradable. Also, they supposed that: demand and supply are at work in both sectors; wages are linked to the level of productivity in the open sector; tradable prices are equals in each country, so PPP holds in this the open sector; while the increase of labour productivity is higher in the tradable sector than in the non-tradable sector; wages tend to equalize between sectors. Next, they considered the developing country having lower productivity level in the open sector than the developed country. Considering the above mentioned hypothesis, if the home country is in a catching-up process with the developed economy,

productivity tends to increase in the open sector, so there is a possibility of wage increase in tradable sector without any inflationary effect. But, due to the wage equalization assumption between sectors, the productivity gain in the open sector will create inflationary pressures in the non-market based sector. In this way, the overall price level will rise faster in the home country (creating a positive inflation differential vis-à-vis the foreign country) than in the foreign country because of the positive productivity differential between sectors in the home country, which in turn will result to a real appreciation of the home country's real exchange rate. This phenomenon is known in literature as the Balassa-Samuleson effect to which the trend appreciation of the real exchange rate in the developing countries can be attributed.

2.2.4 Other real exchange rate models

A consensus has formed that the long-run equilibrium RER is subject to the influence of a relatively wide range of time-varying exogenous and policy fundamentals. In this strand of the literature, the equilibrium RER is defined as the relative price of traded to non-traded a goods that is in line with internal and external balance. Despite the simplicity of this concept, its practical implementation gives a number of different methodological approaches (Elbadawi, 1994).

Following Clark and MacDonald (1999), and (Elbadawi, 1994) we distinguish between two broad classes of models: the fundamental equilibrium RER (FEER) and the behavioral equilibrium RER (BEER).

2.2.5 The Fundamental and Behavioral Equilibrium Real Exchange Rate Models

The FEER concept was originally proposed by Williamson (1985) and extended, among others, by Isard and Faruqee (1998). In the FEER approach, internal and external balances

are usually defined as those compatible with ideal conditions determined by the econometrician. Thus, the equilibrium exchange rate is derived as a function of what the researcher thinks is the optimum internal balance (e.g., the non-accelerating inflation-rate unemployment) and the sustainable external flows (usually projected or assumed to obtain in the medium-to-longer run). Because these conditions are imposed ex-ante, and may not exist in the future, the FEER corresponds to a normative idea of equilibrium RER (Elbadawi, 1994)

According to Williamson (1994), FEER is a real effective exchange rate which ensures the external and internal balance at the same time for more than two countries. The internal equilibrium is characterized not only by an output which is equal to its potential level (the economy produces the maximum level of output), but also by the Non-Accelerating Inflation Rate of Unemployment. This approach allows the researcher to reflect the effect of other factors on the real exchange rate than the productivity differential as it appears in the Balassa-Samuelson framework. Furthermore, the real interest rate differential, fiscal policy, determinants of savings and investments are potential determinants of the level of real exchange rate. Considering all the features of the above mentioned approach, one can confidently say that Balassa-Samuelson framework seems to be the most realistic one, but at the same time the most challenging framework to implement in practice because it supposes a great amount of work, high statistical and data availability for a long period of time. There are a few numbers of studies implementing FEER approach owing to it challenging nature in the case of CEECs countries (Smidkova et al., 2002).

BEER models, on the other hand, consider short-term flow variables as well as factors influencing long-run stock equilibria (Edwards, 1989). The approach is intertemporal as the

equilibrium is assumed to be influenced not only by the current value of the fundamentals, but also by anticipations regarding the future evolution of these variables. Elbadawi (1994) develops a methodology in the context of a cointegrating-error correction time-series model that (1) computes the equilibrium RER as a forward-looking function of the fundamentals; (2) allows for flexible dynamic adjustments toward equilibrium; and (3) allows the identification of the influence of macroeconomic policies on the equilibrium RER. The empirical application of BEER models is subject to problems, as noted by Edwards and Savastano (2000). In particular, the lack of a general equilibrium connection between the equilibrium RER and the current account position, and the frequent disconnect between the econometric specification and the analytical model. Consequently, the interpretation of the results is debatable and policy evaluation is not always rigorous (Elbadawi, 1994).

In addition, the FEER and the BEER MacDonald and Clark (2000) propose a new approach, known in the literature as Permanent Equilibrium Exchange Rate (PEER), which is a derivative of the BEER approach using new statistical tool. The only difference between the BEER and PEER approaches is the econometric tools used to estimate the equilibrium exchange rate.

Another approach is the Natural Rate of Exchange (NATREX) by Stein (1995). This approach gives the differences between a medium and a long term equilibrium exchange rate. The medium term rate is defined similarly to the FEER approach. In addition to that a system of interlinked equations also includes the capital stock and the stock of foreign debt. For the medium term the current values are assumed while for the long term steady state levels are calculated.

2.2.6 Determinants of the Real Exchange Rate

Kempa (2005) agreed that, it is very challenging to compile theoretical literature on exchange rate determination, since there is no generally accepted exchange rate model one could resort to. Moreover, many of the studies on this subject avoid the theoretical issues on the determination of the real exchange rate.

Mundell (1971) provided an early formal analysis of the determination of the equilibrium real exchange rate, using a macroeconomic model of a monetary economy. Mundell's model assumed a small, open monetary economy that faces given prices (no influence over terms of trade) and defined the equilibrium real exchange rate as the relative price of international to domestic goods that equilibrates the money market. The problem with Mundell's model and the other models mentioned above, with the exception of the "fundamentals" models, is that they do not allow for a distinction to be drawn between the effects of short run and long run changes in the determinants of the real exchange rate (Takaendesa 2006).

Literature has shown that the two most used model used for empirical analysis of the determinants of the real exchange rate are the Inter Temporal Optimizing Model by Edwards (1989). Rodriquez (1989), Elbadawi (1994) and others adopted the Edwards model and applied them to some countries. The second model is the analytical model on the Determinants of the long-run equilibrium real exchange rate by Montiel (1999).

Takaendesa (2006) argues that, the Montiel's (1999) model is an extension to Edwards' model and is based on the idea that the real exchange rate is an endogenous variable. In this model, the economy's endogenous variables are determined by three types of variables:

i. Predetermined variables

ii. Exogenous policy variables

iii. Other exogenous variables

Predetermined variables are endogenous variables that change slowly over time, for instance economy's capital stock, technology, net international creditor position and nominal wage. Exogenous policy variables include fiscal and monetary policies, trade policies and other variables under the control of the domestic authorities. Other exogenous variables include observable variables, such as the terms of trade, world interest rates etc., unobservable variables (random shocks) and bubble variables. Bubble variables are those that affect the economy only through their influence on sentiment (Takaendesa 2006).

Thus from the two models above, the variables that affect the real exchange rate include the Balassa-Samuelson effect, changes in the value of international transfers, changes in international financial situations, changes in commercial policy, the terms of trade, changes in fiscal and monetary policy, changes in foreign exchange reserves and changes in nominal exchange rate policy.

Considering the relationship between the real exchange rate and these factors, theory indicates that with regards to the balassa-samuelson effect an increase in differential productivity growth in the tradable goods sector creates an appreciation of the real exchange rate whiles a decrease in the differential productivity growth in the tradable sector result to a depreciation of the real exchange rate (Edwards, 1994, MacDonald, 1998). Concerning international transfers Edwards (1994) and Montiel (1999) agrees that an increase in capital inflows permits an expansion of absorption and consequently an appreciation of the real exchange rate and a decrease in capital inflows consequently leads to a depreciation of the real exchange rate.

Concerning the changes in international financial conditions, Montiel (199) argues that it is caused by the differences in the real interest rate between countries and hence if the real

interest rate differential increases, has the real exchange rate will appreciate and vice versa irrespective of the channel chosen to trace their transmission.

Openness as a determinant of real exchange rate, Models of ERER determination assigns a critical role to the effects of import and export taxes. Permanently higher levels of these taxes (i.e., reducing the openness of the economy) lead to ERER appreciation. This occurs because future consumption becomes more expensive. In response, people tend to favour current consumption; as the demand for all goods increase, the price of nontradables rises, so the ERER appreciates. In applied work it is very difficult to obtain a sufficiently long time series of import and export taxes. Consequently, these are proxied by the ratio of exports plus imports to GDP. An increase in this ratio reflects an increase in the openness of the economy to international trade, presumably caused by a reduction in trade taxes (both explicit and implicit).

Fiscal policy constitutes the last group of basic factors which is considered in the present paper. It can be quantified by different fiscal policy indicators such as the ratio between budget deficit and GDP, the final consumption expenditure of general government normalized by real GDP. Generally, the relationship between the real exchange rate and the above mentioned fiscal indicators is positive; respectively an increase of the government's expenditures or a decrease of taxation (expanding budget deficit) will generate inflation pressures, depreciating the national currency. But also, there may be specific structural problems, particularly in the case of transition economies, which change the sign of correlation (Égert, 2005).

Also Commercial or trade policy is another variable that affects the real exchange in both Edwards' and Montiel's models. An increase, for example, in an import tariff can increase the domestic price of imports, which are part of tradable goods. The increased demand for foreign currency, following an increase in the domestic price of imports, also appreciates the real exchange rate. An increase in export subsidies also creates a balance of payments surplus which requires an appreciation of the real exchange rate to correct. Thus, a more open economy is likely to be associated with a more depreciated real exchange rate and a closed economy is expected to experience an appreciation in its real exchange rate (Takaendesa, 2006)

Concerning the Terms of trade (TOT) defined as the ratio between the export unit value and the import unit value or by dividing the export deflator by the import deflator. The sign of correlation with the real exchange rate depends on the price elasticity of import and exports. An increase in terms of trade, if exports and imports have low price elasticity, can influence the structure of the domestic manufacture, stimulating the increase of the tradable sector and generating an excess demand in the non-tradable sector, respectively rising export revenues and appreciating the nominal and thus the real exchange rate. Otherwise, when export and imports are price sensitive the impact may be negative.

2.3 Empirical Review

Various studies have been done on the real exchange rates both in developing and developed economies. This section therefore tries to review empirical works done on the real exchange rate, its determinants and the relationship between the real exchange rate and other macro-economic variables. Let us take a look at some of these studies

According to Korsah and Braimah(2005), the real exchange rate measures the competitiveness of an economy to international trade. In Sierra Leone, the nominal

exchange rate has been depreciating since the early 1970s as a result of either official intervention, during the fixed exchange rate regime, or a combination of official intervention and market forces, during the managed floating exchange rate regime. Previous studies on the determinants of real exchange rate in developing countries captured the effects of nominal exchange rate on the real exchange rate without capturing the effects of price changes. This paper therefore investigates the determinants of the real exchange rate for Sierra Leone by controlling also for the effects of price changes, using annual aggregate data from 1970 to 2005. The estimated model is based on the inter-temporal optimizing framework of Edwards (1989). Unit root and cointegration tests are carried out and an error correction model of the actual real exchange rate model is estimated in the context of Hendry's general-to-specific modeling while the equilibrium real exchange rate is estimated using the Johansen Maximum Likelihood procedure. The results show that increases in the price level, capital inflow, capital accumulation and trade restrictions appreciate the actual real exchange rate of Sierra Leone while increases in the nominal exchange rate and output depreciate it. Improvement in the terms-of-trade and an increase in capital-inflow depreciate the equilibrium real exchange rate while capital accumulation, increase in output, increase in government expenditure and trade restrictions appreciate the equilibrium real exchange rate. Hence, for a real depreciation to be sustained, policy makers should strengthen efforts to control the rate of inflation and concentrate revenue from capital inflow on investment in the tradable goods sector. Moreover, increased trade liberalization and use of supply-side policies to increase output are important for realizing real depreciation of the real exchange rate of Sierra Leone.

Also, in 2011, Appiah and Adetunde did a work on monthly exchange rate between the Ghana Cedi and the US Dollar and forecast future rates using time series analysis. ARIMA

model was developed using Box and Jenkins method of Time Series Analysis on the monthly data collected from January, 1994 to December 2010 and validated. The result showed that the predicted rates were consistent with the depreciating trend of the observed series. ARIMA (1,1,1) model was found as the most suitable model with least Normalised Bayesian Information Criterion (BIC) of 9.111, Mean Absolute Percentage Error (MAPE) of 0.915, Root Mean Square Error of 93.873 and high value of R- Square of 1.000. Estimation was done by Ljung-Box test, with (Q 18) = 15.146, 16 DF and p-value of 0.514 with no autocorrelation between residuals at different lag times. Finally, a forecast for two-year period from January, 2011 to December, 2012 was calculated which showed a depreciating of the Ghana Cedi against the US Dollar.

Again, a thesis by Osei-Assibey (2010) analyzed the nature of exchange rate behaviour in three LDCs: Ghana, Mozambique and Tanzania. They examine whether exchange rate behaviour in these three countries are influenced by similar factors. The results suggested that exchange rate behaviour in these countries is generally influenced by similar factors. In particular, the series exhibit the empirical regularities found in other exchange rate/financial markets, justifying the application of the ARCH methodology which they use to estimate the volatility of exchange rate in these countries.

In addition, Iossifov and Elena, July (2007), estimated a behavioral equilibrium exchange rate model for Ghana. Regression results show that most of the REER's long-run behaviour can be explained by real GDP growth, real interest rate differentials (both relative to trading-partner countries), and the real world prices of Ghana's main export commodities. On the basis of these fundamentals, the REER in late 2006 was found to be very close to its

estimated equilibrium level. The results also suggest that deviations from the equilibrium path are eliminated within two to three years.

Moreover, according to Takaendesa, 2006, Real exchange rates have important effects on production, employment and trade, so it is crucial to understand the factors responsible for their variations. This study analyses the main determinants of the real exchange rate and the dynamic adjustment of the real exchange rate following shocks to those determinants, using quarterly South African data covering the period 1975 to 2005. The study augments the cointegration and vector autoregression (VAR) analysis with impulse response and variance decomposition analyses to provide robust long run effects and short run dynamic effects on the real exchange rate. The variables that have been found to have a long run relationship with the real exchange rate include the terms of trade, real interest rate differential, domestic credit, openness and technological progress. The estimate of the speed of adjustment coefficient found in this study indicates that about a third of the variation in the real exchange rate from its equilibrium level is corrected within a quarter.

In 2004, Zakari and Afriyie, used a simple monetary model of exchange rate determination for Ghana and employed the technique of co-integration analysis to empirically investigate the principal factors driving the Cedi/Dollar rate of exchange since the adoption of floating exchange rate regime in the country. We augment the basic model with political variables to examine any potential impact on the exchange rate. The empirical results corroborate the model, with the effect that macroeconomic fundamentals play an important role in the cedi-dollar rate dynamics. Similarly speculation based on recent past behaviour of the Cedi/Dollar (to extrapolate the future behaviour of the rate) is crucial and this has been linked largely to underdevelopment of the financial system and the exchange rates market.

However, while our political variable is correctly signed, it is not significant at conventional levels of significance. Finally, we examined the effectiveness of Bank of Ghana intervention (as measured by non-oil forex sales) on the value of the cedi.

In furtherance, Bawumia and Otoo (2003) explored the relationship between monetary growth, exchange rates and inflation in Ghana using an error correction mechanism. The empirical result confirms the existence of a long-run equilibrium relationship between inflation, money supply, the exchange rate, and real income. In line with theory, the findings demonstrate that in the long-run, inflation in Ghana is positively related to the money supply and the exchange rate, while it is negatively related to real income. The empirical deductions from the study also show that inflation adjusts to its equilibrium value fairly rapidly. In addition, the impact of the exchange rate on inflation is transmitted with a one month lag, while the effect of real income and money on inflation takes place with a 2 and 4- month lag, respectively.

MacDonald and Ricci ,2003, also estimated the equilibrium real exchange rate for South Africa using the Johansen cointegration estimation procedure and data spanning from 1970: – 2002. The explanatory variables included in their model included real interest rate differential, real GDP *per capita* relative to trading partners (productivity), real commodity prices, openness, the ratio of fiscal balance to GDP and the ratio of net foreign assets of the banking system to GDP. Based on their cointegration estimation results, much of the long run behaviour of the real effective exchange rate of South Africa can be explained by real interest rate differentials, relative GDP *per capita* (productivity), real commodity prices (terms of trade), trade openness, the fiscal balance and the extent of net foreign assets. As in other empirical studies, they find that an increase in the real interest rate differential,

productivity, terms of trade, fiscal balance and net foreign assets appreciate the real exchange rate in South Africa.

Mkenda in 2001 analysed the main determinants of the real exchange rate in Zambia. The study presents an illustrative model based on the three-good production structure and employs cointegration analysis in estimating the long run determinants of the real exchange rates for imports and exports, and of the internal real exchange rate. The results of this study provide evidence that (i) a decline in the terms of trade and government consumption depreciates the real exchange rate for imports, while an increase in investment share of GDP appreciates the real exchange rate for imports; (ii) a decrease in the terms of trade, an increase in central bank reserves and trade taxes appreciate the real exchange rate for exports in the long run; (iii) in the long 64 run, the internal real exchange rate is strengthened by a decrease in the terms of trade, an increase in investment share and the rate of growth of real

GDP (a proxy for technological progress); (iv) in the short run, however, aid and openness depreciate the real exchange rate indices.

MacDonald in 1998 presented a reduced form model of the real exchange rate to re-examine the determinants of real exchange rates in a long run setting. His model features productivity differentials, terms of trade effects, fiscal balances, net foreign assets and real interest rate differentials as key fundamental determinants of the real exchange rate. Using multivariate cointegration methods, the model is implemented for the real effective exchange rates of the U.S. dollar, Yen and the Deutschmark, over the period 1974 to 1993. He finds evidence of a significant and sensible long run relationship for his model, indicating that the fundamentals mentioned above have an important and significant bearing on the determination of both

long and short run real exchange rates. All the variables were found to have a positive relationship with the real exchange rate; an increase in any of them leads to an appreciation of the real exchange rate.

Among the numerous empirical results, Elbadawi in 1994 concluded that a greater abundance of natural resources relative to human capital stocks –which make non-traded goods relatively more expensive than resource-based exports— affects significantly the equilibrium RER. Likewise, our econometric results indicate that labor productivity growth in the non-traded had been at the core of the different observed trajectories of the RER in African and Latin American countries vis-a-vis Asian economies. High, sustained productivity gains in Asian economies have induced a significant long-term depreciation of the RER, a feature that is completely absent in other developing economies. Finally, we find that the equilibrium-consistent current account appears to be quite important. Observed shocks (of size one-standard deviation) would induce wide swings in the equilibrium RER of around 15%, indicating the need for market flexibility to avoid paying high adjustment costs.

Edwards (1989) built a theoretical model for developing countries to explain the short and long run determinants of the real exchange rate. He applied the model to a number of twelve countries observed over the period 1962 and 1985 by using fixed effect model. His sample includes Brazil, Columbia, Elsavador, Greece, India, Israel, Malaysia, Philippines, South Africa, Srilanka, Thailand and Yugoslavia. His finding is consistent with his theoretical prescription that in the short run both real and nominal variables affect the real exchange rate while in the long run only real variables affect the real exchange. His finding showed that the long-run determinants of the real exchange rate are the terms of trade, level and

composition of government consumption, controls on capital flows, exchange and trade controls, technological progress and capital accumulation. His study reveals that in the short run both the nominal exchange rate and domestic credit as well as the real variables that determine the long run real exchange rate are the determinants of the real exchange rate. The coefficient of terms of trade was found to be negative, the coefficient of the ratio of government expenditure to GDP was found to be negative, the coefficient of exchange and trade controls (proxied by parallel market premium) was found to be negative, the coefficients of technological progress (proxied by output growth) was found to be positive (contradicting the Ricardo-Balassa hypothesis), the coefficient of capital flow (lagged) was found to be negative and the coefficient of capital accumulation (measured as investment-GDP ratio) was found to be positive. He also found that in the short run nominal exchange rate depreciation leads to a depreciation of the real exchange rate while an increase in domestic credit leads to an appreciation of the real exchange rate.

The review of the empirical literature on the determinants of the real exchange rate reveals that while much has been done on developing countries, the authors are not aware of studies on Ghana. Moreover, most of the literatures read, in their model specifications they did not include an election year influence as variable to determining real exchange rate. This study departs from previous studies on the determinants of the real exchange rate by accounting for the direct effects of the election year on the real exchange rate in Ghana. The study Employs a single equation approach and using a combination of both the traditional OLS and the ECM technique to determine the long run and short run RER respectively, using most recent available data to capture the current dynamics in the model. Finally instead of the use of Vector autoregressive model (VAR) as used by many of the literatures reviewed, this steady would employ the ARDL cointegration approach which has gained much ground in recent econometric time series analysis.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter focused on the conceptual framework of the model specified for the study. It consists of five sections. Section one provides the type and sources of data used for the study. The second section focused on the specification of the model used for the study. The third examines the time series properties of the data as well as the empirical strategy used to estimate the model specified .The fourth section looks at the modified model of the Edwards model. Section five discusses how the variables used for the study were defined and measured.

3.1 Data Type and Sources

The study used annual time series data for the period 1980 – 2010 obtained from published sources. The major sources of data included World Bank's World Development Indicators, 2011 CD-ROM, IMF International Financial Statistics, 2011, African Development Indicators, WTO Trade Statistics. Other sources included annual reports of Bank of Ghana 2011, State of the Ghanaian Economy (various issues) by Institute of Statistical, Social and Economic Research (ISSER). All estimations as well as the various econometric tests were carried out using the Microfit 5.01 and E-Views econometric software.

3.2 Model Specification

In this section the adopted model is Edwards'(1989) model of intertemporal optimizing model which is used to determine real exchange rate in Ghana. Unlike other theoretical

models, this model differentiates factors that determine the equilibrium real exchange rate in the long run from those that determine the short-run dynamics of the real exchange rate.

In addition, this model is developed to capture the structure of a typical developing economy. The model has been used to estimate real exchange rate models in many developing economies (for example, Mungule (2004) used it for Zambia and Ghura and Grennes (1993) used it for sub-Sahara Africa (SSA).

The model is represented by the following equation:

RER = e* = x (a, gNT, PT and τ)…… (1)

Where $\delta x/\delta a<0$; $\delta x/\delta gNT<0$; $\delta x/\delta PT>0$; $\delta x/\delta \tau<0$

Equation (1) states that the long run RER is a function of real variables only. The value of real assets, government consumption, price of tradables and trade restrictions. The variables in this equation are normally influenced by changes in other real variables such as terms of trade (TOT) shocks, technological progress, and changes in trade and capital restrictions. Changes in these variables can cause RER to deviate from its equilibrium level.

In estimating the determinants of the real exchange rate, it is necessary to specify an empirical equation for the real exchange rate. Based on the theoretical model developed in equation (1), the real exchange rate is exclusively determined by the following real variables: international terms of trade, trade restrictions, and technological progress and productivity gain and Capital accumulation. Capturing the above-mentioned determinants, a model of real exchange rate was formulated in the following equation

E^{*}=f (TOT, OPENNESS, YG, IGDP) ---------- (2)

The following notations have been used in equation (2): E* is the real exchange rate; TOT is the barter terms of trade, defined as Px*/Pm*; OPEN = (X + M)/Y is the trade restrictions substituted by the openness of an economy; Yg is the measure of technological progress and IGDP is investment as a ratio of GDP (proxy for capital accumulation)

3.3 Modifying the Model to Include a Political Variable

Since political events may also systematically affect the real exchange rate, the standard model is extended to incorporate political factor in order to investigate any impact political developments may have on the real exchange rate. In general, election year is a political variable which is a proxy for the reckless management of the economy due to up-coming elections (Blomberg and Hess, 1997).

Election (POL) year factor, in this study has a dummy variable (POL) thus 1=election year, 0=not an election year.

Substituting equation (3) into equation (2) yields:

$RER_t = h\ (TOT_t, OPENNESS_t, YG_t, INGP_t, POL_t)$ ----------(3)

The modified empirical model explaining the determinants of the real exchange rate in a typical Ghanaian set up therefore can be expressed as follows:

$Lnet = \theta_0 + \theta_1\ (TOT)t + \theta_2\ Ln(OPEN)t + \theta_3\ (Yg)t + \theta_4\ Ln(IGDP)t + \theta_5 P0L(Dummy)_t + U_1t$ ..... (4)

$0_1 >/< 0$, $\theta_2 < 0$, $\theta_3 >/< 0$, $\theta_4 >/< 0$, and $\theta_5 >/< 0$

Where;

POL is the Political year, the θ_i represent the elasticity coefficients and where μ_t is the error term.

An improvement in the TOT can result in either real depreciation or real appreciation. Since a resource boom can be realised by an increase in the TOT.

Increased openness in international trade policy tends to cause depreciation of the RER if it worsens the current account by increasing the demand for imports and reducing the demand for and price of nontradables. Moreover, if openness in the trade regime brings more competition in the tradable sector by reducing the domestic price of tradables in line with the world price level, a real depreciation will occur. Improvement in international trade policies may appreciate the RER, however, it improves the trade account by reducing import bills and increasing the demand for and price of nontradables.

The growth rate of real Gross Domestic Product is normally used in empirical studies to proxy technological progress (Edwards, 1989). Ricardo is said to have been the first one to postulate a negative relationship between economic growth and the relative price of tradable to non-tradable goods. Other authors also pointed out the tendency for the relative price of tradables to non-tradables to decline over time. For example, Balassa indicated that the rate of productivity growth is higher in countries with higher rates of growth, and that within these countries; the productivity gains are higher in the tradable sector (Edwards, 1989).

Edwards (1989) formally incorporated the effect of technological progress in his model. According to his model, the effect of technological progress on the real exchange rate depended on two things; how technological progress affected different sectors and the type

of progress considered, whether product augmenting or factor augmenting (Edwards, 1989:48). If any productivity shock occurred, it would have a positive income effect, which would in turn generate a positive demand pressure on non-tradable goods. The increased demand would increase the price of non-tradables, and hence lead to an appreciation in the real exchange rate.

However, technological progress could also depreciate the real exchange rate. This could happen if technological progress resulted in supply effects and if these more than offset the demand effects. The implication is that technological progress could appreciate or depreciate the real exchange rate. Edwards (1989) found that an increase in technological progress depreciated the real exchange rate in all his regressions. Aron *et al* (1997), on the other hand, found that an increase in technological progress appreciated South Africa's real exchange rate.

Investment as percentage of GDP's effect on the real exchange rate depends on whether an increase in investment changes the composition of spending on traded and non-traded goods.

If an increase in the share of investment in *GDP* changes the composition of spending towards traded goods, it would lead to depreciation in the real exchange rate (Baffes *et al*, 1999; Edwards, 1989). On the other hand, a change towards nontraded goods appreciates the real exchange rate.

3.4 Empirical Methodology

3.4.1 Augmented Dickey-Fuller (ADF) Test

Most macroeconomic time series tend to display an upward trend over time leading to the question of differencing in conferring of stationary properties to the variable. The idea of a

common trend in time series data has motivated the concept of cointegration developed by Engle and Granger (1987). The standard practice in cointegration analysis is to examine the time series properties of the data. This begins with the determination of the univariate properties of the time series.

In time series literature unit root tests like the Dicky Fuller (DF) test is widely used for testing stationarity (non-stationarity) in economic data. If the variables are found to be non-stationary at the levels and they are determined to be stationary in their first-differences, they are said to be integrated of order one, I (1). For this reason, the Augmented Dickey-Fuller (ADF) test is used to test the stationary status of the variables used in this study. The presence of unit root in the series indicates that the variable is non-stationary, hence the degree or order of integration is one or higher. The absence of unit root however, implies that the variables are stationary and the order of integration is I (0).

3.4.2 Co-integration Tests

In practice, economic time series variable are mostly non-stationary and thus renders OLS regression ineffective. To avoid the problem of spurious regression associated with non-stationary variables, researchers often resort to co-integration analysis. Co-integration implies that though individual series may not be stationary, their linear combinations with other variables may yield stationarity. That is to say that co-integration exists between non-stationary variables if the residuals of the co-integrating regression are stationary (Granger, 1986; Hendry, 1986). Thus, spuriousness can only be avoided if a stationary co-integrating relationship is established between the variables.

A plethora of econometric techniques for investigating co-integration relationships among macroeconomic variables are documented in econometric literature. Regarding univariate co-integration technique, Engle-Granger (1987) and the Fully Modified Ordinary Least

Squares (FMOLS) procedures of Phillips and Hansen (1990) are some of the examples. For multivariate co-integration techniques, mention can be made of Johansen (1988); Johansen & Juselius (1990); and Johansen's (1995) co-integration technique that has provided full information for the maximum likelihood co-integration approach. Despite the aforementioned co-integration techniques, this study adopts the autoregressive distributed lag (ARDL) approach proposed by (Pesaran and Shin, 1995; Pesaran *et al*., 2001) to examine the co-integration relationship between real exchange rate, terms of trade and other variables in Ghana. The choice of this co-integration technique is informed by its suitability for the underlying data for the study. Besides, more recent studies have recommended the ARDL approach to co-integration as against the other conventional co-integration approaches such as Engle-Granger (1987).

In particular, the choice of the bounds test approach for this study is based on the following reasons. First, unlike most of the conventional multivariate co-integration procedures which are valid for large sample size, the bounds test is more robust and performs better for small sample size (such as in this study with only 30 observations). Second, contrary to other co-integration techniques, the ARDL does not require all the regressors to be integrated of the same order. In other words, the ARDL is applicable irrespective of whether the underlying regressors are purely $I(1)$, and $I(0)$, i.e. Whether the regressors are all unit roots or all stationary or fractionally integrated. This implies that using this econometric technique avoids the burden of pre-testing of variables for unit roots (Pesaran *et al*, 2001). Another difficulty of standard cointegration technique which the ARDL avoids has to do with large number of choices which must be made. These include decisions regarding the number of endogenous and exogenous variables (if any) to be included, the treatment of deterministic elements, as well as the order of Vector Auto Regression (VAR) and the optimal number of lags to be specified. The empirical results are generally very sensitive to the method and

various alternative choices available in the estimation procedure (Pesaran *et al*, 2001). Furthermore, with the ARDL, it is possible for different variables to have differing optimal number of lags; while in Johansen-type model this is not possible. Moreover, the ARDL approach addresses the endogeneity problem and inability to test hypothesis on the estimated coefficients in the long run associated with the Engle-Granger methodology. Thus, since most of the macroeconomics variables are endogenous in the real exchange rate model, the adoption of the ARDL approach for this study is quite appropriate. Following Pesaran *et al* (2001) as summarized in Choong *et al* (2005), the ARDL is applied by modelling the long-run equation (4) as a general vector autoregressive (VAR) model of order p in z_t.

3.4.2.1 Theoretical Framework of the ARDL Co-integration

In line with Choong *et al.,* (2005) and Oteng-Abayie and Frimpong (2006), the ARDL approach to co-integration as derived by Pesaran, *et al.,* (2001) is applied in this study by modeling equation (3) as a general vector autoregressive (VAR) model of order p, in z_t:

$$z_t = c_0 + \beta t + \sum_{t-1}^{p} \phi_i z_{t-i} + \varepsilon_t,\ \text{t =1,2,.........,T} \quad \text{...(5)}$$

where c_o stands for a *(k+1)*-vector of intercepts and β denoting a *(k+1)*-vector of trend coefficients. Corresponding to equation (15), Pesaran *et al.*, (2001) further derived a vector error correction model (VECM) as follows;

$$\Delta z_t = c_0 + \beta t + \Pi z_{t-1} + \sum_{t-1}^{p} \Gamma_i \Delta z_{t-i} + \varepsilon_t,\ \text{t =1,2,...............,T} \quad \text{.......................................(6)}$$

Where the *(k+1)*x*(k+1)*-matrices $\Pi = I_{k+1} + \sum_{i=1}^{p} \Psi_i$ and $\Gamma_i = -\sum_{j=i+1}^{p} \Psi_j$, i=1,2,....,p-1 capture the long-run multipliers and short-run dynamic coefficients of the VECM. z_t represents the

vector of variables y_t and x_t respectively. Specifically, y_t represents the dependent variable with a unit root, and defined as $\ln RER_t$, whilst x_t is a vector matrix of *I(0)* and *I(1)* explanatory variables namely, TOT_t, $1nOPEN_t$, Yg_t, $1nIGDP_t$,POL_t,) . $\varepsilon_t = \left(\varepsilon_{1t}, \varepsilon'_{2t}\right)'$, is a vector of residuals with zero mean and a homoscedastic process. Assuming further that here is unique long run relationship among the variable the conditional VECM becomes:

$$\Delta y_t = c_{yo} + \beta t + \delta_{yy} y_{t-1} + \delta_{xx} x_{t-1} + \sum_{i=1}^{p-1} \lambda_t \Delta y_{t-1} + \sum_{i=0}^{p-1} \xi_i \Delta x_{t-1} + \varepsilon_{yt}, \quad t=1,2,.....,T \quad .....(7)$$

Now equation (8) provides the framework for the specification of appropriate conditional VECM for this study as follows;

$$\Delta \ln RER_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta \ln RER_{t-i} + \sum_{i=0}^{q} \rho_i \Delta TOT_{t-i} + \sum_{i=0}^{r} \lambda_i \Delta \ln OPEN_{t-i} + \sum_{i=0}^{u} \mu_i \Delta Yg_{t-i}$$
$$+ \sum_{i=0}^{v} \theta_i \Delta \ln IGDP_{t-i} + \sum_{i=0}^{X} \eta_i \Delta POL(Dummy)_{t-i} + \varpi_1 \ln RER_{t-1} + \varpi_2 TOT_{t-1} + \varpi_3 \ln OPEN_{t-1}$$
$$+ \varpi_4 Yg_{t-1} + \varpi_5 \ln IGDP_{t-1} + \varpi_6 POL(Dummy)_{t-1} + U_t .....(8)$$

Where all variables are as previously defined. The terms with summation signs in equation (7) with parameters $\beta, \rho, \lambda, \delta, \mu, \theta, \gamma$ and η, represents the short run dynamics of the model whereas the second part with ϖ_s represents the long run relationship, α_0 is the drift component and U_t is white noise error.

3.4.2.2 ARDL Co-integration Procedure

Basically, the ARDL procedure involves three steps for estimating long run relationship (Pesaran *et al.*, 2001). The first step is to investigate the existence of a level relationship among all the variables in the equation. This is done by estimating equation (8) by ordinary

least square and performing F-test for joint significance of the associated lagged coefficients. Regarding equation (8).

The hypothesis defined as;

H_0: $\varpi_1 = \varpi_2 = \varpi_3 = \varpi_4 = \varpi_5 = \varpi_6 = 0$

H_1: $\varpi_1 \neq \varpi_2 \neq \varpi_3 \neq \varpi_4 \neq \varpi_5 \neq \varpi_6 \neq 0$.

Since the asymptotic distributions of the F-statistics are non-standard under the null hypothesis of no co-integration relationship among the variables under consideration, Pesaran *et al.*, (2001) have tabulated two sets of asymptotic critical values for inference. The first set (lower bound) assumes that all variables are *I*(0) while the second (upper bound) assumes that all variables are *I*(1). The computed F-statistics underlying equation (8) is compared with the critical values and if it is greater than the upper bound critical value, then the null hypothesis of no co-integration is rejected and we can conclude that there exists steady state equilibrium among the variables. On the other hand, if the computed F-statistics is less than the lower bound critical value, then the null hypothesis of no co-integration cannot be rejected, indicating non-existence of long run relationship among the variables. Lastly, if the computed F-statistics fall within the lower and upper bound critical values, then the result is inconclusive and in this case the time series properties of the variables must be known before any inferences can be drawn (Pesaran, *et al.*, 2001). The approximate critical values used for the study are obtained from (Pesaran, *et al.*, 2001).

The second step concerns estimating the long run and short run coefficients of the same equation. It is important to state that the second step is conducted only if there is evidence of a long run relationship in the first step (Narayan *et al.,* 2004). The appropriate long run and short run models associated with (7) can be selected based on the minimization of

information criteria such as the Akaike Information criteria (1973). Once it becomes evident that a long run relationship (co-integration) exists among the variables, the ARDL *(p, q, r, s, u, v,)* long run model can be estimated as;

$$\ln RER_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \ln RER_{t-i} + \sum_{i=0}^{q} \beta_2 TOT_{t-i} + \sum_{i=0}^{r} \beta_3 \ln OPEN_{t-i} + \sum_{i=0}^{s} \beta_4 Yg_{t-i} + \sum_{i=0}^{v} \beta_5 \ln IGDP_{t-i}$$

$$+ \sum_{i=0}^{w} \beta_6 POL(Dummy)_{t-i} + U_t \quad \text{.....(9)}$$

Where, all variables are as previously defined. The final stage involves the ARDL specification of the short run dynamics which can be derived by constructing an error correction model (ECM) to analyze how changes in the regressors impact on real exchange rate (dependent variable) in the short run. The short run dynamic equation to estimate is:

$$\ln RER_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \ln RER_{t-i} + \sum_{i=0}^{q} \beta_2 TOT_{t-i} + \sum_{i=0}^{r} \beta_3 \ln OPEN_{t-i} + \sum_{i=0}^{u} \beta_4 Yg_{t-i}$$

$$+ \sum_{i=0}^{v} \beta_5 \ln IGDP_{t-i} + \sum_{i=0}^{w} \beta_6 POL(Dummy)_{t-i} + \psi ECT_{t-i} + U_t \quad \text{.....(10)}$$

All the variables are as previously defined. **Δ** represents difference operator and ECT_{t-1} is the one period lagged error correction term while the β_s denote the short-run dynamic coefficients of the model's convergence to equilibrium. The coefficient of the error correction term ψ, measures the speed of adjustment to obtain equilibrium in the event of shocks to the system in the short run.

3.5 Definition and Measurement of Variables in the Model

Real Exchange Rate

It is nominal exchange rate adjusted by changes in price level differential between domestic economy and the rest of the world. The real effective exchange rate (REER) is used to estimate the real exchange rate because it is weighted by the trade shares of exporting partners (thus controlling for third country effect). Moreover, most studies that have estimated real exchange rate models have used the idea of real effective (multilateral) rather than real bilateral exchange rate. The real effective exchange rate is computed as follows:

$$REER = \sum_{i=1}^{i=4} Si \left(\frac{ei\ CPIi*}{CPI}\right) \quad (11)$$

Where

REER = real effective exchange rate

i = major export partners of Ghana

*S*i = the weight of country *i* in the total export of Ghana

CPI*i = the consumer price index of country *i*

CPI= Consumer price index in Ghana

Ghana's main trading partners and their respective trade weights were UK 0.3; France 0.06; Italy 0.08; Japan 0.09; Netherlands 0.1; Germany 0.19; and US 0.18. Data sources were World Bank's World Tables and Direction of Trade Statistics, and IMF's International Financial Statistics. The real exchange rate is also called fundamental equilibrium exchange rate or desired equilibrium exchange rate (Williamson, 1994).

Terms of Trade (TOT)

In international economics, terms of trade is defined as the relative price of a country's export to import or the ratio of export prices to import prices. It measures a nation's trading position, which improves when export prices rise faster or fall slower than import prices. Thus an improvement in a country's terms of trade (the increase of the ratio) is good for that country in the sense that it has to pay less for the imports.

Openness (OPENNESS)

This is given by the expression [X + M)/Y] and used as an indicator of trade policy `restrictions such as tariffs and quotas. It should not be overlooked that a less restrictive trade regime is only one of the major factors of openness, as international trade is also determined by other factors affecting imports and exports, including the RER itself (Cottani et al. 1990). Exchange and controls is proxy by the degree of openness of the economy and is the standard practice in many literatures. This is due to the non-availability of consistent and longer period data on tariff revenues as a proportion of imports.

The Growth of Real GDP (Yg)

Gross Domestic Product growth (GDPGR) is the annual percentage change in GDP. GDP is the total value of goods and services produced within the borders of an economy or a country during a given period of time measured in market prices. It is calculated without making deductions for depreciation. It is used as a proxy for Technological progress and productivity improvement (Yg). Technological progress (Yg) has been used as explanatory variable to capture the Ricardo-Balassa effect on the equilibrium RER. According to this hypothesis, productivity improvement in rapidly growing economies tends to be

concentrated in the tradable sector and usually accounts for an appreciation of the RER through increasing the income and price of nontradables (Balassa 1964).

Investment as a Ratio of GDP (IGDP)

Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. It was also measured as a percentage of GDP.IGDP is investment as a ratio of GDP (Proxy for Capital Accumulation).

Election (POL)

Is a political variable which is a proxy for the tendency for the government to over spend due to up-coming elections (Blomberg and Hess. 1997).

CHAPTER FOUR

ANALYSIS AND DISCUSSION OF EMPIRICAL RESULTS

4.0 Introduction

This chapter presents a thorough analysis and discussion of the results of the study. The chapter is divided into three sections. Section one examines the time series properties of the data. It presents the unit root test and the bound test for cointegration. The second section presents and discusses the results of the estimated long run real exchange rate equation using the ARDL approach. The results of the Error Correction Model for the selected ARDL model are presented and analysed in the third section.

4.1 Discussion of Time Series Properties

4.1.1 Results of the Unit Root Test

In any time series data, it is always important to examine the time series properties of the data before further analysis and inferences can be made, as most series are non-stationary in their levels. A test for stationarity of the data involving Real exchange rate model estimations was done to ensure that the variables were not integrated of order two (that is, I(2) stationary) so as to avoid spurious results. The ARDL breaks down with I(2) series since the computed F-statistics provided by Pesaran *et al* (2001) are not valid in the presence of I(2) variables. This is so because the bounds test is based on the assumption that the variables are integrated of order zero (that is, I(0)) or integrated of order one (that is, I(1)).

The Augmented Dickey-Fuller (ADF) test was utilized to check for unit root and order of integration of the variables. The results of the unit root test are presented in Table 4.1.

The regression test included both a constant, as well as a constant and trend for both the log-levels and the first differences.

Table 4. 1 Results of the Unit Root

	Log Level		First Difference	
Variable	**Non Linear Trend**	**Linear Trend**	**Non Linear Trend**	**Linear Trend**
In RER	**-2.561009**	**-3.149424**	**-6.942636****	**-6.850580****
TOT	**-2.417914**	**-2.685189**	**-6.130518****	**-7.644116****
In OPENNES	**-0.976250**	**-3.288895**	**-5.850152****	**-5.994267****
YG	**-2.958302**	**-3.379804**	**-6.305178****	**-6.232448****
InIGDP	**-2.174795**	**-3.459244**	**-7.867014****	**-7.721459****

** denotes the rejection of the null hypothesis of unit root at 5%

The ADF test involves testing the null hypothesis of non-stationarity of the variables against the alternative hypothesis of stationarity.

As can be seen from the second and third columns of Table 4.1, when the regression is estimated at the log level (with and without linear trend), none of the variables becomes stationary. This is because the values of the test statistic for all the variables with and without linear trend are less than the critical ADF value of –3.00 in absolute terms at 5 percent level of significance. Thus, the ADF unit root test results in the table indicate that the null hypothesis of non-stationarity (with and with no trend) cannot be rejected for all the variables at the log levels. This means that the variables are integrated of order one or higher since none of them is stationary at the log level.

All the variables become stationary after the first difference. This can be seen from columns four and five of Table 4.1. This is because the test statistic values for the variables are greater than the critical ADF value of −3.00 (with and with no linear trend) in absolute terms at 5 percent significance level. Therefore, the null hypothesis of non-stationarity can be rejected and the alternative hypothesis of stationarity accepted. Thus, the first difference of the variables is integrated of order zero, I(0) indicating that they are stationary.

The results of the ADF test go to suggest that all the variables are I(1) at the log levels but I(0) at the first difference, demonstrating the existence of unit root in the data for the variables used. The existence of unit root accentuates the presence of non-stationarity in the variables and hence the use of the first difference of the variables for estimation and analysis.

4.2 Bounds Test for Long Run Relationship

To test for co-integration between real exchange rate and its determinants for Ghana, equation (4) is estimated using the Autoregressive Distributed Lag (ARDL) approach to co-integration. The result of the bound testing approach to co-integration is reported in Table 4.2. As a decision rule, the computed *F*-statistics is compared with the upper bound critical value published in Pesaran, *et al*, (2001) before any inference could be drawn. It can be observed from Table 4.2 that the computed F-value = 12.2284, is higher than the upper bound critical value of 4.6075 at the 5% level of significance.

This implies that the null hypothesis of no co-integration can be sufficiently rejected. Thus, there is a strong evidence of long run relationships amongst the variables.

Table 4. 2 Bounds Test for Long Run Relationship

	F-statistics	12.2284**
Critical Values	**Lower Bound *I(0)***	**Upper Bound *I(1)***
1%	3.2004	4.6075
5%	2.6051	3.8690

** denotes the rejection of the null hypothesis of unit root at 5%.

4.3.1 Diagnostic and Stability Tests

In time series econometrics analysis, it is always convenient and proper to carry out diagnostic tests to ensure that the results meet the standard classical linear regression assumptions, to detect any possible spurious results and correct such defects if any, to avoid the possibility of spurious results and conclusions. This is done in this work by using Microfit 5.01 and the results are illustrated in table 4.3.

Table 4. 3 Results of the Diagnostic Tests

Test Statistics	LM Version	F Version
A: Serial Correlation	CHSQ (1) = .62880[.428] F (1, 14)	.31029[.586]
B: Functional Form	CHSQ (1) = 3.2066[.073] (1, 14)	1.7405[.208]
C: Normality	CHSQ (2) = 4.0286[.133]	Not applicable
D: Heteroscedasticity	CHSQ (1) = .92720[.336] (1, 27)	.89176[.353]

Note:
A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residuals

The null hypotheses testing autocorrelation, correct functional form, normality and heteroscedasticity includes: no autocorrelation, correct functional form, normally distributed residuals and no heteroscedasticity (homoscedasticity) respectively. From Table 4.3, it is clear that, the null hypotheses cannot be rejected at the 5% significance level for the given probability values 0.428, 0.073, 0.133 and 0.336 respectively. Thus the real exchange rate function passes all the diagnostic tests. This implies that the real exchange rate function does not suffer from any problem related to serious serial correlation, functional form, normal distribution and heteroscedasticity respectively. Again, in standard econometric analysis, and for that matter cointegration analysis, the stability of coefficients in the regression is crucial. This paper utilizes the CUSUM (Cumulative sum) and the CUSUMSQ (Cumulative sum of squares) of recursive residuals to test for the stability of the coefficients in the real exchange rate regression model. This test is basically a graphical test and is illustrated in appendix II.

4.2 Results and Discussion of the Long Run Coefficients of the Real exchange rate Function

After checking for the existence of cointegration, stability and other diagnostic tests, the next step in the ARDL procedure is the estimation of the long run relationship between the variables in the real exchange rate function. The long run coefficients of the model were estimated from the ARDL (1, 2, 2, 2, 1, 0) selected based on Akaike Information Criterion, using Microfit 5.01 and the results so generated are displayed in Table 4.4.

ARDL (1, 2, 2, 2, 1, 0) selected based on Akaike Information Criterion

Dependent variable is LNRER

Table 4. 4 Estimated Long Run Coefficients using the ARDL Approach

Variable	Coefficient	Std. Error	T-Statistic	Prob.
TOT	1.4457	.16923	8.5426	0.000***
LNOPENNESS	-.90687	.15158	-5.9827	0.000 ***
YG	-23.4605	3.1546	-7.4369	0.000 ***
LNIGDP	.079986	.13748	.58179	0.569
POL	.065158	.094111	.69235	0.499
C	-.76028	.41486	-1.8326	0.087

*** denotes the rejection of the null hypothesis of unit root at 5%

From the results above, the coefficient of terms of trade is positive (1.4457) and significant at 5% significance level. This implies an improvement in terms of trade had a depreciation effect on real exchange rate in Ghana according to the above results. For example, an increase in TOT may lead to sufficient foreign exchange resources to producers of non-tradable goods in the country. Being one of the factors determining production in Ghana, the increased resources may then enable the producers to increase their production of non-tradable goods, hence lowering its price. This may thus lead to depreciation in the real exchange rate in Ghana. This was theoretically confirmed.

In addition, the coefficient of openness was also found from the result estimated above to be negative and significant, thus it has an appreciating effect on real exchange rate. Its coefficient was (-.90687) and implies that real exchange rate varies approximately by -0.90687 given a 1% variation in openness. This inform us that a reduction in, for example an import tariffs which correspond to more openness of the economy to trade decrease the domestic prices of imports, thereby leading to an appreciation of the real exchange rate. The reverse happens when there was an increase in import tariffs. An increase in openness of the

economy had an appreciating effect on real exchange rate. Hence; openness in Ghana had an appreciation effect on real exchange rate.

Moreover, Real growth rate in Ghana leads to an appreciation of real exchange rate as indicated by the negative sign shown in the result. The coefficient of YG was negative and highly significant in explaining real exchange rate in Ghana. The magnitude tells us that a 1% change in real growth, changes real exchange rate by approximately -23.4605%. This implies advancement in technology among other things raised efficiency and productivity of factors of production thereby reduces costs of production and prices of the tradeables, because more of the non-tadables would be preferred and hence increasing their competitiveness. The increased demand would increase the price of non-tradables, and hence leading to an appreciation of the real exchange rate. Thus confirming the Balassa-Samuelson effect.

Again, the coefficient of investment as a percentage of GDP (Capital accumulation) was found to be positive (0.079986) from the estimated long run result and insignificant in determining real exchange rate in Ghana. Even though investment as percentage of GDP was found to be insignificant its positive sign showed depreciating effects on the real exchange rate. However it should be noted that, the effect of investment as percentage of GDP on real exchange rate depends on whether investment in the economy is tilted towards tradable goods or non-tradable goods. If investment changes towards traded goods then it would lead to depreciation of the real exchange rate (Baffes *et al,* 1999; Edwards, 1989). On the other hand when it is tilted towards non-tradable goods it would lead to an appreciation of the real exchange rate. For example, Baffes *et al* (1999) discovered that an increase in investment as percentage of GDP depreciated the real exchange rate in Côte d'Ivoire. We

therefore conclude that the depreciating effect of IGDP on real exchange rate implies investment shares in Ghana are concentrated on tradable goods though not significant.

Finally, though the coefficient of election year (POL) was found to be positive (.065158) from the estimated long run result, it was not statistically different from zero at 5% levels of significance. The results in Table 4.3 indicates that when POL goes up by 1 percent, real exchange rate also goes up by approximately 0.065158%.This implies election which is proxy for the tendency for the government to over spend has a depreciating effect on real exchange rate but not significant to determine real exchange rate in Ghana. Observation of the real exchange rate movement in Ghana during election year shows a depreciation of the real exchange rate, this depreciating effect of election year on real exchange obtained in above estimated long run result dose not significantly determine real exchange movement in Ghana. This confirms the finding of Zakari and Afriyie, 2004, that while our political variable is positively signed, it is not significant in influencing the real exchange rate.

4.3 Results of the Error Correction Model for the selected ARDL Model

Generally, the Error Correction Model (ECM) provides the means of reconciling the short run behaviour of an economic variable with its long-run behaviour. The existence of cointegration relationships among the variables implies the estimation of Error Correction Model to determine the dynamic behaviour of the Real exchange rate equation. The Error Correction Model captures the short run dynamics of the system and its coefficient measures the speed of adjustment to obtain equilibrium in the event of shocks to the system. Table 4.4 reports the results of the short-run dynamics of real exchange rate equation.

ARDL (1, 2, 2, 2, 1, 0) selected based on Akaike Information Criterion

Dependent variable is dLNRER

Table 4. 5 Error Correction Model for the Selected ARDL Model

Regressor	Coefficient	Std. Error	t-Ratio	Prob.
dTOT	.87033	.16931	5.1404	0.000**
dLNOPN	.078854	.17378	.45375	0.655
dYG	-7.5763	1.4050	-5.3922	0.000**
dLNIGDP	-.16832	.059598	-2.8242	0.011**
dPOL	.044340	.063168	.70194	0.149
Ecm(-1)	-.68050	.10682	-6.3705	0.000**

**denote the rejection of the null hypotheses at 5% level of significance.
Results were obtained from Microfit 5.01.

ecm = LNRER-1.4457*TOT+.90687*LNOPN+23.4605*YG -.079986*LNIGDP

-.065158*POL + .76028*C

R-Squared	.95823	R-Bar-Squared	.92204
S.E. of Regression	.10973	F-Stat F(9,19)	38.2373[.000]
Mean of Dependent Variable	-.097891	S.D. of Dependent Variable	.39299
Residual Sum of Squares	.18062	Equation Log-likelihood	32.4914
Akaike Info. Criterion	18.4914	Schwarz Bayesian Criterion	8.9203
DW-statistic	1.7171		

.

The results from the table indicate that the model passed the diagnostic tests. A DW-statistic of 1.7171 indicates that there is no strong serial correlation in the residuals. The overall regression is significant at 5% as can be seen from the R-squared and the F-statistic. R-squared value of 0.95823 indicates that about 95% of the change in the dependent variable

(dLnRER) is explained by changes in the independent variables. Also, an F-statistic value of 38.2373 suggests the joint significance of the determinants in the ECM.

From Table 4.4, the coefficients of the variables provides interesting results since they maintain their signs as in the long run equation except the coefficient of the OPENNESS and IGDP variables whose sign changes from negative to positive and from positive to negative respectively. The coefficients indicate the short-run elasticities.

In the model, terms of trade has a significant depreciating effect on real exchange rate. This means that the long-run and short-run effect of terms of trade on the real exchange rate is the same.

Moreover, the coefficient of the OPENNESS variable this time is positive. It is also not statistically different from zero at 5% level of significance. This shows that in the short run, openness of trade even though has a positive coefficient it is insignificant to determine real exchange rate in Ghana. This implies that in the short-run, an increase in the openness of the Ghanaian economy tends to depreciate the real exchange rate.

Again, the result in the short run shows that, Real growth rate in Ghana leads to an appreciation of real exchange rate as indicated by the negative sign. The coefficient of YG is negative (-7.5763) and significant at 5% in explaining real exchange rate in Ghana. This means that the long-run and short-run effect of real growth rate on the real exchange rate is the same.

Also, the coefficient of Investment as a percentage of GDP though changes to negative; it is statistically different from zero at 5% level of significance. This implies the Ghanaian

economy in the short run is tilted towards non-tradable goods leading to an appreciation of the real exchange rate.

Lastly, the coefficient of the POL variable maintained its positive sign. It is also not statistically different from zero at 5% level of significance, as obtained in the long run. This implies that election has a depreciating effect on real exchange rate but not significant in determining real exchange rate in Ghana both in the long run and in the short run according to this study.

The estimated coefficient of the error correction model (ecm) is highly significant at 1% level of significance and also has the appropriate negative sign. This is an indication of joint significance of the long-run coefficients. From the results in Table 4.4, the estimated coefficient of the error correction model is –68050. This reflects a very high speed of adjustment to equilibrium after a shock. This is because approximately more than 68% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

CHAPTER FIVE

FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

This chapter concludes the entire study. It summarizes the major findings obtained from the study as well as their policy implications. It further provides recommendations based on the findings of the study.

5.1 Summary of Findings

Firstly, the coefficient of terms of trade is positive and significant at 5% implies an improvement in TOT has a depreciating effect on Real exchange rate in both the short run and the long run in Ghana according to the study.

Secondly, the openness variable has a negative impact on real exchange rate in the long run while its short run impact is positive. The implication is that trade liberalization with the aim of promoting trade will in the short run depreciate the real exchange rate of Ghana and would lead to an appreciation of the real exchange rate in the long run. The changing of the sign of the openness variable in the short run and long run real exchange rate equation suggests a possible tradeoff between openness and closeness. In the long run, openness will appreciate real exchange rate while in the short run it would depreciate real exchange rate in Ghana.

Thirdly, the study reveals that, real growth has an appreciation effects on real exchange rate.it also shows that most of the real exchange rate's long-run and short run determinants can be explained by real GDP growth.

Fourthly, investment as a percentage of GDP has a depreciating effect on real exchange rate implies investment shares in Ghana are concentrated on tradable goods in the long run but has an appreciating effect on the real exchange rate as the coefficient changed to negative. However for both periods it's not a significant determinant of real exchange rate in Ghana by this study.

Fifthly, the assertion that, the real exchange rate depreciates in election year. This study however reveals that even though the election year (POL) has a depreciating effect on real exchange as obtained in the estimated result for both long run and short run but does not significantly determines real exchange movements in Ghana.

Lastly, the findings here agreed with the view that the equilibrium real exchange rate is not constant over time, but responds to changes in a number of fundamentals and shocks to the economy (Aron *et al*, 1997).

5.2 Policy implications and Recommendations

The results discussed in the previous chapter have actually thrown light on some policy-related variables that have had significant impact on real exchange rate for the period under study. In view of this, recommendations have also been made to help prevent real exchange rate depreciation in Ghana.

The terms of trade variable had a depreciation impact on the real exchange rate both in the long run and the short run. Policy makers should make policies that best suit the interest of

the country; since the impact of an improvement in TOT on RER is theoretically unclear (Elbadawi and Soto, 1997, Aron *et al*, 1997, Baffes *et al*, 1999, and Edwards. 1989).

The openness variable has an appreciation impact on Real exchange rate in the long run while in the short run it has a depreciation impact. The changing of the sign of the openness variable in the short run and long run real exchange rate equation suggests a possible trade off between trade liberalization (reduction in imports tariffs) and trade restriction(increase in import tariffs).

Export promotion should be highly encouraged as part of the trade liberalization policy. This can take form of regular organization of trade fairs at least every quarter in the year. In addition, there should also be diversification of our exports. This can be done by adding value to our exports so that they attract competitive prices on the world market. Domestic consumers should also be encouraged to use domestic goods and services. This can be achieved through the organization of rural trade fairs and exhibitions at the district level to showcase made in Ghana goods. This will help reduce domestic expenditure on imported goods so as to ensure favourable balance of trade, thereby, resulting to an appreciation of the real exchange rate in Ghana. Government should employ the above trade policies in order to really enhance exports and raise the value of the exchange rate.

Since Real growth rate (technological progress) has an appreciation impact on the real exchange rate. Policy makers should employ supply side policies that would lead to growth in the economy through increase in productivity in all sectors of the economy, but it should not offset the demand effects. These include improvement in the educational system, infrastructure and health facility, creation of an enabling environment and provision of subsidies so that businesses can grow. This in turn would lead to exchange rate appreciation.

Investment as a percentage of GDP had an depreciation effect on real exchange rate though not a significant determinant of real exchange implies IGDP in Ghana was concentrated on tradable goods whiles in the short run was tilted towards non-tradable goods leading to an appreciation of the real exchange rate.

Government should increase both private and public sector investment in order to raise production. Public investment should take the form of increased spending on infrastructural development. This would induce and encourage private sector investment through increased profitability, consequently leading to exchange rate appreciation.

The political variable(tendency for the government to over spend) both in the long run and the short run had a depreciation effects on real exchange rate but doesn't determine real exchange rate in Ghana according to this study. The study recommended that both Government and policy makers should re- consider their stands on the assertion that in every election year real exchange rate depreciates. It is an undeniable fact that per this study the coefficient of real exchange rate in both the short and the long run is positive indicating a depreciation effects on real exchange rate but not a significant determinant of real exchange rate, there may be other variables other than only the election year variable as proven by this study.

5.3 Conclusion

The crux of this study was to explore the determinants of real exchange rate in Ghana. It was conducted by adopting the intertemporal model developed by Edwards (1989).

The objective of this study was therefore to find out the determinants of real exchange rate in Ghana. Specifically, to examine the impact of other key macroeconomic and policy variables

on Real exchange rate in Ghana. Whether Election year is a significant determinant of Real exchange rate in Ghana and to draw policy implications from the findings for macroeconomic management.

The study used a set of annual data from 1980 – 2010 as well as time series analysis and also employed the autoregressive distributed lag (ARDL) approach for estimation to achieve the above objective.

The empirical results of the study suggested that in the long-run real exchange rate determinants were; terms of trade, openness, and the rate of growth. All these variables maintained their sign as good determinants of real exchange rate except OPENNESS was not consistent in the short run.

Investment as % of GDP was not significant in the long run but was significant in the short run.

Election year (POL) was added to test the assertion that in election year real exchange rate depreciates. This assertion could not find its level in this study. Hence election year is not a significant determinant of real exchange rate in Ghana by the study

5.4 Limitations of the Study

A number of limitations were encountered in the course of the study. The study was hampered by financial and material constraints as well as time. There was virtually no funding for the study apart from the government grant of GH¢400.00 which is not only woefully inadequate but also paid at the time the study has been completed. All the funding for the study came from the researcher's already weak financial background. Attempts were made to ensure the validity of the study and its generalization.

The other issue, which has also confronted previous researchers, concerns the unavailability of data, particularly in developing countries like Ghana, on the actual variables suggested by the theoretical models on the determination of the real exchange rate. This means that some of the variables either have to be excluded in the empirical model, though with the risk of an omitted variables bias, or proxies have to be found for those variables. The risk involved in finding proxies is that they may not correctly represent the impact of the actual variables, resulting in inconsistent results. Striking this balance poses a serious challenge to empirical studies on the determinants of the real exchange rate. However, these problems seem not to have significantly affected the findings presented in this study, since they corroborate both the theoretical and empirical knowledge on the determinants of the real exchange rate.

However, like all academic endeavors, there are certain weaknesses of the study which could be addressed by future authors.

REFERENCES

Afari -Opoku, M. (2004), 'Measuring the Real Effective Exchange rate in Ghana', *CREDIT* Research Paper 04/11.

Aron, Janine, Elbadawi, Ibrahim A., and Kahn Brian, (1997), "Determinants of the Real Exchange Rate in South Africa", Centre for the Study of Africa Economies, WPS/97-16, CSAE Publishing, Oxford.

Appiah .S.T and I.A. Adetunde (2011),Department of Mathematics, University of Mines and Technology, Tarkwa, Ghana, Forecasting Exchange Rate Between the Ghana Cedi and the US Dollar using Time Series Analysis

Blomberg, S. Brock and Hess, D. Gregory (1997) 'Politics and Exchange Rate Forecasts',Journal of International Economics, Vol. 43, Nos. ½, p. 189-205.

Baffes, John, Elbadawi, Ibrahim A., and O'Connell, Stephen, A., (1999), "Single-Equation Estimation of the Equilibrium Real Exchange Rate", in Hinkle, Lawrence E, and Montiel, Peter J., (ed.), Exchange Rate Misalignment: Concepts and Measurement for Developing Countries, Oxford University Press.

Black, Stanley, W., (1994), "On the Concept and Usefulness of the Equilibrium Rate of Exchange", in Williamson, John, (ed.), Estimating Equilibrium Exchange Rates, Institute for International Economics, Washington DC.

Balassa, B., (1964), 'the Purchasing-Power Parity Doctrine: A Reappraisal', in: Journal of Political Economy, 72, December 1964.

Balázs Égert, László Halpern and Ronald MacDonald (2005), Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues, William Davidson Institute Working Paper Number 793;

Chowdhury, M.B. (1999), The determinants of real exchange rate: theory and evidence from Papua New Guinea. *Working papers* 99-2, Canberra, Asia Pacific School of Economics and Management, Australian National UniversityCEPA, 2012: Election year Excesses, Cedi Depreciation and Inflation.

Cottani, J., D. Cavallo, and M.S Khan. (1990), ―Real exchange rate behaviour and economic performance in LDCs‖, *Economic Development and Cultural Change*, 39:61-76.

Cassel (1918), the absolute version of PPP postulates that the relative prices (in different currencies and locations) of a common basket.

Clark, P. and R. MacDonald, 1998, "Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs," IMF Working Paper WP98/67(Washington: International Monetary Fund).

Centre for Policy Analysis (CEPA) (2010). "The Current State of the Macro Economy of Ghana 2000-2009."

Choong, C. K., Y. Zulkornain and K.S. Venus (2005) Export-led Growth Hypothesis in Malaysia:An investigation using bounds test. Sunway Academic Journal, 2:13-22.

Dejong, D.N., Nankervis, J.C., Savin, N.E., (1992), Integration versus Trend Stationarity in Time Series, Econometrica, 60, 423-33.

Edwards, S., 1989. Real exchange rates, devaluation and adjustment: exchange rate policy in developing countries. Cambridge: The MIT Press.

Elbadawi, I, 1994. Estimating long-run equilibrium real exchange rates. Estimating equilibrium exchange rates. J. Williamson (Eds.). Washington D.C.: Institute for International Economics.

Edwards, S. and Savastano, M. A., 1999. Exchange rates in emerging economies: what do we know? What do we need to know? [online]. Available:http://ideas.repec.org/s/nbr/nberwo.html.

Elbadawi, Ibrahim, A. and Soto Raimundo, (1997), "Real Exchange Rates and Macroeconomic Adjustment in Sub-Saharan Africa and Other Developing Countries", Journal of African Economies, 6 (3), 75-120.

Elena Loukoianova & Plamen Iossifov, 2007 "Interest Rate Elasticity of Residential Housing Prices," IMF Working Papers 08/ 247, International Monetary Fund.

Engle R.F, and Granger C.W.J., (1987). Co-integration and Error Correction Representation: Estimation and Testing. Econometrica, 55: 251-276.

Faruqee, H. and P. Isard, (1998), Exchange rate assessment: Some recent extension and application of the macroeconomic balance approach. IMF Occasional Paper no. 167, Washington D.C., International Monetary Fund.

Ghura, D. and T.J. Grennes (1993) "The Real Exchange Rate and Macroeconomic Performance in Sub-Saharan. Africa" Journal of Development Economics.

Hirsch, F and Higgins, I., 1970. An indicator of effective exchange rates. IMF Staff Papers. 17: 453-87.

Johansen, S., Juselius, K., (1990), Maximum Likelihood Estimation and Inference on Co-Integration-With Application to the Demand for Money. Oxford Bulletin of Economics and Statistics, 52, 169-210.

Johansen, S., (1995) A Statistical Analysis of I(2) Variables. *Econometric Theory,*11: 25-59

Jeremy C. Stein, 1995. "An Adverse Selection Model of Bank Asset and Liability Management with Implications for the Transmission of Monetary Policy," NBER

Johansen, S. (1988). 'Statistical Analysis of Co-integration Vectors', *Journal of Economic Dynamics and Control* **12**, 231-254.

Killian, L. and M.P. Taylor, 2001. Why is it so Difficult to Beat the Random Walk Forecast of Exchange Rates.EuropeanCentralBankWorkingPaper.

Kenneth Rogoff & Anne Sibert, 1988. "Elections and Macroeconomic Policy Cycles," NBER Working Papers 1838, National Bureau of Economic Research, Inc IMF Country Report No. 04/210 July 2004.

Kempa, Bernd, 2005. "An oversimplified inquiry into the sources of exchange rate variability," Economic Modelling, Elsevier, vol. 22(3), pages 439-458, May.

Kwame Poku Osei-Assibey (2010) Exchange Rate Volatility in LDCs: Some Findings from the Ghanaian, Mozambican and Tanzanian Markets.

Khan, M. S., and Montiel, P. J., 1996. Real exchange rate dynamics in a small, primary exporting country. In: Frenkel, J. A. and Goldstein, M. (eds). Functioning of the International Monetary System. Washington: International Monetary Fund.

Morrissey, O. T. Lloyd, and M. Opoku-Afari, (2005), Real Exchange Rate response to Capital Inflows: A dynamic analysis for Ghana. *Credit Research Paper* No. 04/12Centre for Research in Economic development and international Trade, University of Nottingham.

Montiel, Peter J., 2003. "Post-crisis exchange rate policy in five Asian countries: Filling in the "hollow middle"?" Journal of the Japanese.

Mahamudu Bawumia (2010, Paperback). Monetary Policy and Financial Sector Reform in Africa | ISBN-10: 1453854509 ISBN-13.

Macdonald, R., 1998. What determines real exchange rates? The long and short for it. Journal of International Financial Markets, Institutions and Money. 8: 117-153.

Montiel, P. 1997. Exchange rate policy and macroeconomic management in ASEAN countries. Macroeconomic Issues Facing ASEAN Countries.

Mussa, Michael (1986), "Nominal Exchange Rate Regimes and the Behavior of Real Ex-Change Rates: Evidence and Implications," Carnegie-Rochester Series on Public Policy 25:117-214.

MacDonald, R., and Clark, P.B. (2000). Filtering the BEER: A Permanent and Transitory Decomposition. Published by the International Monetary Fund Research.

Mundell. R. A., 1971. Monetary Theory: Interest, Inflation and Growth in the World Economy. Pacific Palisades, California: Goodyear Pub. & Co.

Mahamadu Bawumia, Phd and Philip Abradu-Otoo(2003) Monetary Growth, Exchange Rates and Inflation in Ghana: An Error Correction Analysis

Mkenda, B. K., 2001. Long-run and short-run determinants of the real exchange rate in Zambia. Göteborg University Working Papers in Economics no 40. [online]. Available: http://www.handels.gu.se/epc/archive/00001717/01/gunwpe0040.pdf [Accessed 05 April 2005].

Mungule, K.O. 2004. The determinants of the real exchange rate in Zambia. *AERC Research Paper* 146.

Nana A.M, 2012. Exchange rate Stability in Ghana-has the Bubble Burst? A Business World Ghana Article.

Narayan, P. K. (2005) The Saving and Investment Nexus for China: Evidence from Co-integration Tests. Applied Economics, 37, 1979-1990.

Obstfeld, Maurice and Kenneth Rogoff (1996), Foundations of International Macroeconomics, MIT Press.

Oteng-Abayie, E.F., and J.M. Frimpong (2006) Bounds Testing Approach to Cointegration: An Examination of Foreign Direct Investment, Trade and Growth Relationships.American Journal of Applied Sciences 3(11):2079-2085

Peter Takaendesa,2006. The Behaviour and Fundamental Determinants of the Real Exchange Rate in South Africa.

Pesaran, M. H., Shin, Y. C. and Smith, R. (2001). "Bound Testing Approaches to the Analysis of Level Relationships", Journal of Applied Econometrics, 16, 289-326.

P. Montiel, C.M. Reinhart/Journal of International Money and Finance 18 (**1999**) 619–635 however, this renewed flow of capital towards emerging market

Phillips, P. C. B., Hansen, B. E. (1990). Statistical Inference in Instrumental Variable Regression with I (1) Processes. Rev. Econ. Studies 57:99-125.

Pesaran and Shin (1995, 1998) *An Autoregressive Distributed Lag Modeling Approach to Cointegration Analysis.* DAE Working papers, No.9514.

Pesaran, M. H., Y. Shin and R. J. Smith, (2001), Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics.* 16: 289-326.

Robert D. Korsah and Samuel J. Braimah (2005), The determinants of the Real Exchange rate In Sierraleone.

Rodriguez, C.A. 1989. Macroeconomic policies for structural adjustment. World Bank Working Paper Series no. 247.

Ronald MacDonald & Luca Antonio Ricci, 2003. "Estimation of the Equilibrium Real Exchange Rate for South Africa," IMF Working Papers 03/44

Rogoff, K., 1996, "The Purchasing Power Parity Puzzle," Journal of Economic Literature, Vol. 34, 1996

Šmídková et al. (2002) estimated a model with a fixed external debt target of 60 percent of GDP for the Czech Republic, Estonia,. Hungary, Poland, and Slovenia.

Samuelson, P., (1964), 'Theoretical notes on trade problems', in: Review of Economics and Statistics, No. 64 (2), 1964.

Virginie Coudert & Cécile Couharde, 2002. "Exchange Rate Regimes and Sustainable Parities for CEECs in the Run-up to EMU Membership," Working Papers.

Williamson, J., (1994), 'Estimates of FEERs', in: Williamson, J., (ed.), 'Estimating Equilibrium Exchange Rates', Institute for International Economics, Washington DC, 1994, pp.177-244.

Williamson, J. (1985), *The exchange rate system: Policy Analysis in International Economics*. Washington D.C., Institute for International Economics.

Zakari MumuniEmmanuel Owusu-Afriyie, 2004, Determinants of the Cedi/Dollar Rate of Exchange in Ghana: A Monetary Approach.

.

APPENDIX I

RESULTS OF THE ARDL ESTIMATES

Autoregressive Distributed Lag Estimates

ARDL(1,2,2,2,1,0) selected based on Akaike Information Criterion

Dependent variable is LNRER

29 observations used for estimation from 1980 to 2010

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNRERD(-1)	.31950	.10682	2.9910[.009]
TOT	.87033	.16931	5.1404[.000]
TOT(-1)	-.94152	.21788	-4.3213[.001]
TOT(-2)	1.0550	.18943	5.5694[.000]
LNOPN	.078854	.17378	.45375[.657]
LNOPN(-1)	-.31415	.18219	-1.7243[.105]
LNOPN(-2)	-.38183	.19243	-1.9842[.066]
YG	-7.5763	1.4050	-5.3922[.000]
YG(-1)	-6.0105	1.5024	-4.0006[.001]
YG(-2)	-2.3781	1.2787	-1.8598[.083]
LNIGDP	-.16832	.059598	-2.8242[.013]
LNIGDP(-1)	.22275	.070983	3.1380[.007]
POL	.044340	.063168	.70194[.493]
C	-.51737	.32741	-1.5802[.135]

R-Squared .99186 R-Bar-Squared .98480
S.E. of Regression .10973 F-Stat. F(13,15) 140.5928[.000]
Mean of Dependent Variable .50616 S.D. of Dependent Variable .89019
Residual Sum of Squares .18062 Equation Log-likelihood 32.4914

Akaike Info. Criterion 18.4914 Schwarz Bayesian Criterion 8.9203
DW-statistic 1.7171 Durbin's h-statistic .93108[.352]

Table 2: Testing for existence of a level relationship among the variables in the ARDL model

****

F-statistic 95% Lower Bound 95% Upper Bound 90% Lower Bound 90% Upper Bound
12.2284 3.2004 4.6075 2.6051 3.8690

W-statistic 95% Lower Bound 95% Upper Bound 90% Lower Bound 90% Upper Bound
73.3706 19.2026 27.6452 15.6306 23.2137

****

If the statistic lies between the bounds, the test is inconclusive. If it is above the upper bound, the null hypothesis of no level effect is rejected. If it is below the lower bound, the null hypothesis of no level effect can't be rejected. The critical value bounds are computed by stochastic simulations using 20000 replications.

Table3: Diagnostic Tests

****

* Test Statistics *	LM Version	* F Version	*
* A: Serial Correlation	*CHSQ(1) = .62880[.428]	*F(1,14) = .31029[.586]	*
* B: Functional Form	*CHSQ(1) = 3.2066[.073]	*F(1,14) = 1.7405[.208]	*
* C: Normality	*CHSQ(2) = 4.0286[.133]	* Not applicable	*
* D: Heteroscedasticity	*CHSQ(1) = .92720[.336]	*F(1,27) = .89176[.353]	*

****

A: Lagrange multiplier test of residual serial correlation

B: Ramsey's RESET test using the square of the fitted values

C: Based on a test of skewness and kurtosis of residual

Table 4: Estimated Long Run Coefficients using the ARDL Approach

ARDL(1,2,2,2,1,0) selected based on Akaike Information Criterion

****

*

Dependent variable is LNRER

29 observations used for estimation from 1980 to 2010

****

*

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
TOT	1.4457	.16923	8.5426[.000]
LNOPN	-.90687	.15158	-5.9827[.000]
YG	-23.4605	3.1546	-7.4369[.000]
LNIGDP	.079986	.13748	.58179[.569]
POL	.065158	.094111	.69235[.499]
C	-.76028	.41486	-1.8326[.087]

Error Correction Representation for the Selected ARDL Model

ARDL (1,2,2,2,1,0) selected based on Akaike Information Criterion

****

Dependent variable is dLNRER

29 observations used for estimation from 1980 to 2010

****

*

Regressor	Coefficient	Standard Error	T-Ratio [Prob]
dTOT	.87033	.16931	5.1404[.000]
dTOT1	-1.0550	.18943	-5.5694[.000]
dLNOPN	.078854	.17378	.45375[.655]
dLNOPN1	.38183	.19243	1.9842[.062]
dYG	-7.5763	1.4050	-5.3922[.000]

dYG1	2.3781	1.2787	1.8598[.078]
dLNIGDP	-.16832	.059598	-2.8242[.011]
dPOL	.044340	.063168	.70194[.491]
ecm(-1)	-.68050	.10682	-6.3705[.000]

****

List of additional temporary variables created:

dLNRER = LNRER-LNRER(-1)

dTOT = TOT-TOT(-1)

dTOT1 = TOT (-1)-TOT (-2)

dLNOPN = LNOPN-LNOPN(-1)

dLNOPN1 = LNOPN (-1)-LNOPN (-2)

dYG = YG-YG(-1)

dYG1 = YG (-1)-YG (-2)

dLNIGDP = LNIGDP-LNIGDP(-1)

dPOL = POL-POL(-1)

ecm = LNRER -1.4457*TOT + .90687*LNOPN + 23.4605*YG - .079986*LNIGDP

-.065158*POL + .76028*C

****

R-Squared	.95823	R-Bar-Squared	.92204
S.E. of Regression	.10973	F-Stat. F(9,19)	38.2373[.000]
Mean of Dependent Variable	-.097891	S.D. of Dependent Variable	.39299
Residual Sum of Squares	.18062	Equation Log-likelihood	32.4914
Akaike Info. Criterion	18.4914	Schwarz Bayesian Criterion	8.9203
DW-statistic	1.7171		

R-Squared and R-Bar-Squared measures refer to the dependent variable dLNRER and in cases where the error correction model is highly restricted, these measures could become negative.

APPENDIX II

CUSUM AND CUSUMQ FOR COEFFICIENTS STABILITY

Figure 1

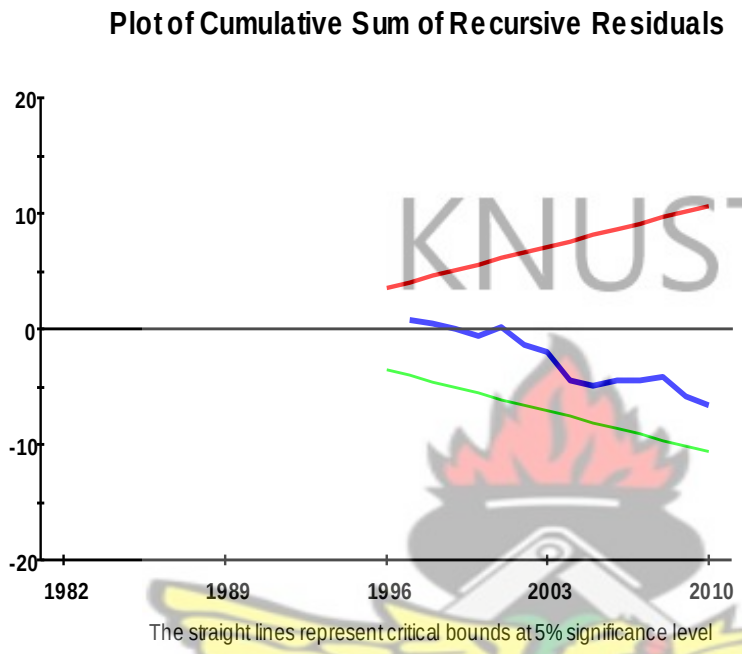


Figure 2

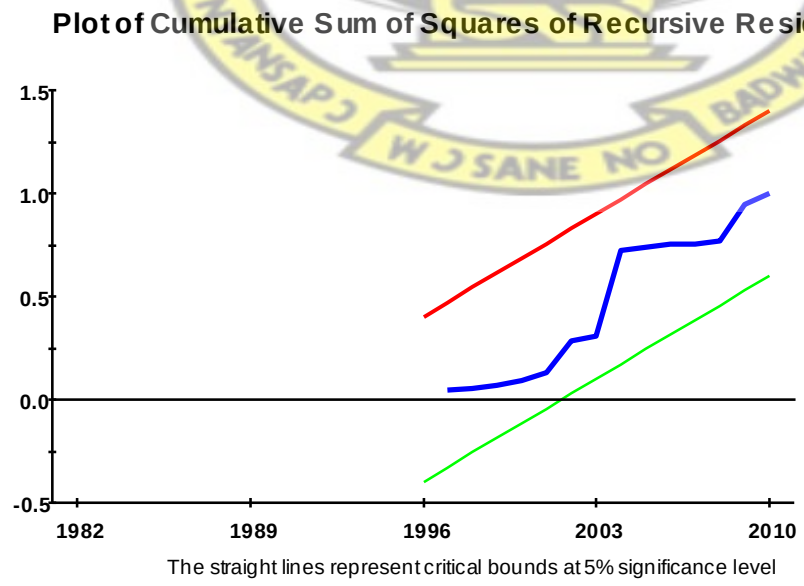


Figure 3

Plot of Actual and Fitted Values of dLNRER

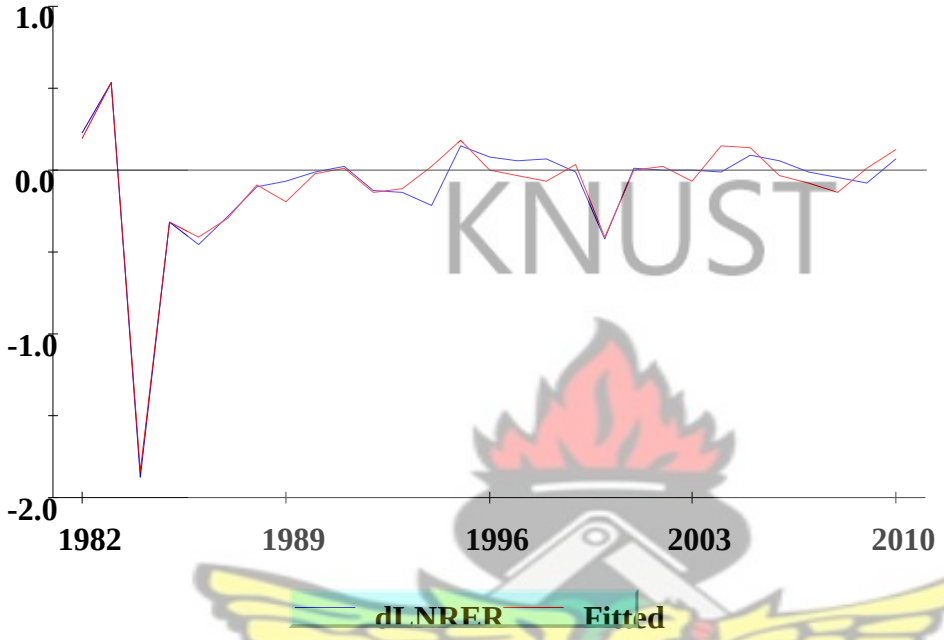


Figure 4

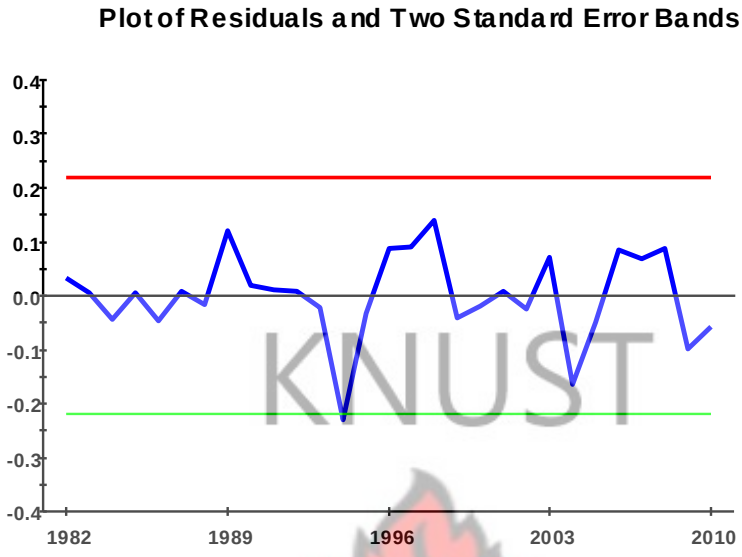


Figure 5

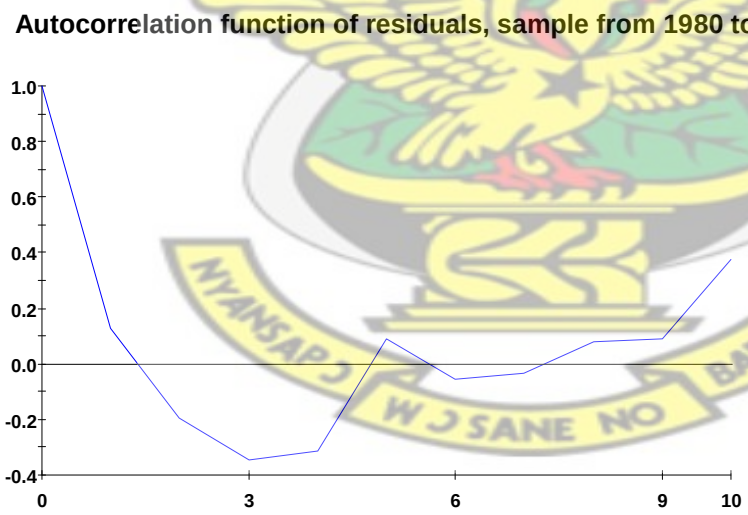


Figure 6

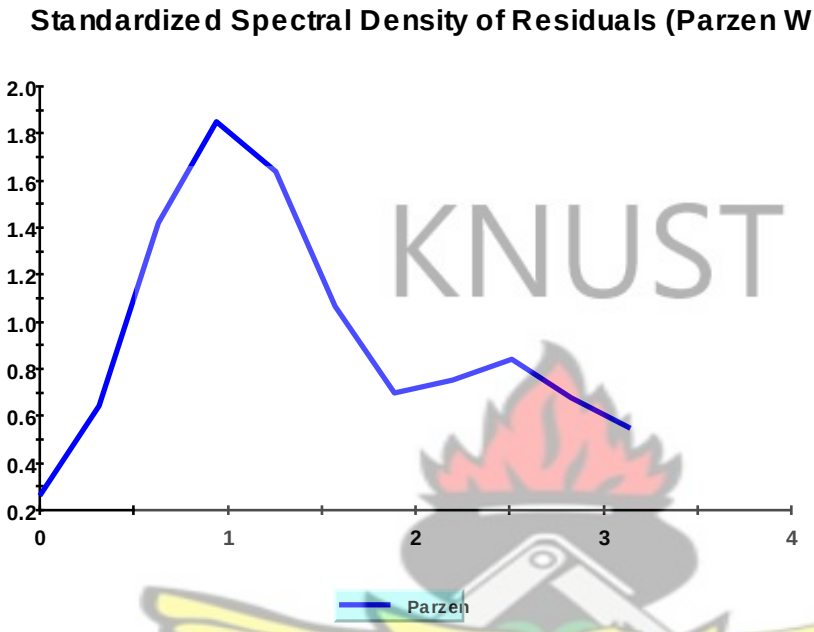
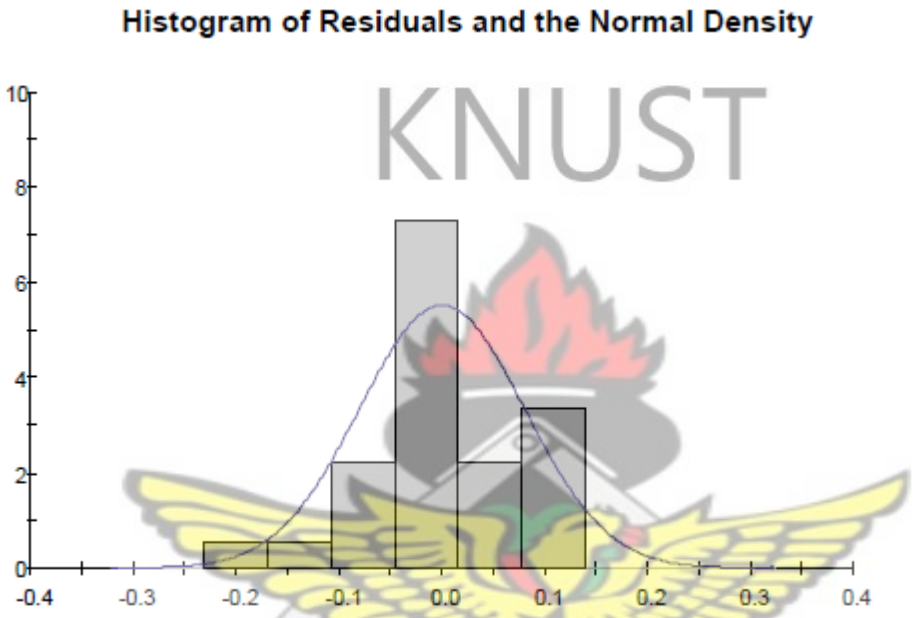


Figure 7



APPENDIX III

DATA USED FOR THE STUDY

Table 7:

Year	RER	TOT	OPENNESS	YG	IGDP	POL
1980	7.5051	2.0952	0.005402337	0.471695791	0.00817	0
1981	16.6921	1.8571	0.004922478	-3.50306747	0.03929	0
1982	20.92159167	1.25	0.00418212	-6.923650299	0.01709	0
1983	35.78764167	1.7037	0.003191669	-4.563737719	0.06543	0
1984	5.459483333	1.32	0.003136427	8.647569256	0.05954	0
1985	3.97555	1.2333	0.003500671	5.091617972	0.07827	0
1986	2.514958333	1.3542	0.003942672	5.199160071	0.08791	0
1987	1.882875	1.3191	0.00430805	4.794898731	0.1023	0
1988	1.6976	1.2584	0.004147438	5.628169742	0.10753	0
1989	1.585641667	1.0575	0.004250581	5.085872512	0.11373	0
1990	1.575133333	1	0.004345339	3.328818229	0.24188	0
1991	1.60795	1.0202	0.004528265	5.28182614	0.18211	0
1992	1.418466667	0.951	0.004578281	3.87941917	0.16215	1
1993	1.239358333	0.8922	0.005106536	4.85	0.14929	0
1994	1.0039	0.9423	0.005052084	3.3	0.166	0
1995	1.159666667	1.0667	0.005511272	4.112418938	0.15403	0
1996	1.26	1.0857	0.006196396	4.602460956	0.15386	1
1997	1.333091667	1.14	0.006214676	4.196357878	0.15542	0
1998	1.422675	1.2421	0.005733544	4.700390795	0.14045	0
1999	1.405083333	1.0957	0.007117505	4.399996536	0.02467	0
2000	0.919433333	1	0.011889138	3.7	0.16968	1
2001	0.929633333	1.0654	0.007135436	4	0.16996	0
2002	0.925616667	1.3561	0.006085509	4.5	0.14991	0
2003	0.92795	1.3488	0.006545416	5.2	0.16129	0
2004	0.91495	1.2509	0.006142929	5.6	0.17976	1
2005	1	1.2464	0.006148664	5.900003848	0.19049	0
2006	1.05255	1.2786	0.006869786	6.4	0.21657	0
2007	1.045441667	1.3672	0.007758095	6.45973558	0.22927	0
2008	0.995091667	1.5527	0.008687588	8.430504083	0.22958	1
2009	0.915525	1.6946	0.007994692	3.991472576	0.23815	0
2010	0.976375	1.7557	0.012162155	8.007257129	0.24715	0

Source: Authors Calculation Using Annual Data from the World Bank WDI 2011, IMF‟s IFS 2011, United Nations Conference on Trade and Development (UNCTAD) Hand Book of Statistics 2011 and Bank of Ghana (BoG) 2011.