THE REPUBLIC OF TURKEY
CUKUROVA UNIVERSITY
INSTITUTE OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS

REAL EXCHANGE RATE MISALIGNMENT AND MACROECONOMIC PERFORMANCE IN OPEN ECONOMIES: ANALYSIS ON SELECTED EMERGING MARKET ECONOMIES

ABDULLA HIL MAMUN

DOCTORAL THESIS

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Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Müdürlüğüne;

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- No changes have been brought to the data used and the results obtained

Finally, the thesis is my original work that has not been presented for a degree in any other university and I am fully responsible for any legal issues..../..../2019

Abdulla Hil MAMUN

ÖZET

DIŞA AÇIK EKONOMİLERDE REEL KUR VE MAKROEKONOMİK PERFORMANS: SEÇİLMİŞ YÜKSELEN PİYASA EKONOMİLERİ ÜZERİNE ANALİZLER

ABDULLA HIL MAMUN

Doktora Tezi, İktisat Ana Bilim / Ana Sanat Dalı

Danışman: Prof. Dr. Harun BAL

Mayıs 2019, 248 Sayfa

Reel Döviz Kuru (RDK) sapmasının açık ekonomilerin makroekonomik performansı üzerindeki etkisine ilişkin geleneksel görüş, RDK sapmasının uzun dönemde makroekonomik performansı negatif yönde etkilediği üzerinde yoğunlaşmaktadır. RDK sapmasının makroekonomik performans üzerindeki etkilerini sorgulayan mevcut çalışmalardan elde edilen bulgular bazı nedenlerden dolayı yanıltıcı olabilmektedir. RDK sapma değerlerinin elde edilişinde genellikle panel veri analizlerinin kullanıldığı bu çalışmaların güçlü homojenlik varsayımları, bu çalışmalardan elde edilen bulguların güvenilirliği konusunda kuşkulara yol açmaktadır. Çoğunlukla RDK sapmalarının açık ekonomilerin büyüme performansları üzerindeki etkilerine yoğunlaşan bu çalışmaların, RDK sapmaları paralelinde değişen ticaret dengesi, toplam yurtiçi tüketim düzeyi ve yatırım düzeyi gibi temel makroekonomik büyüklüklerdeki dinamiklerini göz ardı etmekte olup, karar alma süreçlerinde daha kapsayıcı politik çıkarımları mümkün kılmamaktadır. Bu bağlamda RDK davranışlarının heterojen yapısını doğrulamak için Tek-Denklem Yaklaşımı'nın benimsendiği bu çalışmada, öncelikle seçilmiş 1980-2016 döneminde Yükselen Piyasa Ekonomileri (YPE) için denge RDK ve RDK sapma değerleri tahmin edilmektedir. Bunun ardından Blundell & Bond (1998)'in SGMM tahmin yaklaşımı analiz yöntemi takip edilerek RDK sapmalarının YPE'nin makroekonomik performansları üzerine etkisi, eksik-değerlenme ve aşırı-değerlenme bağlamında ayrı ayrı incelenmektedir. Çalışmadan elde edilen bulgular, RDK sapmasının ve onun karşıt yönlü iki alt bileşenleri (eksik-değerlenme ve aşırı-değerlenme)'nin YPE'nin büyüme performanslarını olumsuz yönde etkilediğini doğrulamaktadır. Ayrıca eksik-değerlenmenin büyüme üzerine ters yönlü etkisi, toplam tüketim düzeyini azaltmasından dolayı daha da güçlenmektedir. Eksik-değerlenme ve aşırı-değerlenmenin ticaret dengesi ve yurtiçi yatırım düzeyi üzerine etkilerine ilişkin bulgular, teorik öngörülerle uyumlu olup, eksik-değerlenmenin dış fazla ve yurtiçi yatırımları teşvik ettiği, buna karşın aşırı-değerlenmenin tam tersi yönde sonuçlar doğurduğuna işaret etmektedir. Bununla birlikte RDK sapması, dış ticaretin denge düzeyine erişimini hızlandırmakta ve yurtiçi yatırım düzeyini teşvik etmektedir. RDK sapmasının ekonomik aktive üzerinde doğuracağı olası etkiler göz önüne alındığında, RDK'nun uzun dönem denge değerinden sapmasını önleyici yönde uygulanacak politikalar, YPE'nin makroekonomik performansları bakımından büyük önem taşımaktadır.

Anahtar Kelimeler: Reel Döviz Kuru Sapması, Tek-Denklem Yaklaşımı, SGMM, Yükselen Piyasa Ekonomileri.

ABSTRACT

REAL EXCHANGE RATE MISALIGNMENT AND MACROECONOMIC PERFORMANCE IN OPEN ECONOMIES: ANALYSIS ON SELECTED EMERGING MARKET ECONOMIES

ABDULLA HIL MAMUN

Ph.D. Thesis, Department of Economics

Supervisor: Prof. Dr. Harun BAL

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Traditional view acknowledges the detrimental impact of Real Exchange Rate (RER) misalignment on the macroeconomic performance of open economies from the long-term perspective. Findings of the earlier studies on the impact of RER misalignment on macroeconomic performance could be misleading as they typically rely on panel data methods in deriving misalignment series which is highly criticized for its strong homogeneity assumption. Moreover, they mostly investigate the growth performance of open economies in response to RER misalignment while dynamics in fundamentals like trade balance, the aggregate level of domestic consumption and domestic investment are also important to draw more inclusive decision. The study first estimates the equilibrium RER and RER misalignment of selected emerging market economies (EMEs) distinctly adopting single equation approach to confirm the heterogeneity of RER behavior in the long-run through 1980-2016 and then examines its impact on macroeconomic performance of the EMEs together with the respective impact of undervaluation and overvaluation employing Blundell & Bond's (1998) System Generalized Method of Moments (SGMM) estimation approach. Results suggest that RER misalignment and its two opposing components- undervaluation and overvaluation hurt the growth of EMEs. Again, the anti-growth effect of undervaluation is later supported by consumption regression as it finds that undervaluation dries up aggregate consumption. The impacts of undervaluation and overvaluation on the trade balance and domestic investment are in line with theoretical claims- undervaluation stimulates trade surplus and domestic investment while overvaluation erodes them. However, RER misalignment helps recover trade imbalances and promotes aggregate domestic investment. Considering the implications of RER misalignment on economic activity, avoiding distortion in RER from its long term equilibrium level is a crucial policy concern for emerging economies.

<u>Keywords:</u> Real Exchange Rate Misalignment, Single Equation Approach, SGMM, Emerging Market Economies.

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Abdulla Hil MAMUN

TABLE OF CONTENTS

CHAPTER V

REER MISALIGNMENT AND MACROECONOMIC PERFORMANCE OF EMERGING ECONOMIES

CHAPTER VI

CONCLUSION

ABBREVIATIONS

ADF	Augmented Dickey-Fuller
ARDL	Autoregressive Distributed Lag
ARE	United Arab Emirates
BEER	Behavioral Equilibrium Exchange Rate
CA	Current Account
CHEER	Capital Enhanced Equilibrium Exchange Rate
CPI	Consumer Price Index
CPS	Center for System Peace
DEER	Desired Equilibrium Exchange Rate
EME	Emerging Market Economies
EU	European Union
EUV	Export Unit Value Index
EREER	Equilibrium Real Effective Exchange Rate
FDI	Foreign Direct Investment
FEER	Fundamental Equilibrium Exchange Rate
FRED	Federal Reserve Economic Data
G	Government consumption
G7	Group of Seven
GDP	Gross Domestic Product
GMM	Generalized Method of Moments
H-P	Hodrick and Prescott
I	Investment spending
IEB	Internal-External Balance
IFS	International Financial Statistics
IMF	International Monetary Fund
KA	Capital Account
LDC	Least Developed Countries
MSCI	Morgan Stanley Capital International
NATREX	The Natural Real Exchange Rate
NFA	Net Foreign Assets
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development

OLS	Ordinary Least Squares
OPEN	Trade Openness
PEER	Permanent Equilibrium Exchange Rate
PP	Phillips-Perron
PPP	Purchasing Power Parity
PROD	Productivity Differentials
PWT	Penn World Table
REER	Real Effective Exchange Rate
RIRD	Real Interest Rate Differentials
S&P	Standard and Poor
SCRER	Stable and Competitive Real Exchange Rate
SGMM	System GMM
SSA	Sub-Saharan African
TOT	Terms of Trade
TPI	Traded-goods Price Index
UIP	Uncovered Interest Parity
ULC	Unit Labor Costs index
UNCTAD	United Nations Conference on Trade and Development
WAEMU	West African Economic and Monetary Union
WB	World Bak
WDI	World Development Indicators
WEO	World Economic Outlook
WPI	Wholesale or Producer Price Index

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1. Background of the Study

The Real Effective Exchange Rate (REER), as a comprehensive summary indicator of the prices of goods and services of a country in relation to the others, has broadly been accepted as a major contributing factor to the macroeconomic performance of any economy, and thus has become one of the most widely researched topics in open economies. Researchers and policymakers have consensus that REER dynamics affect macroeconomic performance, the ways it affects can be interpreted differently.

The REER that is conducive to both internal and external equilibrium of a country is referred to as equilibrium REER. An economy's internal balance is the situation when the economy operates at the level of full employment and external balance is achieved when the balance of payments is close to balance. Deviation in REER from its equilibrium value, that is, overvaluation or undervaluation in REER, which is also termed as REER misalignment exerts considerable impact on macroeconomic performance of open economies. Overvaluation of REER is generally viewed as the unpredictability of the choices of macroeconomic policies that may result in an unsustainable current account deficit, a significant rise in external debt and the risk of possible speculative attacks. However, an undervaluation in REER promotes investment and exports strengthening competitive position of economies which causes the current account position to improve and thereby stimulates output growth of the economies (Jongwanich, 2009; Kaminsky, Lizondo, & Reinhart, 1998; Razin & Collins, 1997; Rodrik, 2008; M. Schröder, 2013; Magud & Sosa, 2013; Bal & Akça, 2015)

Without determining the equilibrium REER, exchange rate deviations will remain a subjective phenomenon. Therefore it is highly necessary to identify the equilibrium REER as well as to examine REER misalignments to evaluate its impact on macroeconomic performance of open economies.

The consistently faster growth performance of emerging market economies (EMEs) as compared to the advanced economies has made them as the key driver of global growth over the last few decades. If the growth records of EMEs are observed from a longer-term perspective, they maintain fairly a greater growth rate than the advanced economies since the 1980s. As figure 1 illustrates, while there was a declining trend in the growth of advanced economies, emerging economies experienced a higher growth over the last three decades, of which the last decade, that is, 2000s was remarkable, as average GDP growth in these economies picked at just over 5.6 percent which was averaged near about 1.6 percent in advanced economies over the same time period and less than 4 percent in EMEs in earlier decades. In the current decade, the growth despite the slowdown is averaged as almost 4.5 percent compared to 2.53 percent of advanced economies. The growth in EMEs has been on a declining trend since the financial crisis of 2008-09, while a modest recovery is continued in advance economies since 2013. Despite the slowdown of economic growth, EMEs still account for over 70 percent of global growth (IMF, 2018).

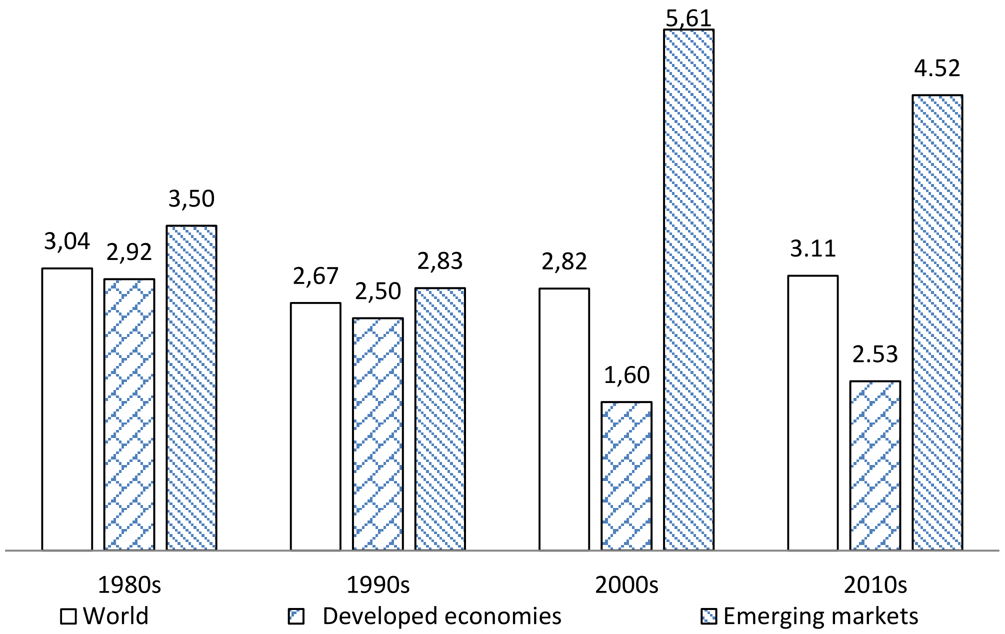


Figure 1 GDP growth rate in past decades
Source: UNCTAD Database, January 2019

While emerging economies are the major contributor to global growth, a great contrast was observed within EMEs in terms of their macroeconomic performance in the last half of the twentieth century, particularly- Latin American countries underwent frequent currency shocks, while Asian economies managed to keep up exchange rate stability except for the period of the Asian crisis of 1997-98.

Latin American countries started to actively manage their exchange rates in the last decade (Habermeier, Kokenyne, Veyrune, & Anderson, 2009). Colombia, Chile, Brazil and other EMEs with their professed inflation-targeting regimes have involved in extensive intervention of their exchange rates and their reserves substantially increased owing to the rise in flow of foreign capital into these countries (Aizenman & Hutchison, 2012; Céspedes, Chang, & Velasco, 2014; Ebeke & Fouejieu, 2018). This change became particularly apparent during the so-called Great Recession in 2008-2011. In contrast to the concerns of many observers, majority of the Latin America countries were able to repel major external shocks - including a sudden, though temporary, reversal of capital inflows, without being subjected to currency collapses or balance of payments crises (Edwards, 2011).

A relatively stable REER is a fundamental factor of economic stability as viewed by many authors (Edwards, 1989a, 2011; Edwards & Levy Yeyati, 2005; Schröder, 2017; Sirimaneetham & Temple, 2009; Sissoko & Dibooglu, 2006; Tan & Chong, 2008) and hence, with the increase in the alternative exchange rate policy opportunities, the effects of choice of exchange rate regime on macroeconomic conditions of emerging economies bear a great deal of attention particularly because of their divergence in exchange rate management.

1.2. Rationale of the Study

Researchers and policymakers have a strong interest in REER misalignment particularly because of its influence in causing instability and are expected to affect the macroeconomic performance of economies. While emerging Asian economies have been able to achieve a miraculous growth, characterized by 8.7% annual economic growth rate following deliberate management of their exchange rate policies, emerging Latin American economies endured persistent currency crisis owing to poor manipulation of the exchange rate regime over the second half of the twentieth century.

However, Latin American economies were stable in the last decades and even after the great recession of 2008-09 as they took lessons from the past and actively intervened in the foreign exchange market. Therefore, an appropriate exchange rate regime that allows maintaining the REER adjacent to its equilibrium value results in stability in macroeconomic performance of open economies.

Realizing the enormous significance of the conjugation of equilibrium REER and REER misalignment on macroeconomic performance, plenty of research effort has been devoted to examining REER movements and its impact on macroeconomic performance of open economies. Consulting with the available empirical studies, the following missing gaps are identified-

1. Despite the EMEs are the major contributor to global growth, nearly 70 percent, no recognized study has been found in recent years evaluating their macroeconomic performance in response to REER misalignment particularly after the East Asian financial crisis, following which both the crisis affected emerging Asian economies and the emerging Latin American economies passing through frequent currency crisis over the last half of the twentieth century have been able to recover through appropriate management of their exchange rate policies (Rajan, 2012; Damill & Frenkel, 2017).
2. Despite there being a wide range of studies concerning the effects of REER misalignment on macroeconomic performance, very few of them cover all the major macroeconomic components contribute to economic growth. They mostly concentrate on the growth and export performance of developing and emerging economies in relation to deviation in REER from its equilibrium values. However, there is no documented empirical evidence found that assesses the consequences of exchange rate misalignment to economic performance covering all major macroeconomic components including the growth of emerging economies, particularly after the Asian crisis.
3. Earlier studies relying on country level and panel data greatly differ in terms of their analytical framework, leading to diverse findings on REER misalignment and its implication on macroeconomic performance of emerging as well as developing economies.

This research is an attempt to bridge these voids. It is in response towards the need felt for a common analytical framework for examining misalignment in REER so as to make a more inclusive decision relating to its effects on economic performance of selected emerging economies encompassing all major components of aggregate expenditure that determine economic growth.

1.3. Objectives of the Study

An economy's macroeconomic fundamentals can be significantly influenced by the shift of exchange rate regimes. Debate on exchange rate regime choice among experts is an ongoing issue, and with the rise in the variety of alternative exchange rate options and capital mobility, and with the intensified international trade and investment relations, the appropriate choice of exchange rate regime to serve the interest of individual economies in the best possible way has become the major concern of policymakers. With this concern, the main purpose of the study is to examine the REER misalignment under different choices of exchange rate and its impact on major components of aggregate expenditure of EMEs.

There is a disagreement among institutions on EMEs. Both the International Monetary Fund (IMF) and Morgan Stanley Capital International (MSCI) classify twenty three (23) countries as emerging markets though there are some differences between the two charts. Standard and Poor's (S&P) and Russell each classify twenty one (21) countries as emerging markets, while there are twenty two (22) EMEs in Dow Jones' list. Table 1 offers a list of common countries that all five institutions classify as emerging markets and the remaining countries classified by individual institution as of 2016.

Table 1
Emerging Market Economies

<table>
<tr><th>Organization</th><th>Common Countries</th><th>Remaining Countries</th></tr>
<tr><td>IMF</td><td rowspan="5">Brazil, Chile, China, Colombia, Hungary, Indonesia, India, Malaysia, Mexico, Philippines, Peru, Poland, Russia, Turkey, Thailand and South Africa</td><td>Argentina, Bangladesh, Bulgaria, Pakistan, Romania, Ukraine and Venezuela</td></tr>
<tr><td>MSCI</td><td>Bangladesh, Czech Republic, Egypt, Greece, Qatar, South Korea, Taiwan and ARE</td></tr>
<tr><td>S&P</td><td>Bangladesh, Czech Republic, Egypt, Greece and Taiwan.</td></tr>
<tr><td>Dow Jones</td><td>Czech Republic, Egypt, Greece, Qatar, Taiwan and ARE.</td></tr>
<tr><td>Russell</td><td>Czech Republic, Greece, South Korea, Taiwan and ARE.</td></tr>
</table>

Source: Author's compilation based on web information of individual institutions

The study will consider economies following floating, free-floating or other managed exchange rate arrangement under monetary aggregate target or inflation targeting framework. Emerging economies from all major regions of the globe have been covered in undertaking the research. Hence, the study includes 21 emerging economies that are Argentina, Bangladesh, Brazil, China, Chile, Colombia, Egypt, Greece, Indonesia, India, Malaysia, Mexico, Pakistan, Philippines, Peru, Poland, South Korea, South Africa, Turkey, Thailand and United Arab Emirates (ARE).

Economic growth, aggregate domestic consumption, domestic investment and trade balance are taken as the key macroeconomic indicator to examine the macroeconomic performance of selected EMEs and thus the research is carried out following some specific objectives-

Firstly, it will investigate the potential determinants of REER with an aim to determine its equilibrium values for each of the EMEs.

Secondly, it will empirically analyze the effect of undervaluation and overvaluation of REER on economic growth, aggregate consumption expenditure, aggregate domestic investment and trade balance.

Finally, it will examine the consequences of REER misalignment on economic growth, aggregate consumption expenditure, aggregate domestic investment and trade balance.

However, a certain exchange rate regime must not be suitable for all economies as the success of a particular choice largely depends on an economy's macroeconomic policies and institutions. Again, a country may abundant a policy and shift in choice may bring the a desirable outcome. The study will critically examine these issues.

1.4. Organization of the study

Following the introduction and background of the study in chapter one, the remainder of the thesis is structured as follows:

Chapter two presents the concepts of REER and explains the approaches used to measure the equilibrium REER with reference to their empirical evidence. Misalignment of REER is the deviation of actual REER from its equilibrium value determined by a set of fundamentals that are discussed in brief.

As the study aims to examine the impact of misalignment on macroeconomic performance of EMEs, a brief review of literature summarizing the theoretical abstracts and empirical results of earlier studies on the nexus between currency misalignment and the selected fundamentals is furnished in chapter three in four broad sections.

Chapter four is devoted to the measurement of equilibrium REER and the corresponding misalignment series of twenty one EMEs. It first lays down the theoretical and empirical framework for the estimation of equilibrium REER. Delineating the methodology, it then proceeds for the estimation of misalignment series.

Derivation of misalignment series of REER allows examining its impact on macroeconomic performance of emerging economies, which is the main interest of the study. This has been dealt with in chapter five. Four different regressions, namely- growth regression, trade regression, consumption regression and investment regression are conducted to address the issue.

Conclusion of the study comes up in chapter six that contains policy implications and limitations and ends with the scope of future research.

CHAPTER II

REER AND MISALIGNMENT: CONCEPTS AND MEASUREMENTS

2.1. Introduction

The REER measures the real value of a country's currency in relation to the basket of currencies of the trading partners of the country. The departure of REER of a currency from its equilibrium value is referred to as REER misalignment. REER and corresponding misalignment of a currency gain special significance both in theoretical and applied economic research and in policy research particularly because of its wide range of uses. While REER is used in determining the equilibrium value of a currency and its corresponding misalignment, they two together play an important role in explaining competitiveness, trade flows, resource reallocation between tradable and non-tradable goods and thereby growth of open economies. With regard to the determination of equilibrium REER, scholars revised and modified the earlier concepts constantly with the advancement of econometric techniques and concurrent economic events particularly since the breakdown of Bretton Woods System in 1971. Elucidating various concepts of exchange rates, this chapter will summarize some of the typical approaches used to estimate the equilibrium REER. It will provide a selective review of literature on the macroeconomic fundamentals used to model the dynamics in REER.

2.2. Exchange Rate

Being the relative price of currencies or outputs between two countries, exchange rate plays an important role in determining the costs and gains relative to both trade and financial transactions. It also acts as the balancing price of supply and demand for foreign currency in the foreign exchange market. For instance, a surplus in foreign currency reflected by BOP surplus causes the exchange rate to fall which is referred to as an appreciation of domestic currency that makes the import cheaper at the cost of fall in income from exports. Consequently, the surplus in BOP reduces and so does the surplus in foreign currency due to the fall in export and rise in imports. In the opposite case, shortage in foreign currency disappears through depreciation of the domestic currency. The exchange rate can be viewed both from nominal and real senses. Again it can be bilateral or multilateral from the real sense.

2.2.1. Nominal vs. Real Exchange Rate

While the nominal exchange rate, the relative price of two currencies, tells the units of home currency that can be exchanged for a unit of a certain foreign currency, the real exchange rate measures the amount of domestic goods and services that can be exchanged for a given amount of goods and services of that particular foreign country. The real exchange rate RER is expressed as the ratio between foreign and domestic price level where the foreign price level is expressed as the domestic currency unit using nominal exchange rate. By formula,

Real Exchange Rate, $RER = \frac{E.P^*}{P}$ (2.01)

where E is the nominal exchange rate, P is the price level at home and $P*$ is the price level abroad. A rise in real exchange rate refers to its depreciation which means that domestic goods are less expensive in relation to foreign goods; alternatively, the domestic currency loses its purchasing capacity. Likewise, a decrease in the real exchange rate represents appreciation that enhances the purchasing capacity of the domestic currency.

But what is imperative to pay attention to the real exchange rate instead of nominal exchange rate in evaluating the effects of change in exchange rate on international trade and trade competitiveness because of two major reasons:

1. Real exchange rate is a floating concept as it changes incessantly in response to the changes in price level even when the nominal exchange rate is fixed.
2. Remaining the foreign price level unchanged, a similar but opposite change in domestic price level and domestic currency value will leave the real exchange rate unaffected and so as for the export demand of foreign and home economies. For instance, a 5 percent increase in domestic price level with 5 percent depreciation in nominal exchange rate remaining the price level abroad unchanged will leave the real exchange rate unchanged and consequently the demand for export of foreign and home economies will remain unaltered.

2.2.2. Real Effective Exchange Rate (REER)

Real exchange rate as shown in equation 2.01 is necessarily bilateral in nature as it measures the relative prices of outputs between two countries. But a country trades with many others simultaneously and therefore a multilateral exchange rate will be useful to measure the relative price of domestic goods and services in terms of a basket of goods and services of other major trading partners which is known as REER (q). REER is the weighted average of bilateral real exchange rate where trade share of a trading partner in a country's total trade constitutes the weight. Thus,

$$\text{Real Effective Exchange Rate, } q = \sum_{i=1}^{n} \left(E_{srt} \times \left(\frac{P_{rt}}{P_{st}} \right) \right)^{w_{sr}} \qquad (2.02)$$

where P_{rt} is the price index of home country (r) at time t, P_{st} is the price index of the trading partner's (s) at time t, E_{rst} is the nominal bilateral exchange rate of country r with s, w_{sr} is the weight of the trading partner s in the country's total trade, and n stands for the number of total trading partners. The share of country s in country r's total trade determines the weight w_{sr}. An appreciated REER is associated with a smaller trade balance and a depreciated REER is expected to bring about the opposite result. Despite the difference between RER and REER, the terms are used interchangeably in most of the empirical studies.

2.2.3. Actual vs. Equilibrium REER

Actual REER may differ significantly from its equilibrium values. REER defined by equation 2.02 is a measure of its actual value. But to arrive at its equilibrium value, one should consider the objectives of attaining the external and internal balance simultaneously for sustainable values given for other variables that may influence these objectives (Nurkse, 1945). Therefore, the value of REER that can confirm the external and internal equilibrium at the same time for given sustainable values of other influencing variables in achieving it is referred to as equilibrium REER. Here, the external equilibrium is a state in which the current account deficit can be financed by a "sustainable" level of capital inflows, while the internal equilibrium is achieved when the market for non-traded goods reaches to a "sustainable" equilibrium (Peter J. Montiel, 2001). There is a substantial degree of agreement among researchers to this definition in developing the approaches to determine the equilibrium REER. The next section summarizes these approaches.

2.3. Approaches to Measuring Equilibrium Real Exchange Rate

Currency movements in the underlying equilibrium mean that they are correctly priced, otherwise they represent misalignments. Therefore, it is necessary to measure equilibrium values of exchange rate to find misalignments of currencies. There are a number of alternative approaches to the determination of equilibrium real effective exchange rate. Driver & Westawa (2005) summarize the empirical approaches to estimating equilibrium exchange rates under different time horizons with their necessary theoretical and statistical assumptions. As the formulation and development of new approaches are observed in regular intervals, an exhaustive discussion of all the approaches is inconceivable. Here, a brief overview of the approaches typically used will be presented with reference to their empirical evidence. The approaches include-

1. The Purchasing Power Parity (PPP) Approach
2. Balassa-Samuelson Approach
3. Uncovered Interest Parity (UIP) Approach
4. The Monetarist Approach
5. Capital Enhanced Equilibrium Exchange Rate (CHEER)
6. The Macroeconomic/ Internal-External Balance Approach
   6.1 Fundamental Equilibrium Exchange Rate (FEER)
   6.2 Desired Equilibrium Exchange Rate (DEER)
   6.3 The IMF's Internal-External Balance (IEB) Framework
   6.4 The Natural Real Exchange Rate (NATREX)
7. Behavioral Equilibrium Exchange Rate Approach (BEER)
8. Permanent Equilibrium Exchange Rate (PEER)
9. Single Equation Approach

They are explained below with their merits and drawbacks.

2.3.1. The Purchasing Power Parity (PPP) Theory

The most commonly used measure of equilibrium REER is backed by the theory of purchasing power parity (PPP) coined by Gustav Cassel in 1918. The absolute PPP condition that leaves people indifferent in purchasing goods from home or abroad is described as equilibrium REER. The PPP theory is based on the basic postulate of one price law which states that, when trade is free and costless, the price of a commodity will be same at home and abroad when converted into a common currency at the nominal exchange rate. Now, if the law of one price holds true for all the commodities entered into a reference basket used to measure price level, the price of the reference basket at home and abroad will be same in a common currency, and the equilibrium REER (q^*) can be expressed as-

$$q_t^* = \frac{E_t P_t^*}{P_t} = 1 \qquad (2.03)$$

which is also known to as absolute PPP where P_t is the home price level and its asterisk stands for foreign price level and E_t is the nominal exchange rate. Hence, the theory of PPP simply implies that the real exchange rate will be constant and unity. Alternatively, the condition for PPP to hold is:

$$p_t - p_t^* = e_t \qquad (2.04)$$

$$where, p_t = lnP_t, p_t^* = lnP_t^* \ and \ e_t = \ lnE_t$$

The law of one price, based on which the equilibrium REER is determined, assumes an integrated competitive market free of transportation costs and official trade barriers. But, such a fictitious market does not really exist because even in the presence of costless free trade, which is also elusive, it is not possible to ship commodities instantly across locations at a particular point of time and hence commodity prices differ in different locations. Besides, prices of goods and services between countries may not be the same when expressed in terms of the same currency particularly because of the inclusion of non-tradable and differentiated goods in their reference baskets. Moreover, the aggregate purchasing power between countries might be different owing to probable differences in the composition of the price indices (MacDonald, 2007; Terra, 2015). Because of the violation of Absolute PPP for the reasons discussed so far, a relatively undisputable variant of PPP is introduced known as relative PPP. Each of the values of real exchange rate has a corresponding value of trade balance. The equilibrium REER always guarantees equilibrium in the current account. Relative PPP should hold true at the equilibrium REER, remaining the variables that determine REER unchanged. The relative PPP states that changes in the relative prices should be translated into the nominal exchange rate spontaneously so that the constant level of REER is maintained. The equilibrium REER under relative PPP can be expressed as follows:

$$q_t^* = \frac{E_t P_t^*}{P_t} = \lambda \tag{2.05}$$

where λ is any constant representing the trade barriers and variation in the reference basket between the countries.

Therefore, based on the PPP theory, equilibrium REER remains constant over time. So far the PPP is concerned as the equilibrium exchange rate, any deviation of the real exchange rate from unity or a constant indicates misalignment in the exchange rate. However, the theory is criticized particularly because of the extensive drawback of PPP from empirical perspective. The mean reversion of the REER to a constant level of PPP is found to be very low or absent in most of the empirical tests (MacDonald, 1995; Rogoff, 1996). Another weakness of PPP is that giving importance on monetary sources of REER fluctuations alone, it fails to give proper attention to the changes in the sustainable REER that are caused by real macroeconomic fundamentals (Edwards, 1989a; Ghura & Grennes, 1993; Macdonald, 2000).

2.3.2. Balassa-Samuelson Approach

One of the reasons why PPP may not hold is due to the inclusion of non-tradable goods in the reference baskets. If the composition of the reference baskets includes both tradable and non-tradable goods and services, PPP will no longer be held for definitions of the real exchange rate. It is the origin of Balassa-Samuelson approach which assumes that the forces underlying PPP related to arbitrage will merely affect traded goods and hence the productivity differentials between traded and non-traded goods sectors will influence real exchange rates defined using the CPI which also incorporates non-traded goods. Wage growth is perceived to be high for countries having high productivity growth, which results in higher real exchange rates. The Balassa-Samuelson effect illustrates that there will be a higher wage in the non-tradable goods sector following a wage increase in the tradable sector of an economy, which will lead to a relative appreciation of currency of that economy. REER in logarithmic form can be given as-

$$q_t = e_t - p_t + p_t^* \quad (2.06)$$

where q is the REER, e stands for nominal exchange rate, p and its asterisk show price levels at home and abroad. As PPP holds for tradable sector, this relation is retained for tradable goods, T:

$$q_t^T = e_t - p_t^T + p_t^{T^*} \quad (2.07)$$

Assuming constant returns to scale in production and perfect mobility of labor domestically between traded and non-traded sectors but is fixed internationally, and based on the wage growth argument in both the tradable and non-tradable sectors, the Balassa-Samuelson model decomposes price level into traded and non-traded prices and hence price levels at home and abroad are expressed as the weighted average price indices of tradable (T) and non-tradable (NT) goods:

$$p_t = \theta p_t^T + (1-\theta) p_t^{NT} \quad (2.08a)$$

$$p_t^* = \theta^* p_t^{T^*} + (1-\theta^*) p_t^{NT^*} \quad (2.08b)$$

where the weight θ is the proportion of traded goods within the economy. Therefore, the general form of the actual REER equation can be derived substituting equation (2.07), (2.08a) and (2.08b) into equation (2.06):

$$q_t = \left(q_t^T + p_t^T - p_t^{T^*}\right) - \theta(p_t^T - p_t^{NT}) + \theta^*(p_t^{T^*} - p_t^{NT^*}) \quad (2.09)$$

The real exchange rate is therefore determined by the real exchange rate of tradable goods, the relative prices of tradable and non-tradable goods between home and abroad and the weights of tradable and non-tradable goods in both economies. Wage increase in the tradable sector of a country resulting from productivity growth will shift to nontradable sector which causes prices of non-tradable goods to rise and thereby the relative prices of nontradables to tradables will grow very swiftly. The end result will be an appreciation of the CPI-based real exchange rate of the associated economy relative to others. MacDonald & Ricci (2005) find evidence of real exchange rate appreciation even if the income growth of an economy deepens the productivity growth and product market competition endogenous to the distribution sector of an economy in response to its income growth with respect to foreign countries. However, Devereux's (1999) finding under such situations is quite contrasting, that is, forces may work in a reverse way and the fast-growing countries may encounter real exchange rate depreciation. Typical empirical studies find that productivity differentials between traded and non-traded goods have some influence on real exchange rate movement, but these are not large enough to be taken into account (Ricci, Milesi-Ferretti, & Lee, 2013).

Stationarity of real exchange rate in terms of tradables and the cointegrating relationship between the relative prices of nontraded to traded goods and CPI-based real exchange rate can batter interpret the Balassa-Samuelson effects econometrically. However, when the Balassa-Samuelson effects are not present, non-stationarity observed in the CPI-based real exchange rate can be explained by tradables real exchange rate (Driver & Westawa, 2005).

2.3.3. Uncovered Interest Parity (UIP) Approach

Interest parity condition neutralizes investors aligning expected returns on deposits of any two different currencies when measured in the same currency. Uncovered interest parity condition that does not make use of a forward contract to hedge against exposer to foreign exchange risk is often used as a basis for explaining exchange rate movement. The condition can be given as-

$$i_t - i_t^* = \frac{S_{(t+1)}^e - S_t}{S_t} \qquad (2.10)$$

where home and foreign nominal interest rates are shown by i and its asterisk, S_t is the nominal spot exchange rate at time t, and S_{t+1}^e is the expected spot exchange rate a year from t.

Now, $$s^e - s = \ln S^e - \ln S = \ln \frac{S^e}{S} = \ln\left(1 - \frac{S^e - S}{S}\right) \approx \frac{S^e - S}{S} \qquad (2.11)$$

Therefore, the uncovered interest parity condition in equation (2.10) can be expressed as:

$$s_{t+1}^{e} - s_t = i_t - i_t^{*} \tag{2.12}$$

where s_t is the log of the nominal spot exchange rate. Clearly, greater domestic interest rates over foreign interest rates will cause expected depreciation of the domestic currency in order to make investors indifferent in holding deposits at home and abroad. Deducting expected inflation differential from both sides of equation 2.12, we can arrive at the real interest parity condition the study is much concerned with. Hence, the real interest parity condition stands-

$$q_{t+1}^{e} - q_t = r_t - r_t^{*} \tag{2.13}$$

where r and its asterisk stand for home and foreign real interest rate, respectively, q is the REER and q^e is its expected value. Reorganizing equation 2.13, we get-

$$q_t = q_{t+1}^{e} - (r_t - r_t^{*}) \tag{2.14}$$

That is, observed REER, $q_t$is a function of the expected REER, q^e and real interest rate differential, $(r_t - r_t^{*})$.

Rather than tying down the level of REER, the UIP condition more explicitly explains the adjustment path towards the equilibrium or the rate of change in REER (Roudet, Saxegaard, & Tsangarides, 2007). What makes the use of UIP challenging is the unobservable expected REER, q^e, a precise measure of which in accordance with real interest differentials is also unlikely (Driver & Westawa, 2005). Moreover, most of the exercises attempted to explain changes in exchange rate by interest rate differentials are proved to be futile as the interest rate differential is repeatedly found to bear inappropriate sign (Lewis, 1995). Most importantly, UIP is empirically unsuccessful in envisaging exchange rate movement as its estimates ignore the probable changes in the expected long run, or equilibrium, exchange rate.

2.3.4. The Monetarist Approach

Assuming both PPP and UIP hold continuously, the monetarist model of exchange rate determination emphasizes on money market clearing condition in determining prices in each economy. The money market clearing condition for home and foreign can be given as:

$$m_t - p_t = \eta y_t - \nu i_t \tag{2.15}$$

$$m_t^* - p_t^* = \eta y_t^* - \nu i_t^* \tag{2.16}$$

where *m* and *p* are log of the domestic money stock and price level, respectively. *y* is the log of domestic income level and *i* is the nominal domestic interest rate. Asterisks are used to show the money market equilibrium condition at foreign.

Rearranging equation 2.15 and 2.16 for price levels of the home and abroad, respectively, and setting them into equation 2.04 to confirm PPP holds continuously, we get-

$$e_t = (m_t - m_t^*) - \eta(y_t - y_t^*) + \nu(i_t - i_t^*) \tag{2.17}$$

which is the so-called ‘reduced-form exchange rate equation’ under the monetary approach implying that nominal exchange rate is determined by relative money supplies, relative income levels and relative interest rate. UIP condition to hold, the expected rate of depreciation of the home currency has to be $(i_t - i_t^*)$, the interest rate differential between home and foreign bonds as shown in equation 2.10. Domestic currency depreciates at an equivalent rate at which domestic money supply is increased and increases the domestic interest rate, and thus the interest rate differential, causes depreciation by reducing the demand for the real balance of domestic currency. But it is noteworthy that the change in real variables that can bring about a change in demand for real balance can only alter the nominal exchange rate. For example, remaining money stock and interest rate fixed, a rise in domestic income level leads to an appreciation of domestic currency by increasing real demand for money and thereby pushing the price level down. However, this version of the monetary model is based on the flexible price argument- be they wages, prices or exchange rates. MacDonald & Taylor (1994), based on cointegration technique, find the framework is valid for analyzing ling-run exchange rate and do better than other models for out-of-sample forecasting outperforming the random walk. Husted & MacDonald (1999), in order to scrutinize certain Asian currencies for the period 1974 to 1996, and Rapach & Wohar (2004), while investigating currencies of 19 countries using Mark & Sul (2001) data set that covers quarterly data from 1973:1–1997:1, apply panel cointegration analysis and also find evidence to support the monetary approach in estimating equilibrium exchange rate. Chinn's (2000a) investigation on the "synthetic" euro using monthly data for a greater part of the 1990s based on the Johansen cointegration technique confirms a monetary approach relationship as well. However, Rapach & Wohar (2002) use vector error-correction models to investigate monetary approach relationship and do not find the model suitable for interpreting the long run equilibrium exchange rate nearly half of the countries they consider.

2.3.5. Capital Enhanced Equilibrium Exchange Rate (CHEER)

The drawbacks of UIP and PPP suggest that alternative approaches are needed. One approach that explains the persistence in real exchange rate is known as Capital Enhanced Equilibrium Exchange Rate (CHEER) that combines both UIP and PPP in order to obtain well-defined measures of equilibrium exchange rate by estimating a cointegrating relationship among relative prices, nominal interest rate differentials, and the nominal exchange rate (Sren Johansen & Juselius, 1992; Macdonald, 2000; MacDonald, 2007; MacDonald & Marsh, 2014).

According to this approach, the nominal interest rate differential (UIP condition) and relative prices (PPP condition) together determine the exchange rate. Even though the PPP may explain shifts in REER in the long-run, the non-zero interest rate differentials that may be required for financing capital account may stray away from the REER from equilibrium.

The log-linear form of nominal uncovered interest parity (UIP) condition in equation 2.12, where s is the natural logarithm of nominal exchange rate S, the rate at which domestic currency is exchanged with foreign currency, can be expressed as:

$$s_{t+k}^{e} - s_t = i_t - i_t^*$$

or, $$\Delta s_{t+k}^{e} = i_t - i_t^* \qquad (2.18)$$

where i and its asterisk represent the nominal interest rate at home and abroad, respectively. Now, if PPP holds true, it means that the value of expected nominal spot exchange rate s_{t+k}^{e} can be determined by using relative prices, and thus expression 2.18 takes the following form:

$$i_t - i_t^* = \theta_1(p_t - p_t^*) - s_t \quad (2.19)$$

where p and its asterisk are natural logarithms of price indices at home and abroad, respectively. Clearly, if interest rate differentials die out in the long-run, as reported by Driver & Westawa (2005), the exchange rate is determined in accordance with PPP.

Empirical studies suggest that interest rate differentials are non-stationary, that is, I(1) processes (Juselius & MacDonald, 2000), the linear combination of an appropriate interest rate differential and the real exchange rate may cointegrate down to the following stationary process:

$$[s_t + \theta_1(p_t - p_t^*) + \theta_1(i_t - i_t^*)] \sim \mathrm{I}(0) \quad (2.20)$$

Hence, the CHEER approach, in cointegration terms, is about to exploit the following vector:

$$x' = [s, p, p^*, i, i^*] \quad (2.21)$$

The approach can effectively forecast bilateral exchange rate changes owing to the faster speed of mean-reversion of REER than it is found for PPP to a constant level (Johansen & Juselius, 1992; MacDonald & Marsh, 2014)

2.3.6. The Macroeconomic/ Internal-External Balance Approach

A variety of approaches are developed in order to determine the equilibrium exchange rate based on the macroeconomic balance approach that incorporates both the internal and external balances that recognizes the deviations from PPP more clearly. Internal balance is associated with the output level consistent with full employment and a low and sustainable rate of inflation, the NAIRU. And when the countries are in internal balance, a sustainable desired net flow of resources between them identifies the external balance. Hence, the net savings produced at the output level associated with internal balance have to be equal to current account balance which needs not necessarily to be equal to zero for an economy to be in equilibrium both internally and externally. Therefore, the general relationship to pinpoint macroeconomic balance approach can be offered by the following identity:

$$CA_t \equiv -KA_t \equiv S_t - I_t \quad (2.22)$$

where CA denotes current account, KA denotes capital account, S and I stands for national savings and investment spending, respectively. All the approaches under the macroeconomic balance use alternative representations of this equation.

2.3.6.1. Fundamental Equilibrium Exchange Rate (FEER)

Williamson's (1985, 1994) Fundamental Equilibrium Exchange Rate (FEER) can be characterized as a normative measure of exchange rate determination in the sense that it focuses on ‘economic fundamentals’ identified for persistent behavior of a particular set of economic conditions or variables desired over a medium-term disarticulating the cyclical economic conditions and temporary economic factors. Though normative due to the consideration of ideal economic circumstances, one is still free in selecting different sets of economic conditions to measure the exchange rate using this approach. As a measure based on macroeconomic balance, this approach focuses on the determination of a REER which is conducive to internal and external balance of an economy simultaneously, where internal balance refers to the output level consistent with that of NAIRU (high employment, low inflation) and a sustainable desired net flow of resources between economies when they are in internal balance typically represent the external balance.

Identity that level out the current account (CA) to the negative of capital account (KA) is the central notion of this approach as shown below-

$$CA_t \equiv -KA_t \quad (2.23)$$

The determinants of CA receive the prime attention in this approach which usually depends on the full employment output level of home (Y^d) and abroad (Y^f), and the REER. The identity in 2.23 can then be expressed in functional form as 2.24a or in the linear equation as 2.24b:

$$CA_t = f(q_t^*, \bar{Y}_t^d, \bar{Y}_t^f) = -\overline{KA}_t \quad (2.24a)$$

or, $$CA_t = a_0 + a_1 q_t^* + a_2 \bar{Y}_t^d + a_3 \, \bar{Y}_t^f = -\overline{KA}_t \quad (2.24b)$$

Here, q^* is the equilibrium REER that equates the current account with exogenously determined equilibrium value of the sustainable capital account $\overline{KA}$ critically arrived taking several pertinent economic factors into account over the medium term. $\bar{Y}^d$ and $\bar{Y}^f$ are the full employment values of domestic and foreign output level, respectively. Theoretically, $f_{q^*}, f_{\bar{Y}^d} < 0$, meaning that REER and domestic level are expected to have an inverse impact on the current account, while $f_{\bar{Y}^f} > 0$, that is, change in foreign output level brings about a similar change in current account position. The equilibrium REER in FEER will then be the solution of 2.24a or 2.24b, which can be given as:

$$q_t^* = f(\overline{KA}_t, \bar{Y}_t^d, \bar{Y}_t^f) \quad (2.25a)$$

or, $$q_t^* = \frac{-\overline{KA}_t - a_0 - a_2 \bar{Y}_t^d - a_3 \, \bar{Y}_t^f}{a_1} \quad (2.25b)$$

Clearly, the calculation of FEER depends on the extensive estimation of parameters and judgment that includes a current account model, potential output estimates of the concerned economy along with its trading partners and judgmental estimates of the sustainable capital account. What makes this approach highly simplified is the exogenously determined sustainable level of capital account which is set based on past evidence that requires identification of base year associated with the country's past experience. However, a theory of exchange rate determination is not incarnated in the FEER approach offered by Wren-Lewis (1992) as they emphasize that the FEER is a 'method of estimation of a real exchange rate which is compatible with medium-term macroeconomic equilibrium'. One of the reasons why it does not constitute a true equilibrium is the hysteresis effects as the current account in the medium-term will be affected by temporary shocks that will work as a source of wealth stocks to get off from equilibrium and the time horizon over which the wealth-income ratios are restored to their desired level may be much longer than that required for internal and external balance to be achieved (Artis & Taylor, 1995; Driver & Westawa, 2005).

Nevertheless, the approach implicitly relies on the assumption that the actual REER will converge to the FEER over time. Hence the approach actually set a medium-run current account theory to determine the exchange rate. It is expected that a deviation in actual REER from FEER will compel it to set in motion that will ultimately eliminate this deviation, but as the approach characterizes only equilibrium position, the nature of the adjustment forces remains unstipulated. In addition to this, in the calculation of FEER, the values of trade elasticities are required to be measured to learn about the responsiveness of exports and imports to the change in relative price. It adds an additional tire of complexity as the values of trade elasticities depend on the form of current account equation used for the calculation which may drive to an inappropriate estimate of FEER (Jongwanich, 2009).

2.3.6.2. Desired Equilibrium Exchange Rate (DEER)

Despite the presence of considerable theoretical and empirical analysis for the analytically and conceptually apprehensive current account model and estimates of potential output of the concerned economy and its trading partners required for FEER estimation, the factors that determine the sustainable net capital flows are not well recognized. In order to define sustainable capital flows more aptly, John Williamson (1994), Artis & Taylor (1995) and Wren-Lewis & Driver (1998) give greater importance to the optimal fiscal policy. In other words, the 'target current account' that Williamson (1994) used to describe sustainable capital flows, and the subsequent foreign debt should be in accordance with what policymakers think desirable or optimal. The term Desired Equilibrium Exchange Rate **(**DEER) introduced by Bayoumi, Clark, Symansky, & Taylor (1994) is thus the reflection of researchers concern on the link between FEER and desired or optimal fiscal policy, which is nothing but an alternative to FEER.

2.3.6.3. The IMF's Internal-External Balance (IEB) Framework

This approach is an extension of the macroeconomic balance framework offered by Faruqee, Isard, & Masson (1999) to arrive at a more acceptable estimate of desired capital account rather than approaching it judgmentally. The primary feature of this approach is that it confesses the view of observing equilibrium current account as the gap between desired aggregate investment and saving at the level of full employment, which, in turn, is equal to the sustainable capital account. To be precise, this approach works with the following variant of 2.24a:

$$CA_t = \bar{S}_t - \bar{I}_t = -\overline{KA}_t \tag{2.26}$$

In an extensive analysis of the factors determining the full employment aggregate saving $\bar{S}$ and investment $\bar{I}$ underlying in this approach, Debelle & Faruqee (1996) suggest to estimate them as a behavioral function of the difference between actual and potential output, the dependency ratio and the government deficit. Equation 2.24b and 2.25b can then be presented as follows:

$$CA_t = a_0 + a_1 q_t^* + a_2 \bar{Y}_t^d + a_3\, \bar{Y}_t^f = \bar{S}_t - \bar{I}_t \tag{2.27}$$

$$q_t^* = \frac{\bar{S}_t - \bar{I}_t - a_0 - a_2 \bar{Y}_t^d - a_3\, \bar{Y}_t^f}{a_1} \tag{2.28}$$

Assuming the other determinants of the current account are at their full employment level, the equilibrium REER is then calculated as the exchange rate that will generate a current account equal to $\bar{S}_t - \bar{I}_t$. Any discrepancy between the saving-investment gap resulting from the estimation of the dynamic saving-investment equation and current account position will be eliminated through the movement of exchange rate towards its equilibrium value. It is a measure of medium-term equilibrium REER as it has been developed focusing on the mid-term flow equilibrium considerations alone. However, there is scope to extend the model to the direction of long-run equilibrium. Though the approach includes some credible variables as determinants of the net capital account, it ignores the probable role of factors like rate of returns that may influence the denomination of assets held in domestic and foreign currencies (Clark & MacDonald, 1999).

2.3.6.4. The Natural Real Exchange Rate (NATREX)

An alternative approach for the determination of equilibrium exchange rate offered by (Stein & Allen, 1997) is the NATREX which is closely linked with FEER. Stein, (1994) describes the NATREX as ‘the rate that would prevail if speculative and cyclical factors could be removed while unemployment is at its natural rate’. NATREX can be viewed from the medium and long-run point of view. Medium-run NATREX is associated with the medium run equilibrium that requires to satisfy the basic postulate of simultaneous internal and external balance advocated by macroeconomic balance model. Internal balance is compatible with the rate of capacity utilization which is at its stationary mean. Any deflationary pressures from excess demand or inflationary pressures from the overheated economy are assumed to be absent and cyclical factors are omitted in attaining the equilibrium real exchange rate. Again, the domestic real interest rate needs to be equal to the world real interest rate along with the exclusion of speculative capital movements and movements of international reserves in order to maintain external balance. The omission of the cyclical factors, speculative movements of capital and movements of international reserves in explaining the behavior of the fundamental variables that are the main driving forces behind the investment and saving decision helps derive the medium-term equilibrium real exchange rate $q(F_t;Z_t)$ (Stein, 2006).

Along with the conditions of medium-run equilibrium, the additional condition for attaining the long-run equilibrium real exchange rate $q(Z_t)$, which is the long-run NATREX, is a predetermined ratio of foreign debt to GDP for which the provision ‘debt grows at the same rate as the GDP’ has to be contented. The real fundamental factors Z_t that determine this fluctuating medium to long-term real exchange rate include thrift, productivity, capital intensity and net foreign debt, which influence long desired capital flows and change the equilibrium real exchange rate (Frait & Komárek, 2001).

The dynamic adjustment of the medium-run equilibrium to the long run equilibrium $[q(F_t;Z_t) - q(Z_t)]$ is added to the long-run equilibrium exchange rate $q(Z_t)$ to arrive at the NATREX model. Hence,

$$NATREX = \mathrm{q}(Z_t) + \left[q(F_t;Z_t) - \mathrm{q}(Z_t)\right] \tag{2.29}$$

The actual REER (q_t) is the sum of NATREX with its deviation from the medium-run equilibrium, that is,

$$q_t = \left[q(Z_t) + \{q(F_t;Z_t) - q(Z_t)\}\right] + \left[q_t - q(F_t;Z_t)\right] \tag{2.30}$$

Being stochastic, deviation of the actual real exchange rate from medium-run equilibrium has zero expectation and the actual real exchange rate R_t has the property of heading to long-run NATREX, $R(Z_t)$ based on time-varying real fundamentals Z_t (Stein, 2006).

2.3.7. Behavioral Equilibrium Exchange Rate (BEER)

Despite the benefits of ensuring internal consistency of macroeconomic linkages, the FEER is a normative measure of equilibrium real exchange rate as it is backed by the explicit assumption of macroeconomic balance. Avoiding the concept of macroeconomic balance, the Behavioral Equilibrium Exchange Rate (BEER) proposed by Clark & MacDonald (1998) expressively turns aside the normative dimensions in determining equilibrium real exchange rate which is consistent with the prevailing level of economic fundamentals. The modeling technique it employs captures over time movements in real exchange rates rather than the movements in the medium or long-run equilibrium level and hence can be treated as a concept of short-run equilibrium exchange rate which is mostly empirical (Driver & Westawa, 2005).

The BEER approach is established on the basic UIP condition. Omitting the expected inflation differential from this condition, it accepts the real determinants of real exchange rates. Accordingly, real exchange rate in BEER approach is linked to the expected real exchange rate and real interest rate differentials adjusted with the time-varying risk premium proxied by the share of outstanding domestic and foreign government debt in GDP.

The real form of UIP condition in equation (2.14) after necessary adjustment of risk premium can be given as:

$$\Delta q^e_{t+k} = (r_t - r^*_t) + \lambda_t$$

or, $$q^e_{t+k} - q_t = (r_t - r^*_t) + \lambda_t$$

or, $$q_t = q^e_{t+k} - (r_t - r^*_t) - \lambda_t \tag{2.31}$$

Now, due to the deficiency of observed expectations of future levels of the real exchange rate, employing the UIP relationship in 2.31 as an empirical model is arduous despite the inclusion of the risk premium, which leads Clark and MacDonald (1998) to assume that expected future exchange rates are designated by the long-run behavior of the macroeconomic fundamentals. Treating q_{t+k}^{e} as the long-run or systematic component of the REER ($\overline{q_t}$), equation 2.31 can thus be expressed as:

$$q_t = \overline{q_t} + (r_t - r_t^{*}) - \lambda_t \tag{2.32}$$

The variables that Clark and Macdonald (1998) use as long-run fundamentals to determine the expected future exchange rate are terms of trade (TOT), net foreign assets (NFA) as a ratio of GDP, and the relative price of traded to non-traded goods (TNT) proxied by the ratio between CPI and PPI used as a measure of Balassa-Samuelson effect. The variables are basically derived from the stock-flow consistent model of Frenkel & Mussa (1985) that are measured relative to their foreign counterparts. Consequently, expected future exchange rate, as a function of long-run macroeconomic fundamentals, can be given as:

$$\overline{q_t} = f(TOT, NFA, TNT) \tag{2.33}$$

Therefore, BEER is a statistical approach that links real exchange rate to real interest rate differentials, the ratio of domestic to foreign government debt, terms of trade, the relative price of traded to non-traded goods and net foreign assets in the setting of a single equation. The selection of the fundamentals is somewhat ad hoc in the sense that the frontier offered by the underlying theory with regard to the choice of fundamentals in developing the model is relatively wide.

The estimated equilibrium exchange rate is the fitted value of the estimated equation found for the observed or long-term (sustainable) values of the fundamentals. Clark & MacDonald (1998) name the equilibrium exchange rates found for the observed values of the fundamentals as current values of equilibrium REER, while the long-run equilibrium REER is supposed to be determined by the long-run or sustainable values of the economic fundamentals. Clark & MacDonald (1998, 2004) in their original research and subsequent studies on BEER apply Hodrick-Prescott (H-P) filtering to obtain the values of economic fundamentals that sustain in the long-run. Thus, while the difference between the observed value of REER and the current value of equilibrium REER defines the current misalignment, total misalignment is the deviation of observed REER from its long-run equilibrium value.

Clark & MacDonald (1998) categorize the fundamentals affecting the actual REER into three vectors: Z_{1t} is the vector of economic fundamentals having persistent effects over the long run, Z_{2t} is the vector of economic fundamentals influence the REER in the medium term and the vector T includes all transitory factors. Therefore, we can appear at the observed REER as:

$$q_t = \beta_1' Z_{1t} + \beta_2' Z_{2t} + \tau' T + \varepsilon_t \tag{2.34}$$

where τ is the vector of reduced-form coefficient and ε is a random disturbance term.

The current value of equilibrium REER, q^*, depends on the observed (current) values of medium term and long term economic fundamentals, that is:

$$q_t^* = \beta_1' Z_{1t} + \beta_2' Z_{2t} \tag{2.35}$$

The misalignment defined in terms of the difference between the observed and current value of REER is named as current misalignment (Peter B Clark & MacDonald, 1998):

$$\text{Current Misalignment, } cm_t = q_t - q^* = \tau' T + \varepsilon_t \tag{2.36}$$

However, there is a possibility that the observed values of economic fundamentals Z_{1t} and Z_{2t} may stray away from their long-term (sustainable) values $\bar{Z}_{1t}$ and $\bar{Z}_{2t}$. Therefore, the long-term (sustainable) equilibrium values of REER, $\bar{q}_t$, is:

$$\bar{q}_t = \beta_1' \bar{Z}_{1t} + \beta_2' \bar{Z}_{2t} \tag{2.37}$$

Thus, the deviation of observed REER from its long-run equilibrium value represents total misalignment. That is,

$$\text{Total Misalignment, } tm_t = q_t - \bar{q}_t \tag{2.38}$$

We can decompose the tm_t in the following way:

$$tm_t = (q_t - q^*) - (\bar{q}_t - q^*)$$

or, $$tm_t = (\tau' T + \varepsilon_t) - (\beta_1' \bar{Z}_{1t} + \beta_2' \bar{Z}_{2t} - \beta_1' Z_{1t} - \beta_2' Z_{2t})$$

or, $$tm_t = (\tau' T + \varepsilon_t) + [\beta_1'(Z_{1t} - \bar{Z}_{1t}) + \beta_2'(Z_{2t} - \bar{Z}_{2t})] \quad (2.39)$$

Therefore, total misalignment is the composition of two components: the current misalignment and the effect of departure of current fundamentals from their sustainable values. Misalignment determined in this way is more general in comparison to FEER in the sense that it can be used to explain the cyclical movements in the real exchange rate while FEER is entirely a medium to the long-term concept (Peter B Clark & MacDonald, 1998).

2.3.8. Permanent Equilibrium Exchange Rate (PEER)

Permanent equilibrium exchange rate (PEER) is a related representation of the BEER. While the BEER approach relies on long-run macroeconomic fundamentals in modeling exchange rate behavior, exchange rate in PEER approach is determined only by the fundamentals having a persistent effect on it. In other words, PEER assumes the fundamentals are at their steady state in estimating the equilibrium value of exchange rate. Consequently, BEERs will not be similar to that of the measures of medium-term equilibrium exchange rate like FEERs unless the economic fundamentals that are expected to influence exchange rate in the medium and long-run do not match with their long-run steady-state value of equilibrium (Driver & Westawa, 2005). Even if they match, exchange rate may be misaligned due to the transitory elements and stochastic errors. With this conception, Clark & MacDonald (2004) attempt to decompose the factors underlying the BEER into permanent and transitory components:

$$q_t = q_t^P + q_t^T \quad (2.40)$$

where q_t^P stands for permanent component of real exchange rate and q_t^T is its transitory component. Beveridge & Nelson (1981) decomposition has widely been used by a number of studies to interpret the persistent, or permanent, component of real exchange rate with data up to around the end of 2000. Clark & MacDonald (2004) use a more recent statistical technique offered by Gqnzalo & Granger (1995) to separate out the permanent component of real exchange rate which they refer to as the permanent equilibrium exchange rate, or PEER. This approach of equilibrium exchange rate determination is particularly useful in explaining misalignment caused by transitory elements in situations where PEER differs significantly from BEER.

2.3.9. Single Equation Approach

Considering the Single Equation approach offered by Edwards (1989a) and Elbadawi (1994) as a benchmark, Baffes, Elbadawi, & O'connell (1999) outlined an econometric procedure for estimating equilibrium REER and misalignment. In this approach, the equilibrium REER is regarded as the steady-state or long-run real exchange rate that depends on a vector of permanent values for the fundamentals. Hence, they aim to generate a series of equilibrium REER drawing actual data on real exchange rate and fundamentals. Based on the fundamentals they considered, the equilibrium REER, q^* can be given as the following function:

$$q^* = q(TOT, G_N, G_T, I/GDP, OPEN) \tag{2.41}$$

where TOT is the terms of trade, G_N and G_T stand for government spending on tradable and nontradable goods, respectively, I/GDP is the investment share of GDP, OPEN refers to openness.

The long-run equilibrium relationship between REER and its fundamentals can be estimated using the following generic form equation-

$$lnq_{rt}^* = \beta' F_{rt}^s \tag{2.42}$$

where q_{rt}^* is the equilibrium REER of country r at time t, β' is the vector of coefficients of the long-run parameters to be estimated, F_{rt}^s is the vector of permanent or sustainable values for the set of fundamentals of country r at time t. The rationale for choosing the sustainable or permanent values for the fundamentals is that economic time series generally displays a considerable amount of short-term 'noise' as they combine both trend and cyclical components. Therefore, it is necessary to eliminate the short-term fluctuations in the fundamentals in order to arrive at their permanent values. Baffes et al. (1999) employs Beveridge-Nelson (B-N) decomposition while recent studies rely on the Hodrick-Prescott (H-P) filtering technique to extract the permanent components of the fundamentals dispelling their short-term fluctuations (Marcel Schröder, 2013; Toulaboe, 2017).

The empirical model consistent with 2.42 to unfold the values of the estimators in the vector β replacing the values of REER and sustainable values of its fundamentals can be given as:

$$lnq_{rt}^{*} = \beta' F_{rt}^{s} + \varepsilon_{rt} \tag{2.43}$$

where ε_{rt} is assumed to be white noise. Once the estimators in β are estimated, one can easily compute the sustainable equilibrium values of REER just by replacing the values of fundamentals in 2.42 which will pave the way for the calculation of misalignment series.

2.4. Misalignment: Concept and Measurement

So far we have discussed different approaches to measuring the equilibrium real exchange rate. In this section, the concept and measurement of misalignment will be discussed in detail. Comparison of the observed exchange rate of a country with its equilibrium value helps us learn the degree of misalignment in exchange rate. The observed value of exchange rate commonly used for this comparison is the REER. Thus, measurement of misalignments, the deviations of the observed REERs from its estimated equilibrium values, involves several steps. The first order of business is the computation of the REER series. Once the series is in hand, one can advance for measuring the equilibrium REER that again involves several approaches based on how they define exchange rate and model the dynamics. Identification of appropriate approach is vital to arrive at the equilibrium REER pertinent to the study which also has utility in deriving the misalignment series at the end. A brief explanation of the different steps is presented below.

2.4.1. Computation of REER

Identification of the price index that fits best in order to construct the REER is an important concern. Price indices that are commonly used include the Consumer Price Index (CPI), the producer or wholesale price index (WPI), the traded-goods price index (TPI), the export unit value (EUV) index and the unit labor costs (ULC) index. Each has some merits and limitations as outlined by Chinn (2006), Terra and Vahia (2008) and Terra and Valladares (2010). A desirable price index is one that bears the following properties: exclusively include tradable goods and the goods compositions are identical (Terra & Valladares, 2010). Construction of such an index in practice is almost impossible. For instance, the EUV index is comprised exclusively of tradable goods, but the diversity of goods compositions across courtiers is remarkable. Similarly, less variation in the compositions of goods is noticeable for CPI and WPI; however, the share of nontradable goods in them is not ignorable. The TPI proposed by Xu (2003), a weighted average of the export and import price index where shares of exports and imports in total trade measures the weights, is also likely to be guilty of the same fault as like EUV index. While the composition of CPI and WPI is more homogeneous across countries in comparison with EUV index, the share of nontradable goods in CPI is greater than that of WPI as WPI excludes nontradable retail sales services from the nontradable consumer services that are included in CPI (Chinn, 2006). In this sense, WPI is a better choice for computing REER.

Indeed, there are studies on the comparison of the performance of different price indices, but there is no consensus on any of them. Most of these studies are backed by the PPP approach of exchange rate determination. The notion is that the PPP condition asserts that the purchasing power of currencies should not change across countries when compared for the same basket of goods, the same features should, therefore, be comprehended by a suitable relative price index. Price indexes that assign a large weight to non-traded goods are often caused to experience long-run deviations from PPP. Kim (1990), while examining the PPP hypothesis for the US and its major industrialized trading partners using WPI and CPI pulling historical data and cointegration approach, warns to apply such a price index as he finds cointegration for the WPI-based real exchange rates despite the random walk hypothesis is not rejected for the CPI-based real exchange rates. Chinn (2000b) performs PPP testing drawing

EUV index, CPI, PPI or WPI and using Johansen cointegration test for some Asian economies for the period 1975-1996 and results based on PPI are found to yield better evidence for PPP. Using quarterly time series data for the period 1974-1997 of US with its eight trading partners, Xu (2003) examines the performance of alternative price indices and finds TPI as a more suitable proxy than CPI and WPI for PPP tests and exchange rate forecasting. Terra and Vahia (2008) employ EUV index, WPI, value added deflators, ULC index, normalized ULC index and CPI for 16 countries between 1975 and 2002 to examine which of the indices yields better PPP evidence and find support in favor of WPI for a large number of countries. In a recent study, Pelagatti and Colombo (2015) offer a sufficient condition for constructing price indices that allows the one price law to interpret PPP and theoretically prove that CPI does not fulfill this condition. However, whether the condition is satisfied by the other price indices is an empirical question.

Again, in making an appropriate choice regarding price indices, the dispute over theoretical and practical devices is noteworthy. Conceptually, WPI that underweight nontradable goods is available for few industrialized economies and for a small span of time. Though the ULC in manufacturing is a reliable index as IMF regards since it helps overcome the problems of diversity in goods compositions and inclusions of nontradables, but most developing countries do not have sufficient data for its computation (Sekkat, 2016), which is true for TPI as well. The one for which the largest volume of data for many industrialized and emerging economies are readily available and fairly comparable across countries is CPI and hence it becomes the index of choice for measuring REER from practical perspective as the availability of data is the main obstacle in selecting other indices though they are conceptually better.

However, use or choice of price indices largely depends on the handiness and reliability of data for the time frame a study aims to predict. Empirical studies on equilibrium REER determination are found to have employed a combination of price indices to produce the series of REER. For instance, Terra and Valladares (2010), while investigating the appreciation and depreciation episodes of real exchange rate for a set of 85 countries for the period 1960-1998, construct the REER series using WPI when they are available and trustworthy or CPI otherwise.

The choice of suitable price index leads one to compute the REER which can be defined as:

$$\log(REER) = \sum_{i=1}^{n} w_{sr} \times \log\left(E_{srt} \times \left(\frac{P_{rt}}{P_{st}}\right)\right) \tag{2.44}$$

where P_{rt} is the price index of home country (r) at time t, P_{st} is the price index of the trading partner's (s) at time t, E_{rst} is the nominal bilateral exchange rate of country r with s, w_{sr} is the weight of the trading partner s in the country's total trade, and n stands for the number of total trading partners. The share of country s in country r's total trade determines the weight w_{sr}. A depreciation means there is a rise in REER.

2.4.2. The Equilibrium REER

The equilibrium value of REER confirms simultaneous equilibrium of both internal and external sectors of an economy. Literature on the determination of equilibrium REER is substantially rich and ever-evolving. Section 2.3 summarizes some of the typical approaches that include CHEERS, FEERs, BEERs, DEERs, PEERs, NATREX, just to name a few. Choice of approach fundamentally depends on the objective one desires to attain. For instance, CHEERs will be suitable if one focuses on nominal exchange rate estimation. Similarly, for the estimation of REER compatible with medium-term equilibria, FEERs, NATREX and DEERs equally apt since they give more attention to the estimation of either complete macroeconomic models or simply current accounts. On the other hand, BEER is applicable when we are interested to have REER controlling variations in it caused by actual changes in relative prices of nontradables without focusing on their long-run equilibrium values (Terra and Valladares, 2010; Goldfajn and Valdés, 1999). However, all these approaches rely on a set of macroeconomic fundamentals to model the dynamics of REER. Here, a general framework for the determination of equilibrium REER will be presented.

Following Edwards (1989b), Elbadawi (1994), Faruqee (1995), Clark & MacDonald (1998), Monteil (1999), Baffes et al. (1999) and Kemme & Roy (2006), the variables that should be included into the function of the equilibrium REER include terms of trade (TOT), government spending on nontradables (G_N), government spending on tradable goods (G_T), net financial assets position (NFA), investment (I), trade openness (OPEN), productivity differentials or Balassa-Samuelson effect (PROD/BS), international interest rate (IIR) or real interest rate differentials (RIRD (r-r^*)), Debt Services (DEBT) and Official Development Assistance (ODA). Therefore, the equilibrium REER (q^*) can be given as the following function:

$$q^* = q\left(TOT,\ G_N,\ G_T,\ NFA,\ I,\ OPEN,\ PROD,\ IIR/r-r^*,\ DEBT,\ ODA\right) \qquad (2.45)$$

The way these fundamentals affect the equilibrium value of REER is shortly explained below:

1. Terms of Trade (TOT)

Being the relative price of exports to imports, the impact of change in TOT depends on two facts: a) the relative strength of income and substitution effect, b) whether the change in TOT is caused by a change in prices of exports or imports. Therefore, the TOT shock on equilibrium REER cannot be determined in advance. As evident from Alejandro (1982), a permanent increase in export prices generates positive income effect by improving TOT and hence real national income. It leads to a rise in demand for both tradable and nontradable goods that result in an appreciating effect on REER by producing upward pressure on relative prices of nontradables. At the same time, a depreciating effect on REER caused by substitution effects on the demand and supply sides makes the net effect uncertain. There will be a real currency depreciation if income effect dominates over the substitution effect, and real currency appreciates in the opposite case. Therefore,

$$\frac{dq^*}{dTOT} \lesseqgtr 0 \qquad \begin{cases} \text{if substitution effect dominates over income effect} \\ \text{if income effect dominates over substitution effect} \end{cases}$$

2. Government Spending on Nontradable (G_N) and Tradable Goods (G_T)

An increase in government expenditure could lead to depreciation or appreciation depending on its distribution between tradable and non-tradable goods. A rise in government expenditure on non-tradable goods increases their prices by stimulating demand. Since the REER refers to the domestic relative price of tradable to nontradables measured in terms of proportion between the price index abroad and home price index in simplest form (that is, $REER = eP_T^*/P_N = P_T/P_N$, where P_T^* for prices of tradables at abroad and P_T for prices of tradables at home, P_N stands to mean nontradables prices at home), rise in prices of nontradable goods would therefore cause a real appreciation by raising the value of domestic price index, that is, $dq^*/dG_N < 0$.

By the same token, rise in government expenditure on tradable goods is likely to be turned into increased demand for tradable goods and accordingly resulted in a real depreciation laying down the value of home price index which means $dq^*/dG_T > 0$.

As like TOT, results of increased government expenditure on REER are ambiguous that generally depend on the composition of the consumption basket of the government. If the prices of nontradables rise faster than the prices of tradables following an increase in government expenditure, there will be appreciation in real exchange which is empirically supported by Makin & Ratnasiri (2015). Moreover, the so-called resource withdrawal channel offered by Frenkel & Razin (1996) suggests that government expenditures backed by private sector taxes could generate a real exchange rate depreciation which is consistent with the findings of Alshehabi & Ding (2008). In general, nontradable goods receive the lion's share of government expenditure and accordingly higher government expenditure is likely to increase REER, that is, a real appreciation of exchange rate (Toulaboe, 2017).

3. Net Financial Assets Position (NFA)

Capital flows play an important role in the determination of REER. Theory asserts that NFA, the difference between the value of assets a country won overseas and foreigners won at home, has a significant impact on REER in the long-run. An increase in NFA means net capital outflow and therefore it leads to depreciation of REER by reducing inflationary pressure in the domestic economy due to lower domestic spending. Therefore, $dq^*/dNFA > 0$. However, the dispute on such a positive relationship between NFA and REER is also noteworthy. The argument is that a depreciation of the real exchange rate could generate trade surpluses necessary to finance the higher interest payments triggered by a decline in NFA (Koske, 2008). Thus, the relationship between the NFA and REER could be negative as well, that is, $dq^*/dNFA < 0$.

4. Trade Openness (OPEN)

Trade openness, proxied by the sum of exports and imports over GDP, indicates how exposed a country is to the rest of the world and expected to have a positive effect on REER, meaning that higher trade liberalization depreciates REER. There are several arguments to support such a relationship. From the theoretical perspective, trade liberalization policies to open up a country in the international market increasing the competitiveness of its tradable goods generate a demand switching effects from non-tradable to tradable goods, prices of nontradables relative to tradable goods fall, a depreciation of REER occurs. In other words, greater liberalization reduces prices of importables domestically. It depreciates the REER by imposing an upward pressure on the demand for foreign currencies to take the benefits of economy imports and reducing the demand for home currency (Dufrénot & Yehoue, 2005). Jongwanich (2009) argues that greater openness induces greater demand for tradables and accordingly a depreciation of REER is necessary to shift the demand from tradable goods to non-tradable goods in order to return to the equilibrium. Therefore, $dq^*/dOPEN > 0$.

Terra & Valladares (2010) raise a question about the aptness that the sum of exports and imports over GDP as a measure of trade openness since it may differ across countries depending on the variables like size and geography of the economies. However, they also defend the use of openness as a practical measure for single country case on the time series dimension since the aforementioned variables have the least impact on it as their changes are trivial over time.

5. Investment (I)

The impact of domestic investment on REER is uncertain and it depends on the distribution of investment spending between tradable and non-tradable goods. When the domestic investment is biased toward nontradable goods, prices of nontradables fall and thus register a depreciation of REER. Similarly, higher investment in tradable sectors appreciates REER. Hence, $dq^*/dI \lesseqgtr 0$. In other words, $dq^*/dI > 0$, when a greater share of domestic investment goes for the production of non-tradable goods and $dq^*/dI < 0$ when the domestic investment is biased toward tradable goods.

6. Productivity Differentials/ Balassa-Samuelson Effect (PROD/BS)

Productivity differentials refer to the relative productivity in tradable sector to nontradable sector and it captures the eminent Balassa-Samuelson effect. Productivity growth in emerging economies is likely to be intense in the tradable sectors. Accordingly, for homogeneous prices of tradables across countries, wage increase in tradable sectors owing to rapid technological progress shifts to wages in nontradable sectors of emerging economies (Balassa, 1964; Samuelson, 1964). Productivity growth in tradable sectors raises the demand for labor in this sector. Assuming full employment, tempting labor in the nontradable sector offering higher wages is the only way to meet this higher labor demand in tradable sectors. It induces the wage rate to rise in the nontradable sectors (Jongwanich, 2009). This shift in wage increase to nontradable sectors drives down the REER (appreciation) due to higher prices of the nontradable goods, that is, $dq^*/dBS < 0$.

Baak (2012) replaces the productivity differentials by the relative price of tradable to nontradable goods (TNT) to incorporate the Balassa-Samuelson effect to model the equilibrium REER. The CPI and PPI are used as proxies of the prices of nontradables and tradables, respectively. The relative productivity of tradable to nontradable sectors is negatively related to the relative prices between these two sectors and therefore productivity growth that leads to appreciation is attributed to the fall in the relative price of tradable to nontradable goods, that is, an inverse relationship between the relative price of tradable to nontradable goods and REER is expected. The partial derivative appears as $dq^*/dTNT < 0$.

7. Real Interest Rate Differentials (RIRD)

Real interest rate differential is the difference between the real interest rate at home and abroad where the real interest rate is the annual average government bond yield over inflation rate based on CPI. Since interest rate parity condition holds better over the long horizon (Juselius, 1995; MacDonald & Nagayasu, 2000; Bekaert, Wei, & Xing, 2007; Hoffmann & MacDonald, 2009), yields on long term government bond are recommended to derive the series of RIRD (Terra & Valladares, 2010; Baak, 2012). Again, studies on developing and emerging economies largely use US Treasury Bill rate as international interest rate as US interest rate are found to be the major factor contributing to capital inflow to these economies (Fernández-Arias & Montiel, 1996).

Capital flows respond to this interest rate differentials. Rather than using RIRD, Terra & Valladares (2010) rely on international interest rates to comply with Goldfajn & Valdés (1999) but admit that RIRD is the suitable choice, while Goldfajn & Valdés (1999) do not choose RIRD as domestic monetary policy has control over their volatility to a large extent.

Lower international interest rates or higher RIRDs strengthen capital inflows and hence produce REER appreciation creating inflationary pressure by stimulating domestic spending, that is, $dq^*/dRIRD < 0$.

8. Debt Services (DEBT)

A country's debt services refer to its payments and reimbursements of interest and higher domestic debt services, therefore, implies greater demand for foreign currencies which results in a potential depreciation of REER. Therefore, $dq^*/dDEBT > 0$.

9. Official Development Assistance (ODA)

An increase in ODA causes an increase in capital inflows when ODA is spent on imports of capital goods, it gives rise to domestic investment and expansion of exports through augmenting competitiveness (Berg, Hussain, Aiyar, Roache, & Mahone, 2006). Hence, an increase in ODA depreciates REER, that is, $dq^*/dODA > 0$. But when the increase in ODA is translated into higher domestic spending and therefore increases inflationary pressure and would cause appreciation in REER. In this case, the anticipated relationship between the ODA and REER is negative, that is, $dq^*/dODA < 0$, such an affair is known as 'Dutch Disease' in literature .[1]

Apart from the above mentioned fundamentals, studies consider some other factors causative to the fluctuations of REER. Some of them are change in official reserve (RES), monetary policy performance (MP) and a crisis dummy variable. Remaining the level of money supply fixed, an increase in the level of foreign currency

[1] When the rise in inflow of foreign currency exerts adverse impact on an economy through currency appreciation is termed by the phenomena 'Dutch Disease'.

reserve is expected to appreciate REER ($dq^*/dRES < 0$). A monetary policy conducive to strengthen centrathe l bank's balance sheet position is also expected to appreciate REER ($dq^*/dMP < 0$). Studies on oil rich countries like Russia, Saudi Arabia, Brazil, Mexico, Canada, Norway and Nigeria use an index of oil price volatility (OPV) and argue that oil price volatility has inverse impact on REER (Habib & Kalamova, 2007; Aliyu, 2009; Volkov & Yuhn, 2016), that is, rise in oil price volatility depreciates REER ($dq^*/dOPV > 0$). A crisis variable taking the value one (1) to represent the crisis year and zero (0) otherwise has been used by many studies. However, it is not that all these fundamentals are equally important while modeling equilibrium REER behavior, the choice of fundamentals for a given economy largely depend on the economic structure of that particular economy.

2.4.3. Measuring Misalignment

The degree of misalignment in REER is simply the deviation of the observed value of REER from its sustainable equilibrium values in terms of percent. Thus, one can measure it using the following formula:

$$m_{rt} = \frac{q_{rt} - q_{rt}^*}{q_{rt}^*} \times 100 \qquad (2.46)$$

where m refers to the misalignment in REER, q is the observed REER and q^* is the sustainable values of equilibrium REER, r stands for the country concerned and t for time.

A positive value of m signifies the REER overvaluation, that is, overvaluation of domestic currency against its foreign counterpart. Likewise, when m appears to be negative, it indicates an REER depreciation, that is, undervaluation of domestic currency against foreign currency. However, a zero (0) value of m stands for no misalignment in REER, that is, neither appreciation, nor depreciation.

2.5. Summary

The chapter attempts to clarify the concepts of exchange rate and approaches to measuring equilibrium REER with reference to their empirical evidence. Based on the ever-evolving literature on the determination of equilibrium REER, the chapter summarizes some of the typical approaches that include PPP approach, Balassa-Samuelson approach, Uncovered Interest Parity Approach, Monetarist Approach, CHEERs, FEERs, BEERs, DEERs, PEERs, NATREX, IEB approach and Single Equation Approach. The righteousness of the approaches is also discussed shortly. However, a set of macroeconomic fundamentals determine the dynamics of REER for the majority of the approaches. The fundamentals include terms of trade, government spending on non-tradable goods, government spending on tradable goods, net financial assets position, investment, trade openness, productivity differentials or Balassa-Samuelson effect, international interest rate, real interest rate differentials, Debt Services and Official Development Assistance. The derivation of REER from its equilibrium value enables one to obtain the misalignment series by taking the percentage deviation of equilibrium REERs from their observed values. Chapter four presents a carefully crafted analysis on the determination of equilibrium REER and corresponding misalignment for the selected emerging economies.

CHAPTER III

LITERATURE REVIEW

3.1. Introduction

REER, as a summary measure of important economic information, has gained recognition in theoretical discussion among economists and policymakers. Despite the unanimity they hold, the ways REER misalignment affects macroeconomic performance of open economies are construed differently. As illustrated in figure 2, misalignment in REER brings about a change in trade balance through changing competitive position of an economy at least in three possible ways, by changing the relative prices of exports and imports, by altering the relative prices of tradable and non-tradable goods and by reallocating resources between tradable and non-tradable sectors due to the change in relative wage rate. The price uncertainty resulting from currency misalignment also affects the aggregate level of domestic consumption and domestic investment. As they all together (that is, the trade balance, domestic consumption and domestic investment) determine the level of national output of an economy, therefore, REER misalignment is one of the crucial factors that describe the growth of open economies. Rather than confining the macroeconomic performance to growth, the study will also take trade-balance, aggregate consumption and aggregate investment into account to have a more

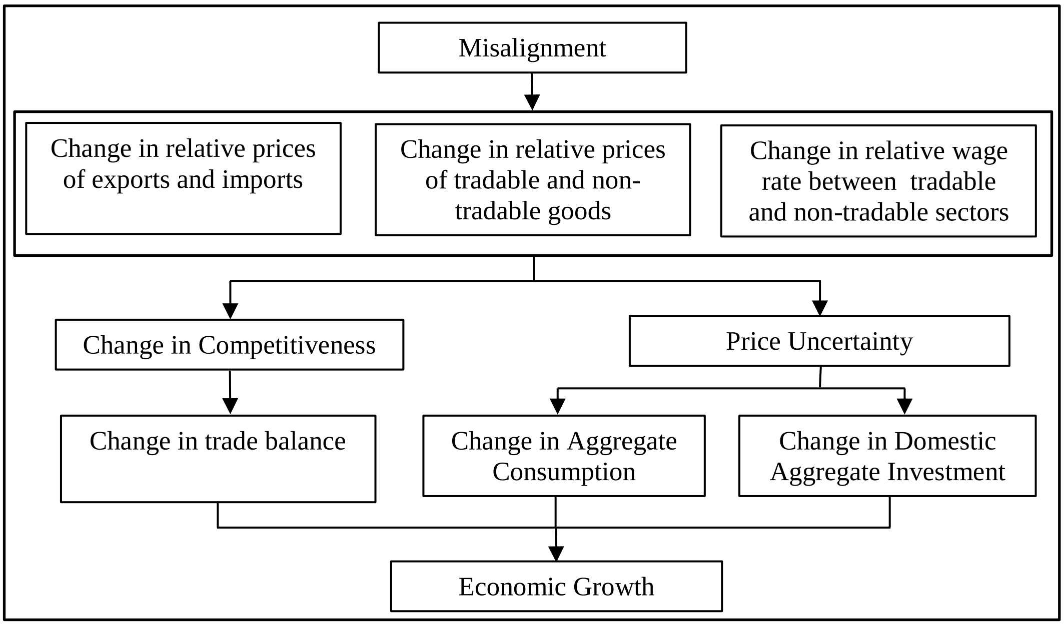


Figure 2 The Link between Misalignment and Macroeconomic Performance
Source: Author's construction

comprehensive picture of the effects of REER misalignment in open economies. With the theoretical backdrop, the chapter will also summarize the empirical literature on the link between REER misalignment and macroeconomic performance of open economies.

3.2. Currency Misalignment and Economic Growth

Economic growth is supposed to be strongly related to the behavior of real exchange rate for a range of reasons. While appreciation in REER is expected to hinder economic growth through the deterioration of external balance, a real depreciation is thought to provide an environment conducive to long-run economic growth reinforcing competitiveness and thereby improving the current account. REER may work as one of the links between policy and performance, REER stabilizing policies to an extent may boost economic growth. Again, the way policies affect both growth and real exchange rate may increase the correlation between the two variables without necessarily implying causality in one direction or another (Cottani, Cavallo, & Khan, 1990). The empirical literature on real exchange rate misalignment and economic growth goes back to the 1960s to 1980s (Edward, 1989; Dollar, 1992 for instances), but much of the recent studies on the growth impact of misaligned exchange rate can be perceived in the context of Washington Consensus view. This view regards both sorts of REER misalignments, that is, deviations of real exchange rate from its equilibrium values in any directions are bad from the long-term growth perspective (Williamson, 1990), which has been supported by number of empirical studies (Aguirre & Calderón, 2005; Comunale, 2017; Cottani et al., 1990; Frikha & Hachicha, 2013; Ghura & Grennes, 1993; Sallenave, 2010; M. Schröder, 2013, 2017; Toulaboe, 2011).

Majority of the empirical studies investigating the link between currency misalignment and growth provide evidence of a negative association between them for developing and emerging economies. **Edwards (1989a)** was the first pioneer to estimate the impact of REER misalignment on economic growth for 12 developing countries over the period 1962-1984. Actually, Edward’s the theoretical model has applied the following fundamentals (terms of trade, capital account, government consumption, exchange controls, an excess supply of domestic credit and technological progress), in order to determine the REER equilibrium levels. The study finds misallocation of resources due to the distortions in relative prices of tradable and non-tradable sectors caused by real exchange rate misalignment, which has a negative impact on economic growth.

Constructing an index of outward orientation, **Dollar (1992)** investigated the impact of real exchange rate misalignment on economic growth for a large sample of 95 developing countries for the period 1976-85 and devaluation of the real exchange rate was found to be intensely growth promoting in many poor countries.

As for **Cottani et al. (1990)**, they have studied the correlation between REER misalignment and economic performance using data pertaining to some twenty four less developed countries (LDCs) over the period 1960-1983. The OLS estimation results have demonstrated a strongly dominating negative association prevailing between economic growth and misaligned REER.

Ghura & Grennes (1993) have in turn used Edwards's model to explore the impact of REER misalignment on economic growth regarding thirty three Sub-Saharan Africa countries, over the period 1970-1987 using pooled time-series and cross-section data. These authors have tried to measure the REER misalignment by means of parallel market exchange rate or the black market. The empirical investigation confirmed the adverse effect of REER misalignment on economic performance, i. e., on economic growth, imports, exports, saving and investment.

Razin & Collins (1997) considers a large sample of ninety three developed and developing countries over the period 1975 to 1992 to examine how the growth experiences of the countries are related to currency misalignment and identify a nonlinear association between them. They find that overvaluations have to be very high to slowdown economic growth, while a moderate to high undervaluation seems to enhance economic growth more rapidly.

Domaç & Shabsigh (1999) examine the empirical relationship between real exchange rate misalignment and economic growth in Egypt, Jordan, Morocco, and Tunisia collectively for the period 1970-95 utilizing three different measures of REER misalignment based on purchasing power parity; a black market exchange rate; and a structured model, and confirm the adverse effect of misalignment on growth for all measures of misalignment. With reference to the economic reform policies, particularly, policies relating to exchange rate initiated in the late 1980s and early 1990s, the paper confirms the adverse impact of misalignment on growth for all measures of misalignment prior to the policies undertaken and major alignments toward a more sustainable equilibrium resulted in the post-policy period that enhances the growth potentials of the concerned economies.

Aguirre & Calderón (2005) have used the fundamentals of Edwards's (1989a) model with respect to 60 countries during the period ranging from 1965 to 2003 to estimate the impact of REER misalignment on economic growth while using panel and time series cointegration methods. Their attained results based on generalized method of moments (GMM)-IV system estimation exhibit that misalignments impact economic growth in a nonlinear fashion, that is, a larger size of misalignment leads to a larger decline in economic growth.

Sallenave (2010) measures REER misalignments employing the behavioral approach BEER and evaluates its growth effects for the G20 countries over the period 1980-2006. Findings differ largely from developed to emerging economies- while it marks misalignment is relatively pronounced in emerging countries, a relatively sluggish speed of convergence towards the estimated equilibrium exchange rate is evident for developed economies. However, turning to the analysis of growth regression, the overall growth effects of misalignment are found to be negative.

Toulaboe (2011) investigates the relationship between the mean growth rate of per capita GDP and REER misalignment for 33 developing countries from Sub-Saharan Africa, Asia and Latin America. The results indicate that average REER misalignments are negatively correlated with economic growth. **Abida (2011)** derives REER misalignments applying Fundamental Equilibrium Exchange Rate (FEER) approach to measure its impact on economic growth of selected Maghreb countries (Morocco, Tunisia and Algeria) for the period 1980-2008 and finds that misalignment tones down economic growth and thereby support conventional paradigm. **Frikha & Hachicha (2013)** also confirm similar results for seven MENA countries for the period 1960-2010 applying ARDL approach and Edwards (1989b) theoretical model as a tool for measuring misalignment.

In another study on the impact of REER misalignments on GDP growth in the EU, **Comunale (2017)** uses a panel of 27 EU countries for the period 1994–2012 and finds that while misalignments have association with lower long-run growth, the volatilities in exchange rate do not have robust effect on GDP growth, though spillovers and global factors seem to matter in all the specifications both in the short and long run.

Employing similar model to determine misalignment for a sample of 63 developing countries over 1970–2007, **Schröder (2013, 2017)** suggests that not the equilibrium REER but its misalignments do have an effect on economic growth in developing countries.

However, much has been focused on the decomposition of misalignment indicators in recent studies in order to illustrate the growth effect of deviations of real exchange rate from its equilibrium values which results in a rising agreement amongst researchers to reject the view that REER misalignments are bad from the long-term growth perspective as they have found REER overvaluation has an adverse impact on economic growth, while undervaluation stimulates it. **Gala & Lucinda (2006)** have conducted a study based on PPP deviation measures to estimate the impact of REER misalignment on economic growth as regards 58 developing countries during the 1960-1999 time periods. Using the OLS and Pooled OLS estimation, the results have indicated that if the REER happens to be 10 percentage points more devalued, everything else being constant, real per capita income average growth rate could be 0.122 percentage points higher. In other words, a real depreciation is linked with higher GDP growth.

In a study on investigating the role of real exchange rate misalignment on long-run growth for a set of ninety countries using time series data from 1980 to 2004, MacDonald & Vieira (2010) identifies that a country's more depreciated real exchange rate promotes its long-run economic growth, while a real appreciation hinders it, and the results are found to be pronounced for developing and emerging countries.

Both the studies of **Béreau, Villavicencio, & Mignon (2012)** and **Grekou (2015)** identify a nonlinear relationship between currency misalignment and economic growth as Razin & Collins (1997) and Aguirre & Calderón (2005) do, which implies that a greater size of misalignment worsens economic growth greatly. Using an extensive panel, **Béreau, Villavicencio, & Mignon (2012)** measure currency misalignments for a set of advanced and emerging economies for the 1980 to 2007 period so as to estimate its impact on economic growth. With regard to the differentiated impact of currencies' overvaluations and undervaluations on economic growth, results of the study indicate that whereas overvaluation negatively affects economic growth, REER undervaluation significantly enhances it. **Grekou (2015),** who revisits the growth effects of currency misalignment for the period 1985-2011 for CFA zone economies retaining the BEER approach to derive currency misalignment and then relying on panel cointegration approach, obtains identical results. However, the inclusion of debt channel by taking the dynamics of foreign currency denominated debt into account makes the study distinct from the rest. It identifies a dampening valuation effect on growth in the undervaluation regime through the surge of foreign currency denominated debt due to real undervaluation. In a recent study, Tipoy, Breitenbach & Zerihun (2018), while examining the transmission mechanisms of exchange rate undervaluation on economic growth for a set of emerging economies using annual data from 1970 to 2014, find that undervaluation has a positive impact on economic growth.

Though devaluation fosters economic growth of developing and emerging economies, it may bring about a contractionary effect beyond a certain limit. Considering data for a large sample of countries over the period 1980-2009, **Couharde & Sallenave (2013)** identify the threshold value of devaluation for Asian and non-Asian emerging economies beyond which it has an adverse impact on growth. The threshold value for non-Asian emerging economies is much lower than its Asian counterpart.

Owoundi (2016) discusses the effects of misalignments, determined by behavioral equilibrium exchange rate model, on growth by considering different exchange rate regimes of 17 countries in Sub-Saharan Africa using Bayesian inference techniques covering the period 1980-2011 and taking into account the uncertainty on growth determinants based on a panel GMM system estimation and finds that currency misalignment do not have favorable impact on economic growth. However, decomposition of misalignment indicators illustrates that overvaluation has a negative impact on growth, while undervaluation has almost no effect. Magud & Sosa (2013) also identify that misalignment of exchange rate from its fundamental lowers economic growth, however, overvaluation of exchange rate has an adverse impact on economic growth, while the impact of undervaluation is uncertain. In an earlier study based on such decomposition, **Rodrik (2009)** obtains similar results based on PPP based measure of REER, economic growth is found to be more rapid during the undervaluation episodes, however, episodes of overvaluation are associated with lower economic growth. **Berg & Miao (2010)** agree with Rodrik's findings but they give more importance on deviations from fundamentals in measuring REER misalignments.

Habib, Mileva, & Stracca (2017) employs five-year average data for a panel of over 150 countries to investigate the impact of REER movements on economic growth in the post Bretton Woods period and finds that annual real GDP growth is markedly impaired (raised) by a real appreciation (depreciation), beyond the previous estimates in the literature. Nevertheless, this effect is only confirmed for developing countries and for pegs.

In a recent study, **Ulasan (2018)** empirically assesses the association between REER misalignment and economic growth for a large number of countries taking an updated data set over the sample period 1990-2014 into consideration and finds that the measure of REER misalignment has a positive impact on growth of the low and middle-income countries whereas no significant impact on growth of richer countries, implying the more overvalued currency over the long run lower the growth in developing countries.

3.3. The impact of REER misalignment on International Trade

Exchange rates can influence trade in a variety of ways. Being relative prices of tradable to non-tradable goods of an economy and hence capturing the relative costs and productivity of that economy in relation to the rest of the world, real exchange rates work as a measure of competitiveness that theoretically have considerable impact on the incentive of allocation of resources between the tradable and non-tradable sectors (Auboin & Ruta, 2013). Two of the most researched features on the link between exchange rate and international trade concern with exchange rate volatility and misalignment. Variability of exchange rate hampers international trade and makes investment decision difficult by imposing additional risks and transaction costs on traders and investors. On the other hand, the impact of currency misalignment on international trade is largely determined by its impact on relative prices of exports. REER misalignment in terms of real undervaluation makes export cheaper and thereby increases the competitiveness of exports and import-competing sector in the world market at the cost of consumers and non-tradable sector (Broz & Frieden, 2008). Therefore, the impacts of currency misalignment on prices do not differ from those of an export subsidy and import tax (Nicita, 2013). Though the economic literature in the area of exchange rate volatility and trade relationship has been evolved during the 1970s through the 1990s as a logical response towards the end of (the gold standard) the fixed but adjustable system of exchange rates, study in the area of currency misalignment and trade is relatively slim that have gained more prominence after 2000. This part of the study reviews the pertinent academic literature that attempts to estimate the effect of exchange rate misalignments on international trade.

IMF study in 1984 in response to increased exchange rate volatility immediately after the breakdown of the Bretton Woods Agreement explained how trade could be affected by currency misalignment. International trade flows can be destabilized owing to improper price signals resulting from inflation rate or cost differentials attributed to wider and deeper exchange rate fluctuations and sustained misalignment of exchange rates away from equilibrium levels (Dell'ariccia, 1999). Misalignment can work as an impediment in allocating resources of an economy between its tradable and non-tradable sectors in accordance with relative cost and productivity differentials by altering investment decisions and thus can impose adjustment and resource misallocation costs on that economy. Levels of protection against the external competition by means of price-based trade barriers might be destabilized due to misalignment, which can force to amend trade restrictions to uphold the supply in the pattern it is existing (IMF, 1984).

Marshall-Lerner (M-L) condition suggests that devaluation/ depreciation will improve current account if the sum of elasticities of demand for export and import is greater than unity. But the outcome basically depends on the two opposing effects at work due to depreciation- price and volume effects. Price effect resulting from devaluation always worsens current account making export cheaper in foreign currency and import expensive in domestic currency. On the other hand, the volume effect as a result of depreciation improves current account as cheaper exports stimulate export volume while the volume of imports falls as being expensive. Hence, if the volume effect of depreciation outweighs its price effect, it exerts a positive impact on trade balance (i.e. exports minus imports) (Pilbeam, 2006). Therefore, whether exchange rates undervaluation can have an effect on trade in the short and/or in the long-run is an empirical issue.

Misalignment can either be the result of government intervention with the aim of altering the real exchange rate (currency manipulation), or it can be the undesirable consequence of policies taken to achieve macroeconomic objectives. Countries may be found to have involved in illicit currency manipulation to affect the trade balance producing 'fundamental misalignment' with the motivation of increasing net exports (Staiger & Sykes, 2010).

The impact of misalignment on trade flows and on real economic activity differs from short-run to long-run. In the long-run, when markets are free from distortions particularly because of fully flexible prices, misalignment has no effect on trade flows. But in the short-run, some prices may not adjust instantaneously. This sticky behavior of prices alters the relative prices due to the movements in nominal exchange rates which eventually affects international trade flows altering the allocation of resources between the sectors producing tradable and non-tradable goods (Auboin & Ruta, 2013). A nominal depreciation of the home currency in the short-run when prices are sticky brings about a real depreciation of the exchange rate. It implies that products produced abroad become relatively expensive compared to home products. Consequently, there will be expenditure switching as consumers at home will switch to home products, import less and export more since foreign consumers prefer less costly home products as well. Therefore, standard macroeconomic framework predicts the trade balance to be an increasing function of the exchange rate in the short-run (Krugman, Obstfeld, & Melitz, 2012). Among the recent studies, Kodongo & Ojah (2013) also find evidence in support to this view while they investigate it empirically employing panel VAR techniques using yearly data of nine major African countries during 1993–2009. On the other hand, setting home products prices in a foreign currency or in a vehicle currency like US dollar and euro is a sign of import restrictions rather than export promotion and dispense a different impact of depreciation on trade balance (Staiger & Sykes, 2010).

Effect of Misalignments of exchange rates on the trade balance is generally channeled through its impact on trade competitiveness that signifies a country's gains and losses in selling the products it produces in the international market. Trade competitiveness is achieved when a country is able to produce better products at a lower cost than other countries competing in the international market, which is an important determinant of a country's external payment position (Clark, Bartolini, Bayoumi, & Symanski, 1994). A country's trade competitiveness is largely determined by the movement in the REER (Edwards & Golub, 2004). Other things remaining the same, undervaluation of exchange rates give incentive to domestic exporters to compete in the international market making exports cheaper. It also gnaws the competitiveness of the export-competing sector by making import more expensive. Though appreciation or depreciation of exchange rate do not guarantee the loss or gain of competitiveness, movements of domestic wages and prices (the so-called internal interventions) do matter (Bajo-Rubio, Berke, & Esteve, 2016), many countries around the world operating under both fixed and flexible exchange rate regimes undervalue their currencies to improve their trade balances since the early 1970s.

Baldwin & Krugman (1989) and Clark et al. (1994) explain how currency overvaluation can be the cause of persistent loss of trade competitiveness with the notion of 'hysteresis effect'- an effect that persists when its causes are removed. They argue for the role of invisible assets like distribution networks, consumer loyalty and reputations on the competitiveness of an economy along with the role of price and installed capacity. During the period of sustained misalignment, firms abroad may have invested in invisible assets, leading to a loss in the market share of domestic firms that cannot be recovered merely through a return of the domestic currency to its steady-state value. However, McCausland (2002) explains the same from a different perspective. An unanticipated policy change that reduces domestic competitiveness and enhances importers return may drive foreign firms to enter into the industry if an adjustment is not prompt. This would have a feedback effect on trade and competitiveness that would reduce the competitiveness of domestic firms further. An unanticipated change of policy at the same but opposite scale to the initial policy change that triggered new foreign firms to enter will not drive them to exit and consequently, the domestic firm will not regain its market share and competitiveness.

Though recent empirical research has found a significant impact of REER misalignment on export performance or trade balance and suggests that a proactive exchange rate policy in accordance with price incentives, that is, undervaluation can foster manufactured exports and growth, empirical research on the relationship between REER misalignments and export performance or trade balance is inconclusive.

Jongwanich (2009) examines the equilibrium REER and its misalignments in developing Asian countries through the period 1995–2008. While investigating the relationship between misalignment and export performance, the study identifies a positive relationship between the REER and export performance in contrast to an opposite relationship between REER misalignment and export value almost in all countries. It implies that though depreciation in REER leads to higher exports and thus to the higher trade balance, REER misalignment, together with real appreciation, could have an adverse impact on export performance.

Sekkat & Varoudakis (2000) use three indicators- REER changes, REER volatility, and (model-based measures of) REER misalignment in order to examine the impact of exchange rate policy on manufactured export performance on a panel of major Sub-Saharan African (SSA) countries over the period 1970–1992 and suggest that exchange rate management matters for export performance. In particular, the study finds a negative relationship between REER misalignment and manufactured exports. However, they argue that a decrease in misalignment has a much more positive impact on manufactured exports than a real depreciation has.

The approach adopted by **Nouira, Plane, & Sekkat (2011)** is somewhat different as they attempt to investigate the role of persuasive exchange rate policy in line with price incentives on manufactured exports for 52 developing countries during the period 1991-2005 and find that many of the countries undervalue their currencies with the objective of ensuring price competitiveness to foster manufactured exports. Despite the fact that improving price competitiveness through undervaluation of domestic currencies imposes the cost of macroeconomic disequilibrium on the economies, the starring role of REER misalignment in terms of undervaluation in fostering manufactured exports is well established.

Imbs & Wacziarg (2003) examine the evolution of sectoral composition in relation to the level of development for the period 1969–1997 and find a robust relationship between product diversification and level of per capita income. A similar relationship is found prevalent between export diversification and per capita output by Cadot, Carrère, & Strauss-Kahn (2011) while exploring the development of export diversification patterns along the economic development path for a group of 156 countries over 19 years from 1988 to 2006. Therefore, product diversification and export diversification go hand in hand as the first promotes the later and they both have robust impact on per capita income growth which is supplementary to the findings of Hausmann, Hwang, & Rodrik (2007) which assert that a country's growth is positively influenced by the growth of income of the countries to which it exports.

REER misalignment is supposed to play an acute role in this conjuncture. From empirical point of view, **Ghura & Grennes (1993), Grobar (1993) and Sekkat & Varoudakis (2000)** find that overvaluation that many of the developing countries received as their desirable exchange rate policy at the early stage of their development targeting to diversification of their product was proved to be unsuccessful in achieving so as such a policy was found to have unfavorable impact on export diversification impacting the manufactured export to GDP ratio adversely.

Rodrik (2008), in a recent study, suggests that currency undervaluation can stimulate exports diversification of countries having a weak institutional framework. The basic argument for this is exports of manufactured and sophisticated goods that are more contracts-intensive and relationship-intensive than the primary goods (Nunn,

2007) are often constrained by a country's weak institutional frame-work (Nouira et al., 2011) that can be compensated by currency undervaluation. Nevertheless, empirical verdict on the causal effect of REER misalignment on diversification of export is still unclear as studies confirming the presence of such impact (Rajan & Subramanian, 2011; Freund & Pierola, 2012) are opposed by a series of their counterpart (Sekkat, 2016; Levy-Yeyati, Sturzenegger, & Gluzmann, 2013; Agosin, Alvarez, & Bravo-Ortega, 2012). The conceptual consideration for the absence of such an impact is quite straightforward- undervaluation drives the price of imports of certain factors (like machinery, intermediate goods) up that are crucial for the production of exportable goods from home economy which impedes export diversification. If the relative rise in factor prices doesn't exceed the price of exportable in the international market, the institutional framework will determine the competitiveness of export and export diversification. Evidence suggests that the desire of international entrepreneurs to increase the share of their exports cause them to pay more in informal payments (Brach & Naudé, 2012). Therefore, the weak institutional framework might offset the trade competitiveness achieved from undervaluation.

3.4. REER Misalignment and Domestic Consumption

Inflation redistributes income between workers and producers. On the other hand, currency depreciation exerts inflationary effects in an economy. Therefore, misalignment of exchange rate is expected to bring about a change in domestic consumption through its impact on inflation. As postulated by earlier studies, exchange rate volatility has a direct and significant effect on the variability of inflation. Bahmani-Oskooee (1991) supported this conjuncture estimating a model similar to Katsimbris & Miller (1982), Taylor (1981), Glezakos & Nugent (1984) and Chowdhury (1991) used to measure the relationship between rate of inflation and its variability just by incorporating a measure of variability of exchange rate into the model employing cross-country data from 20 developed (DCs) and 76 less developed countries (LDCs) over the period 1973-80. The conjuncture was further reinforced by Arize & Malindretos (1997) based on cross-country quarterly data for 41 countries over the period 1973-1990.

Referring to devaluation inflationary, Alexander (1952), in one of his seminal works, probably first familiarize exchange rate as one of the fundamental influencing factors of domestic consumption. His argument goes as follows. A long time lag of adjustment in wages to inflation attributed to currency depreciation causes wage increase to fall short of inflation, which put forth a negative impact on workers consumption while it is positive for producers. As the marginal propensity to consume (MPC) for workers is higher than that of the producers, there will be a fall in aggregate consumption.

In another influential work, Obstfeld & Rogoff (1998) identify the channels through which exchange rate uncertainty can adversely affect households and firms decision-making process directly or indirectly. The direct channel postulates that exchange rate fluctuations are undesirable to households and firms and thus produce undesirable effects on their decisions about consumption and leisure. Exchange rate uncertainty, as they argue, deters trade and so do the production or income of home and abroad and ultimately the aggregate consumption. The indirect channel assumes that firms may charge higher prices or a risk premium so as to hedge against the risks that might appear from future exchange rate fluctuations, which will eventually lower aggregate consumption.

Domestic consumption is perceived to be 60 to 70 percent in any economy and despite there prevails a vigorous link between exchange rate uncertainty and domestic consumption from the theoretical perspective, empirical research on the nexus is not still adequate. Moreover, the studies available in the literature use a measure of exchange rate volatility, either standard deviation based or GARCH based, in order to examine its impact on private consumption, misalignment of exchange rate is left unaddressed until the present.

In a sequence of persuasive studies, Bahmani-Oskooee and his co-authors (see e.g. Bahmani-Oskooee & Hajilee, 2010; Bahmani-Oskooee & Xi, 2011; Bahmani-Oskooee & Xi, 2012; Bahmani-Oskooee & Hajilee, 2012; Bahmani-Oskooee, Kutan, & Xi, 2015) dedicate their interest in exploring the empirical relationship between currency depreciation and domestic consumption.

Bahmani-Oskooee & Hajilee (2010) show that the relationship between currency depreciation and the wages of workers maps the relationship between currency depreciation and domestic consumption. Estimating the wage equations for 18 countries drawing annual data over the period 1969 to 2005, they examine how currency depreciation effect wages of the workers dividing them into two groups- skilled and unskilled and find that depreciation cuts the wages of unskilled workers and raises skilled workers’ wages, the similar conclusion drawn by Alexander (1952).

In order to identify the direct effect of currency depreciation, Bahmani-Oskooee & Xi (2011), Bahmani-Oskooee & Xi (2012) and Bahmani-Oskooee et al. (2015) estimate the consumption function introducing exchange rate and a measure of its variability as a determinant of consumption in addition to its traditional factors, i.e., income and interest rate.

Bahmani-Oskooee & Xi (2011) estimate the consumption function for 17 industrial economies taking annual data during 1964 through 2008 relying on the bounds testing approach to cointegration and error-correction modelling and suggest that exchange rate volatility (standard deviation based) that effects domestic consumption in the short-run in 12 of the 17 countries last in the long-run only for 9 countries. Moreover, positive and highly significant exchange rate coefficient signifies the dampening effect of currency depreciation on aggregate consumption for seven countries.

Bahmani-Oskooee & Hajilee (2012) then extended their sample to 50 countries and estimate the consumption function for the 1975-2006 period which reveals that exchange rate effects consumption significantly in the short run, but the effect does not transmit into the long run in most countries. However, exchange rate depreciation is found to reduce domestic consumption nearly half of the countries studied.

Bahmani-Oskooee & Xi (2012) carry out their estimation of consumption function drawing quarterly data from the US, Japan and Canada for the period 1970-2008. Based on bounds testing approach to cointegration and error-correction modelling, they argue that income, interest rate, exchange rate and its volatility (GARCH-based) significantly affect aggregate consumption of Japan in the short-run that last in the long-run for all other variables apart from the exchange rate, results similar to US and Canada. However, they find exchange rate uncertainty has a positive effect on US and Japanese consumption in the long-run, while it is negative for Canadian case.

Another study of **Bahmani-Oskooee et al. (2015)** counter to Bahmani-Oskooee & Xi (2011) but employs similar model drawing quarterly data from 12 emerging economies concludes that the short-run effects of exchange rate uncertainty (GARCH-based) on domestic consumption that is obvious for almost all countries last into the long-run only in half of the countries. As like the industrial economies, coefficient of exchange rate is found to be positive and highly significant to illustrate that currency depreciation reduces domestic consumption almost in half of the emerging economies they investigate.

In a recent study on 19 Sub-Saharan African countries covering annual data between 1999 and 2014, **Oseni (2016)** examines the impact of exchange rate volatility and private consumption appointing system-GMM dynamic panel and GARCH(1,1) to produce the series of exchange rate volatility and finds that the effects of volatility in exchange rate on private consumption in SSA countries is significant and negative. He argues that fluctuations in exchange rate that make local currency weaker also make imports of goods expensive accompanied by a rise in prices of exports due to their greater demand in the international market. Besides, exchange rate uncertainty reduces local investment driving capital out and so does the income level and aggregate consumption.

Therefore, all the above studies commonly support the arguments offered by Alexander (1952) and Obstfeld & Rogoff (1998).

3.5. Currency Misalignment and Domestic Investment

The link between exchange rate uncertainty and domestic investment is theoretically ambiguous. Some studies suggest that domestic investment could have been promoted by exchange rate uncertainty while the opposing views are also admirable; however, most studies approve the view that as like domestic consumption, exchange rate uncertainty affects domestic investment through producing inflationary effects in an economy. Therefore, two broad kinds of literature are relevant for placing-first on the relationship between price uncertainty and investment, and second on the direct relationship between exchange rate volatility and investment.

The last section sums up the empirical literature on the relationship between exchange rate uncertainty and price uncertainty. Here a summary of the first broad literature, that is, the effects of price uncertainty on the investment decision will be filled.

Higher inflation leads to the higher nominal interest rate that degrades accounting profit. Now, if the accounting profit realized from an investment project does not exceed the cost of capital due to higher nominal interest rate resulting from higher inflation, it may discourage farms to borrow and invest. On account of this, it is generally assumed that increased uncertainty about wages and prices reduce investment by raising the capital cost. However, the theoretical and empirical evidence differ sharply on this issue.

Tobin (1965) was probably the first who formally introduced the relationship between inflation and investment. The well-known Tobin effect that has acquired a special place in contemporary economic literature states that an increase in inflation helps long-run capital formation. However, an anti-Tobin effect, that is, a negative long-run effect of inflation on investment is also possible from a theoretical perspective as identified by **Stockman (1981)**. Most of the theoretical and empirical literature in the field of inflation-investment nexus revolve around these two illustrious works. Going back to Hartman (1972), including Abel (1983) and Dietrich & Hecerman (1980), Tobin-effect is found theoretically evident. In contrast, Pindyck (1982) has documented theoretical evidence in support of anti-Tobin effect, that has been supplemented by the empirical evidence offered by Feldstein (1982) and Barro (1995).

Hartman (1972) and Pindyck (1982) examine the behavior of investment in the development of inflation uncertainty and they end with different conclusions. Allowing price and cost to be random in each period to incorporate price and cost uncertainty in a discrete-time dynamic model with adjustment cost, Hartman (1972) argues that level of investment of competitive risk-neutral firms with linear homogeneous production function might be higher due to higher uncertainty in output price with an aim to circumvent future uncertainty. On the other hand, Pindyck (1982) includes price uncertainty in a continuous-time dynamic model considering current price known and future prices random and finds higher price uncertainty lowers investment of competitive risk-neutral firms. One of the reasons of such contrasting finding is that while Hartman's (1972) result is led by the convexity of marginal revenue product of capital, the convexity of marginal adjustment cost plays a central role in Pindyck's (1982) analysis. However, using the stochastic specification of output prices and convex costs of adjustment similar to Pindyck (1982), Abel (1983, 1985) examines the impact of price uncertainty on investment of competitive risk-neutral firm and reach to the conclusion resembling Hartman (1972). Maximizing the net present value of a firm that makes a once-for-all investment decision, Dietrich & Hecerman (1980) derive the demand for real capital and agree with Hartman's (1972) argument as the demand function they derive shows the character of increase in firms demand for capital (investment) when there is greater uncertainty about wage and price changes.

In an influential contribution, **Dixit and Pindyck (1994)** try to understand the investment behavior in an uncertain context. They evaluate the option value of an investment project as it represents the value of waiting for investment using 'theory of optimal inertia' and find that firms prefer waiting rather than investing in a situation when the current rate of return is far in excess of the cost of capital.

Two major attempts to resolve the dilemma of long-run positive and long-run negative investment effects of inflation reported by Tobin (1965) and Stockman (1981) and supported by successive literature were taken by Gillman & Kejak (2011) and Tan (2012). They disapprove the modelling framework of earlier studies as they do not put money into the utility function or integrate it as a cash-in-advance constraint necessary to model money in an appropriate way.

Gillman & Kejak (2011) attempts to resolve the dilemma of long-run positive and long-run negative investment effects of inflation reported by Tobin (1965) and Stockman (1981) applying the cash-in-advance constraint to both consumption and investment based on calibration and simulation of postwar US annual data for 1954–2000 and reach to the conclusion that the effects of inflation on the balanced path growth rate of output, the investment rate and the real interest rate is negative which is limited to some reasonably high rate of inflation beyond which increasingly low investment eventually leads to a fall in capital to relative to labor, and a rise in the real interest rate.

Tan (2012) criticizes Tobin and anti-Tobin effects and successive development of literature in relation to these effects from the view that all they model money in a wrong way ignoring the liquidity of money used to acquire short-run consumption needs and illiquidity of capital used to acquire long-run consumption needs. Extending Freeman's (1985) pure exchange model, a unified approach that concedes these features within a dynamic general equilibrium model, the study shows that the inflation regime and transfer of seigniorage together determine the monetary policy effects in the long-run. Transfer of seignorage to the young causes Tobin effect to be realized in the low inflation regime and anti-Tobin effect in the high inflation regime. In contrast, transfer of seignorage to the old will bring about an opposite result.

Irreversible investment was first introduced to investment literature by **McDonald & Siegel (1985)** who show that even modest levels of uncertainty push the opportunity cost of investing of a risk-neutral price taker firm up and thus lessen investment. Craine (1989), Pindyck (1988, 1991) and Zeira (1990) reinvestigated the issue and argued that increased uncertainty toned down the investment expenditure of a competitive risk-neutral firm, which was further revitalized by the contribution of Bertola (1998).

Apart from these few earlier studies, most of the recent empirical literature based on time series and panel data identify a negative relationship between price uncertainty and investment.

Madsen (2003) estimates the possible overall effects of inflation on investment applying an efficient generalized instrumental variable method for a period thru 1963-1999 using panel data of the 14 OECD countries. The study finds that inflation subsides investment in non-residential buildings and structures and in machinery and equipment which supports the view that the extraordinary investment performance of OECD economies in the 1990s was accredited by low inflation environment of these economies. In another study on 21 OECD countries on the direction and strength of the combined impact of inflation on corporate investment during 1960–2005 based on reduced model estimation, Cizkowicz & Rzońca (2013) identify a statistically significant negative relationship between them.

In order to identify whether industries experiencing substantial periods of higher uncertainty about real wages, the real price of materials and the real price of output have shown markedly different investment behavior compared to other industries, **Huizinga (1993)** empirically examines quarterly data from the first quarter of 1954 to the third quarter of 1989 from 450 manufacturing industries of US and comes to the conclusion that higher inflation uncertainty that results in uncertainty about the net present value of an investment project, the project should be delayed until the uncertainty disappears or until the payoff desired from the project increases enough to compensate the higher uncertainty.

Asteriou & Price, (2005) study the relations between uncertainty, investment and economic growth during 1966-1992 for a group of 59 industrial and developing countries estimating reduced form equations utilizing panel data and finds that uncertainty stemming from different macroeconomic factors including inflation reduces both investment and growth.

Caruso (2001) does not find any contrast with the irreversible investment decisions reported by McDonald & Siegel (1985) while he examines the differential investment effects of permanent and temporary price uncertainty using auxiliary regressions to compute price forecast errors drawing data from the agriculture, industrial and tertiary sectors of over 300 Italian industries for the period 1980–1994. The study identifies an inverse relationship between price uncertainty and real investment and ascertains that persistent price uncertainty deters fixed capital accumulation more relative to its transitory components.

Peeters (2001) investigates the impact of demand and price uncertainty on corporate investment using a large data set, namely 308 firms from Belgian for the period 1984-1992 and 1298 firms from Spain for the period 1983-1993. While a direct measure exhibits a significant correlation between the aforementioned uncertainties and corporate investment, application of GMM estimations including the uncertainty elements in dynamic investment equations suggest that output price uncertainty dampens investment in Belgium and Spain.

Firm-level studies also suggest that uncertainty shrinks the firm's current level of investment. Among the firm level studies, the contributions of **Cukierman (1980)** and **Smith & van Egteren (2005)** are noteworthy. **Cukierman (1980)** investigates the choice of a risk-neutral firm free to collect information employing a Bayesian framework and finds that it seems to be profitable to the firm to delay investment decision in the development of uncertainty so as to collect information and consequently level of current investment of a risk-neutral firm falls with the rise in uncertainty. In another study, **Smith & van Egteren (2005)** develops a model incorporating the effect of inflation on the decision of earnings allocation which predicts that both the expected and unanticipated inflation and its volatility give a false account of firms' internal financing choices, intensify frictions in the financial markets, shrink the level and efficiency of investment, and thus reduce total output.

Henceforth, the second broad literature on the direct relationship between exchange rate volatility or misalignment and investment will be deliberated. To examine the direct effect of exchange rate volatility on investment, Campa & Goldberg (1995), Darby, Hallett, Ireland, & Piscitelli (1999), Bleaney & Greenaway (2001), Servén (2003), Kandilov & Leblebicioğlu (2011), Bahmani-Oskooee & Hajilee (2013) and Iyke & Ho (2017) estimate the investment function incorporating exchange rate and a measure of its variability as a determinant of investment in addition to its traditional factors like income and interest rate. However, the literature on the direct effect of exchange rate misalignment on aggregate investment is rather few.

Campa & Goldberg (1995) study the impact of exchange rate volatility on investment in US manufacturing using industry-level data for the period 1972-1986 and argue that the external exposer dominates in determining the relationship. The study finds that low mark-up industries are relatively unresponsive to exchange rate changes, though it exerts a strong impact on sectoral investment. On the other hand, exchange rate fluctuations are absorbed in mark-ups by high mark-up industries and thereby pass through relatively little impact on real investment.

Darby et al., (1999) extend the Dixit & Pindyck (1994) model in order to examine the effects of exchange rate volatility on investment. Their model identifies both investment stimulating and investment depressing situations that can broadly be reduced to two factors, namely, the opportunity cost of waiting and the present value of investment. Referring to firm-level investment, they argue that whether investors prefer to wait rather than investing depends on the relative worth of the opportunity cost of waiting and the present value of investment. Higher opportunity cost of waiting than the present value of an investment will induce investors to wait rather than to invest. This firm-level study has also been extended to the national level estimating an aggregate demand function for France, Italy, Germany, UK and the US for which the real cost of capital is constructed using the implicit business sector investment and output deflators and a long term interest rate. They also include exchange rate misalignment in their model along with its volatility and find that both volatility and misalignment have a significant negative impact on aggregate investment for all five of these larger OECD economies.

While investigating the impact of the level and volatility of the terms of trade and the REER on investment and growth for a panel of 14 sub-Saharan African countries over 1980–1995, **Bleaney & Greenaway (2001)** find that terms of trade instability have a negative impact on growth, while REER instability has on investment. Once the REER overvaluation is eliminated, an improvement in terms of trade increases both growth and investment. One important aspect of the study Bleaney & Greenaway (2001) carried out is that their model also comprises a measure of exchange rate misalignment which reveals that in addition to exchange rate uncertainty, its misalignment can affect domestic investment. With regard to misalignment, the study finds that misalignment causes the investment ratio to move in the opposite direction.

Servén (2003) empirically examines the association between real exchange rate uncertainty and private investment in developing countries using a large cross-country time series data set on private investment and its determinants containing 61 developing countries for the period 1970-1995 adopting GARCH-based measure of real-exchange-rate volatility and identifies that it has a robust adverse effect on investment, which is found to be larger for economies that are relatively open and in those having less developed financial system.

Kandilov & Leblebicioğlu (2011) assess the impact of exchange rate volatility on firms' investment employing plant-level panel data from the Colombian Manufacturing Census for the period from 1981 to 1987 and estimating a dynamic investment equation using the system-GMM estimation. The study documents a robust negative impact of exchange rate volatility on plant investment.

Bahmani-Oskooee & Hajilee (2013) argue that the relationship between exchange rate uncertainty and investment concentrated on firm-level data is equally applicable at the aggregate. They evaluate the short-run and long-run impact of exchange rate volatility on domestic investment drawing data from 36 countries over the period 1975-2008 Using the bounds testing approach for cointegration and error-correction modelling. Results of the study approve the transitory effects of exchange rate volatility on domestic investment in most countries as the short-run effects of exchange rate volatility on domestic investment that was found for 27 of 36 countries last into the long-run only in 12 countries. However, in 14 of those 27 countries, exchange rate uncertainty increases domestic investment, while decreases in the rest.

Iyke & Ho (2017) revisit this issue at the macro-level by differentiating the short-run impacts of exchange rate uncertainty from long-run impacts. Employing annual data for Ghana covering the period 1980–2015, ARDL bounds test result of the study finds differential impacts of exchange rate uncertainty on domestic investment in the short run. That is, while investment is enhanced by the current level of uncertainty, levels of uncertainty in the previous period check investment. Nevertheless, in the long run, exchange rate uncertainty influences domestic investment positively.

Therefore, empirical studies on the effects of exchange rate uncertainty on investment spending support the view that volatility and misalignment in exchange rate dispense negative impact on firm-level and aggregate investment.

3.6. Summary

This chapter offers the theoretical as well as the empirical literature on the impact of REER misalignment on macroeconomic performance of open economies. Misalignment in REER affects economic growth through the change in countries competitive position. Research on the relationship between REER misalignment and economic growth has been rippled following Williamson's (1990) recommendation that any distortion of REER from the value set by its fundamentals will hamper economic growth. While majority of the empirical studies support this view, studies with opposing views are also found in an admirable quantity. Change in trade competitiveness due to the change in relative productivity caused by the changes in relative prices of products and factors of tradable and non-tradable goods owing to REER change also causes trade balance to change. Price uncertainty is said to have an adverse impact on the aggregate level of domestic consumption and domestic investment which in turn affects economic growth. Since REER misalignment contributes to price uncertainty, it is expected to have a direct negative impact on domestic consumption and domestic investment. However, many of the recent investigate, as summarized in this study, include a measure of REER volatility/misalignment in the consumption and investment function and find that it can affect consumption and investment in either direction.

CHAPTER IV

MISALIGNMENT OF REER FOR SELECTED EMERGING ECONOMIES

4.1. Introduction

The main purpose of the study is to examine the impact of REER misalignments on macroeconomic performance of selected emerging economies. Therefore, the first order of business is to determine the misalignment series of REER. REER is misaligned when it strays from its long-term equilibrium values. Equilibrium REER is an unobservable entity and therefore its estimation is inevitable to produce the misalignment series to study its impact on macroeconomic performance of economies. In this chapter, we shall design the theoretical and empirical constructs for the estimation of equilibrium REER, which will then be used to generate the misalignment series of selected emerging economies.

4.2. Theoretical and Empirical Model for the Estimation of REER Misalignments

The literature on the estimation of equilibrium REER is extensive and ever-evolving. Some of the model-based widely used approaches include Capital Enhanced Equilibrium Exchange Rate (CHEER), Fundamental Equilibrium Exchange Rate (FEER), Desired Equilibrium Exchange Rate (DEER), The Natural Real Exchange Rate (NATREX), Behavioral Equilibrium Exchange Rate (BEER), Permanent Equilibrium Exchange Rate (PEER) and Single Equation Approach that are described in chapter two. The approaches mainly differ in terms of they define and model the dynamics of exchange rate.

Terra and Valladares (2010) and Koukouritakis (2012) offer a brief explanation of the contexts in which the approaches suit best. As the study is concerned with the long-run equilibrium REER, it precludes the CHEER which focuses on estimation of nominal exchange rate. FEER, NATREX and DEER are not also fit for the study since they are indirect approaches of equilibrium REER estimation. They give more attention to the estimation of either complete macroeconomic models or simply current accounts and the resulting equilibrium REER is compatible with medium-term equilibria. Though BEER measures equilibrium REER directly, the modelling technique it employs captures over time movements in real exchange rates rather than the movements in the medium or long-run equilibrium level and hence can be treated as a concept of the short-run equilibrium exchange rate (Driver & Westawa, 2005). PEER is a related representation of BEER which fundamentally differs in the way that exchange rate in this approach is determined only by the fundamentals having a persistent effect on it. The single equation approach estimates the long-run equilibrium REER directly drawing a vector of sustainable values for the fundamentals.

The Single Equation approach offered by Edwards (1989a), Elbadawi (1994) and Baffes et al. (1999) deems the long-run equilibrium REERs is likely to be determined by a set of economic fundamentals. The fundamentals they use include terms of trade (TOT), government spending on nontradables (G_N), government spending on tradable goods (G_T), investment (I), trade openness (OPEN). However, the theory underlying this approach offers relatively a wide range of fundamentals to choose in developing the model. Edwards & Savastano (1999) present some representative empirical studies that have assessed the extent of misalignment employing the single equation approach in developing and transition economies during the late 1980s through the 1990s. The study also examines the recent literature on the estimation of equilibrium REER based on Single Equation approach in developing and emerging economies (for instance, Rahman and Basher, 2001; Macdonald & Ricci, 2004; Kemme and Roy, 2006; Toulaboe, 2011; Elbadawi, Kaltani and Soto, 2012 and Schröder, 2013) aiming to identify the fundamentals they use. In addition to the aforesaid fundamentals, these studies also consider resource balance to GDP ratio (RESGDP), net financial assets position (NFA), debt services (DEBT), the relative productivity in tradable sector to non-tradable sector (PROD) or the relative price of tradable to non-tradable goods (TNT) to incorporate the Balassa-Samuelson effect, real interest rate differentials (RIRD) and official development assistance (ODA) to model the equilibrium REER. However, unavailability of data for all these variables throughout the sample period limits the study to include them all in the theoretical model of equilibrium REER (q^*) determination that takes the following form:

$$q^* = q(TOT, G_N, G_T, NFA, I, OPEN, PROD, r - r^*, ODA) \qquad (4.01)$$

The empirical model for estimating the relationship between REER and its fundamentals can, therefore, be given as:

$$lnq^*_{rt} = \beta' F^s_{rt} \qquad (4.02)$$

where q_t^* is the equilibrium REER of country r at time t, β' is the vector of coefficients of the long-run parameters to be estimated, F_{rt}^s is the vector of permanent or sustainable values for the set of fundamentals of country r at time t. The empirical model presented below is nothing but the replication of equation 4.02:

$$lnq_t^* = \beta_0 + \beta_1 lnTOT_t + \beta_2 lnPROD_t + \beta_3 G_t + \beta_4 I_t + \beta_5 OPEN_t + \beta_6 NFA_t + \beta_7 ODA_t + \beta_8 (r_t - r_t^*)_t + \varepsilon_t \qquad (4.03)$$

It is expected that government spending on nontradables, net financial assets position, relative productivity in the tradable sector to non-tradable sector, real interest rate differentials and official development assistance have a positive impact on REER while it is inversely related with government spending on tradable goods, trade openness and the relative price of tradable to non-tradable goods. However, the impact of terms of trade and investment can either be positive or negative. A brief discussion on the direction in which equilibrium REER moves in response to the change in fundamentals is offered in chapter two, based on which the expected signs of the coefficients are as follows: $\beta_1 \lesseqgtr 0, \beta_2 < 0, \beta_3 \lesseqgtr 0, \beta_4 \lesseqgtr 0, \beta_5 > 0, \beta_6 > 0, \beta_7 \lesseqgtr 0, \beta_8 < 0$.

4.3. Data Sources

Annual frequency data for the period 1980-2016 have been used for the following twenty one EMEs: Argentina, Bangladesh, Brazil, Chile, China, Colombia, Egypt, Greece, Indonesia, India, Republic of Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, South Africa, Thailand, Turkey and ARE. Sources and necessary explanation of the variables are summarized below.

The **real effective exchange rate** is a multilateral exchange rate to measure the relative price of domestic goods and services in terms of a basket of goods and services of other major trading partners which is the weighted average of bilateral real exchange rate where trade share of a trading partner in a country’s total trade constitutes the weight. REER data are readily accessible from various sources, but none of the sources have a complete set of data for the countries selected for the study. Consequently, the study relies on different sources for REER data that include International Financial Statistics (IFS) of IMF, the Bank for International Settlements (BIS) and BRUEGEL datasets. Though the sources vary, what is common is that all these REER indices are based on CPI. The base year is kept fixed across the economies.

Terms of Trade data, which is the relative price of a country's exports to its import expressed as the ratio of unit value index of exports to its imports, has been compiled from the United Nations Conference on Trade and Development (UNCTAD) and IFS of IMF.

Net foreign assets include net holdings of portfolio equity assets, foreign direct investment (FDI) assets, debt assets, financial derivative assets and foreign exchange reserves minus gold. The ratio of net foreign assets to GDP has been considered for the study. NFA data is mainly drawn from Lane and Milesi-Ferretti (Lane & Milesi-Ferretti, 2007) that contains data for the period 1970-2014 in its updated version. The data is completed with WDI net foreign assets data of WB with necessary modification.

Net official development assistance (ODA) consists of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC) of the Organization for Economic Co-operation and Development (OECD) and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients. It includes loans with a grant element of at least 25 percent (calculated at a rate of discount of 10 percent). The study uses data of ODA as a percent of GDP from WDI of WB.

Unreachable time series of certain fundamentals that explain equilibrium REER is the rudimentary limitation for the implementation of the empirical model. They include investment spending, government spending on non-tradable goods, trade policy and productivity differentials. These explanatory variables have to be proxied by appropriate alternatives so as to estimate equilibrium REER.

Investment spending (I) data which is proxied by gross capital formation is drawn from World Development Indicators (WDI) of World Bank (WB), Penn World Table 9.0 (PWT 9.0) and UNCTAD.

Government consumption (G) broadly falls on two categories: expenditure on tradable (G_T) and non-tradable (G_N) goods. But data on the share of government expenditure on nontradables and tradables to GDP are not distinctly attainable. Therefore, it has been replaced by the share of government consumption as percent of GDP collected from WDI of WB. Edwards (1989b), argue that government consumption is likely to be excessively flowed into non-tradable goods and thus can be perceived as a proxy for G_N. In contrast, Elbadawi and Soto (1997) do not markedly find it true irrespective of countries. Accordingly, the study allows the data to determine whether G represents G_N or G_T as Schröder (2013) and Nouira and Sekkat (2015) suggest.

The direct measure for **trade policy** is not available. In general, countries with higher trade volumes are assumed to have a more liberal trade regime. That is why empirical studies substantially use the sum of exports and imports over GDP to proxy this variable. Variable formed in this manner shows a country's exposure to the rest of the world and thus it is the measure of the openness of the country to the international market. There is no unique source of data for the variable. The study piles up data from PWT 9.0, WDI of WB and UNCTAD to construct the variable.

Productivity differentials have been used to incorporate the Balassa–Samuelson-effect. One of the ways to measure the productivity differential is the relative productivity of labor (measured in terms of GDP per worker) between individual economy and abroad (Maeso- Fernandez, Osbat, & Schnatz, 2002). But the major obstacle in the practice of this measure is the absence of widespread data on employment level for many of the emerging economies. In this study, productivity differentials have been proxied by the relative productivity between emerging economies and Group of Seven (G-7) countries, which is constructed as a percent of home country's GDP per capita to the G-7 average GDP per capita for each of the EMEs. Both the GDP per capita data for EMEs and G-7 countries are compiled from the World Bank and OECD national accounts data set.

Real Interest rate differentials control capital flows and they together determine the foreign borrowing decision. Hence the variable plays an important role in determining EREER. But the limitation of data is an acute problem to include the variable in the model. The same is true for **debt services** variable.

4.4. Estimation Procedure of the Determination of Misalignment in REER

Majority of the earlier studies applies panel data approach to estimate misalignment in REER for a group of countries. The panel estimates are supposed to be imprecise as they are based on the homogeneity assumption which is inappropriate in explaining the behavior of cross country long-run REER (Dufrénot & Yehoue, 2005;

Schröder, 2013b). Schröder (2013b) also addresses some other concerns of using panel data approach in measuring REER misalignment gathering evidence from the literature.[2] Roudet et al. (2007) and Schröder (2013b), based on their study on a group of African countries both individually and through panel data find that panel estimates are misleading and therefore advice to use country-specific estimates of equilibrium REER instead of panel data estimators. Hence, The study estimates the Equilibrium REER empirically for each of the countries separately adopting Single Equation approach offered by Edwards (1989a), Elbadawi (1994) and Baffes et al. (1999). To estimate the long-run parameters of the model in 4.03, the approach involves the following steps: the first is to examine the stationarity or order of integration of the variables. The second step involves estimation of the long-run cointegrating relationship among the variables that are integrated of the same order, that is, of order 1. A unique combination of fundamentals may not always form a long-run relationship with REER irrespective of countries. Consequently, the study will consider alternative combinations of fundamentals for estimating the long-run cointegrating relationship and the final choice will be based on the following criteria proposed by Montiel (2007). Specification for which there exists long-run cointegrating relationship among the variables and comply with all necessary diagnostic checks will be taken into account. For the specification, the estimated parameters must be stable, signed according to economic theory and significant. For more than one such specification, preference will be given to the one that minimizes the information criteria.

The presence of a long-run cointegrating relationship infers the existence of a long-run equilibrium relationship between REER and its fundamentals. Therefore, it is necessary to obtain the sustainable values of the fundamentals that explain the long-run behavior of REER, which is the third step of the procedure. Detrending the explanatory variables of the desirable specification derived by the H-P filtering process (Hodrick & Prescott, 1997) will enable us to attain the sustainable or permanent values of the fundamentals, which can then be used to arrive at the long-run equilibrium values of REER. Finally, the misalignment series can be derived by simply taking the difference between the actual and long-term equilibrium values of REER in terms of percent.

[2] See Schröder (2013) for detail

4.4.1. Unit Root Test

We need to conduct both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests in order to make a robust conclusion about stationarity or order of integration. Model for simple Dickey-Fuller Test of Unit Roots can be given as-

$$\Delta y_t = \lambda y_{t-1} + u_t \qquad (4.04)$$

The null hypothesis of unit root (H_0: $\lambda = 0$ (Non-stationary)) is tested against the alternative hypothesis of stationary (H_0: $\lambda < 0$). It assumes stochastic disturbance term, u_t as white noise. But if it is not, autothe correlation problem arises. To eliminate the autocorrelation problem, Dickey-Fuller extended their test procedure suggesting an augmented version of the test including extra lags of the dependent variable. Three possible forms of augmented version of the test and thus called Augmented Dickey-Fuller (ADF) Test are as follows-

$$\Delta y_t = \lambda y_{t-1} + \sum_{i=1}^{n} \beta i \, \Delta y_{t-i} + u_t \qquad (4.05)$$

$$\Delta y_t = \alpha_0 + \lambda y_{t-1} + \sum_{i=1}^{n} \beta i \, \Delta y_{t-i} + u_t \qquad (4.06)$$

$$\Delta y_t = \alpha\alpha_0 + \alpha_1 t + \lambda y_{t-1} + \sum_{i=1}^{n} \beta i \, \Delta y_{t-i} + u_t \qquad (4.07)$$

The number of lag for which residuals become white noise, that is, u_t~iid$(0, \sigma 2)$ and Autocorrelation disappears is set by Akaika Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC). Again the null hypothesis of unit root (H_0: $\lambda = 0$ (Non-stationary)) is tested against the alternative hypothesis of stationary (H_0: $\lambda < 0$).

The test statistic t= $\hat{\lambda}$/Se($\hat{\lambda}$) does not follow the conventional t-distribution. Therefore, we must use the critical values calculated by Dickey-Fuller (1979,1981) and thus known as Dickey-Fuller distribution and tabulated by Mackinnon (1991). If the statistical value of t (in abthe solute form) is greater than its critical value, we reject $H_{0,}$ meaning that the series is stationary, otherwise not.

On the other hand, the test suggested by Phillips-Perron (PP) is a nonparametric test that has no assumption about residuals. It does not assume errors are normal, in DF test errors are assumed to be normal. If not, we are to extend the model adding lags and conduct ADF test. Moreover, PP does correction of Heteroskedasticity along with the correction of the autocorrelation problem.

The model suggested for PP Test is as follows:

$$y_t = \rho\, y_{t-1} + u_t \tag{4.08}$$

Or

$$\Delta\, y_t = \lambda\, y_{t-1} + u_t \qquad \text{where, } \lambda = \rho\text{-}1 \tag{4.09}$$

Assumption about u_t is not important for the reasons mentioned above. Some corrective form of t test is used (for ρ or λ) in order to correct serial correlation and heteroskedasticity of u_t. It also tests the null hypothesis of unit root (H_0: ρ=1 or $\lambda = 0$ (Non-stationary)) against the alternative hypothesis of stationary (H_0: ρ<1 or $\lambda < 0$). The asymptotic distribution of PP t statistic is same as the ADF t statistic and therefore Mackinnon’s (1991) critical values can be used for decision making. If the statistical value of t (in the absolute form) is greater than its critical value, we reject $H_{0,}$ meaning that the series is stationary, otherwise not.

4.4.2. Test for Cointegration

Trended (non-stationary) time series can potentially create major problems in empirical econometrics due to spurious regression. Most macroeconomic variables are trended and therefore the spurious regression is highly likely to be present in most macroeconometric models. One way of resolving the problem is to difference the series successively until stationarity is achieved and then use the stationary series for regression analysis. However, if we difference the variables, the model no longer provides a unique long-run solution. Economic theories show long term relationship in the level form of the variables, when we difference the variables, the model loses long term relationship between the variables. Cointegration can solve this problem. Two or more non-stationarity series can be cointegrated at their levels if their order of integration is same, that is, they become stationary after the same number of differences.

The study applies Johansen (1988) cointegration approach in order to identify the possible long-run cointegrating relationship among the variables. Johansen & Juselius (1990) investigated the long-term relationship between variables following the VAR approach. The VAR equation takes the following form:

$$Z_t = A_0 + A_1 Z_{t-1} + A_2 Z_{t-2} + \cdots + A_k Z_{t-k} + u_t \tag{4.10}$$

u_t is white noise error, that is, $u_t \sim iid(0, \sigma^2)$

where Z_t is an (nx1) vector of I(1) variables, A_0 is an (nx1) vector of constants and u_t denotes the white noise process with zero mean.

Since $Z_t \sim I(1)$, therefore, the VAR model stated above requires to be transformed into a vector error correction model (VECM) of the form-

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \cdots + \Gamma_k \Delta Z_{t-k} + \prod Z_{t-1} + u_t \tag{4.11}$$

Where, ΔZ_t is a nX1 dimensional vector showing the first difference of the variables, $\Gamma_i = I - A_1 - A_2 - \cdots - A_k$ $(i = 1, \ldots., k-1)$ and $\prod = -(I - A_1 - A_2 - \cdots - A_k)$.

Since u_t is a white noise process with zero means, the rank r of the long-run matrix $\prod$ indicates how many of the linear combinations of Z_t are stationary. The trace test and maximum eigenvalue test statistics determine the number of co-integrating vectors (r). Trace and maximum eigenvalue test statistics can be given as:

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} 1 - \hat{\lambda}_i \qquad r= 0, 1,\ldots.., n-2, n-1 \tag{4.12}$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1}) \quad r= 0, 1,\ldots.., n-2, n-1 \tag{4.13}$$

where r is the number of cointegrating vectors under the null hypothesis and $\hat{\lambda}$ is the estimated value for the ith ordered eigenvalues from the $\prod$ matrix, 0<I$\hat{\lambda}_i$I<1 and $\hat{\lambda}_1 \geq \hat{\lambda}_2 \geq \cdots \geq \hat{\lambda}_n$, that is, with the rise in a number of variables, eigenvalues falls.

Trace test (λ_{trace}) is a joint test for which, null hypothesis H_0: Number of cointegrating vector r≤q against the alternative hypothesis H_a: Number of cointegrating vector r>q is tested. In contrast, the maximum eigenvalue test (λ_{max}) conducts a separate test on each eigenvalues for which, null hypothesis H_0: Number of cointegrating vector, r is tested against the alternative hypothesis H_a: Number of cointegrating vector, r+1. If the test statistic is greater than the critical value provided by

Johansen & Juselius (1990), the null hypothesis that there are r co-integrating vectors contrary to the alternative that there are r+1 (λ_{trace}) or more than r (for λ_{max}) will be rejected.

4.4.3. Obtaining Sustainable Values of the Fundamentals

The existence of a long-run cointegrating relationship between REER and its fundamentals allows estimating EREERs and its corresponding misalignments for which it is necessary to obtain the sustainable or permanent values of the fundamentals that constitute the long-run EREER. This is because; economic time series generally contains both the trend and cyclical components. Following Nurkse (1945), the trend component should be treated as sustainable as its movements are permanent and therefore compatible with the notion of equilibrium. Hence, it is necessary to remove the fluctuations in the short-run that are associated with the business cycle to arrive at the sustainable values of fundamentals.

The decomposition of trend and cyclical components of time series is performed employing the conventional data smoothing technique called H-P filter (Hodrick & Prescott, 1997). The conventional value of the smoothing parameter λ is set to 100 for yearly data following earlier research (Backus & Kehoe, 1992; Schröder, 2013; Ravn & Uhlig, 2002). The sustainable values thus derived are used to feed the estimated model in order to attain the EREERs and the degree of misalignment can then be obtained simply taking the deviation of observed REER from its equilibrium level in percent. Positive misalignment represents overvaluation of domestic currency while negative misalignment signifies its undervaluation.

4.5. Empirical Results on Equilibrium REER and Misalignment

The existence of a long-run cointegrating relationship between REER and its fundamentals is necessary to estimate EREER and misalignment of REER. The precondition to test for cointegration among the variables is that the variables have to be integrated of the same order, particularly of order one, that is, I(1). Accordingly, at the very outset, the order of integration of the variables for each of the countries have been tested separately resorting ADF and PP unit root tests both for 'intercept' and 'trend and intercept'. Test results are summarized in Appendix B from table 72 to table 92. Variables that are integrated at order one are used in alternative combinations to examine the long-run cointegrating relationship between REER and its fundamentals for each of the countries. The study investigates the long-term cointegrating relationship between REER and fundamentals that determine its equilibrium value following the VAR approach. The optimal lag length of the VAR models are summarized in a table in appendix C. Stability of VAR models examined by using inverse roots of AR characteristic polynomial are presented in Appendix D. The VAR models are stationary and thus stable as the inverse roots lie inside the unit circle for all selected models. A combination that satisfies Montiel's (2007) criteria (discussed in 4.3) is then used to estimate the cointegrating equation and the speed of adjustment in REER toward its equilibrium level. Models thus obtained to estimate the long-run equilibrium REER are structurally stable as confirmed by CUSUM test summarized in Appendix E for all selected EMEs. Feeding the cointegration equation with the sustainable or permanent values of fundamentals derived by HP filtering that form the long-run equilibrium relationship with the fundamentals will enable one to attain the equilibrium REER and corresponding misalignment as the difference between actual REER from its equilibrium level in percent.

4.4.1. EREER and Corresponding Misalignment: The Case of Argentina

Both the ADF and PP test summarized in table 72 in appendix confirm the stationarity of the variables REER, NFA and ODA at first difference at 1 percent significance level. Though the level of significance varies across tests and specifications, both ADF and PP tests suggest that TOT and PROD are also stationary at first difference. According to the ADF test, G is stationary at first difference with the trend and intercept only, however, PP test confirms that G is stationary at first difference across specifications at 1 percent significance level. Therefore, all the variables are integrated of order one, that is, I(1), which allows examining the long-run cointegrating relationship between REER and its fundamentals.

The final specification of the model following the model selection criteria discards OPEN and I though they are stationary at first difference. The model for estimating the long-run cointegrating relationship between REER and its fundamentals thus can be given as-

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, NFA_t, ODA_t) \quad (4.14)$$

Cointegration test results presented in table 2 indicates that there is 1 cointegrating equation according to trace and maximum eigenvalue test and therefore long-run cointegrating equation can be estimated.

Table 2

Cointegration Test Results for Argentina

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	112.3665*	0.0022	63.14060*	0.0000
r≤1	49.22586	0.6710	17.93077	0.8811
r≤2	31.29509	0.6507	13.94877	0.8262
r≤3	17.34632	0.6144	10.62432	0.6846
r≤4	6.721994	0.6102	6.272664	0.5785
r≤5	0.449330	0.5027	0.449330	0.5027

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 3

Cointegration Equation for Argentina

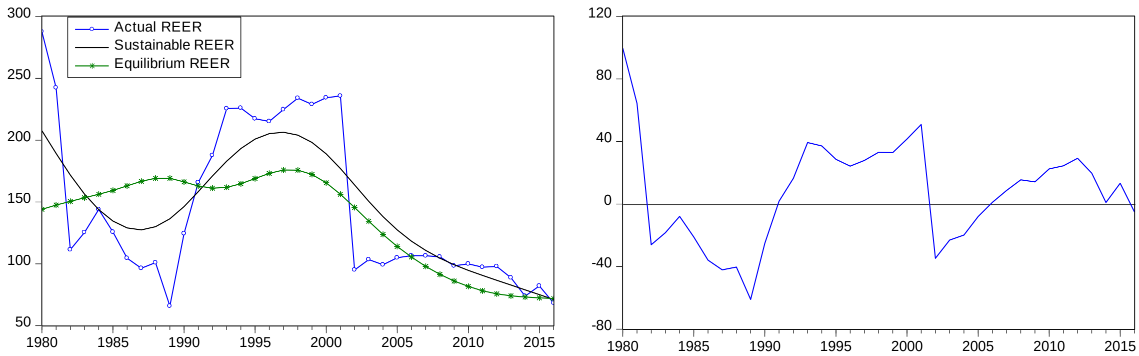
$$\ln q_t^* = 5.874 - 3.290 lnTOT_t - 3.280 lnPROD_t + 0.198 G_t + 0.010 NFA_t + 7.614 ODA_t$$

	lnTOT	lnPROD	G	NFA	ODA
S_e	(0.282)	(0.654)	(0.027)	(0.006)	(1.634)
t	[−11.652]*	[−5.013]*	[7.429]*	[1.765]***	[4.660]*

Notes: Speed of adjustment in REER (t-statistic): -0.4989* (-5.593)
LM Autocorrelation Test: p-value=0.5109 (LM (1)), 0.4108 (LM(2))
White Heteroskedasticity: p-value= 0.0517
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Table 3 displays the normalized cointegration vector with the necessary robustness check results. Residuals are uncorrelated and homoscedastic at 5 percent level of significance according to LM and white heteroskedasticity tests, respectively. Therefore, the specified model is appropriate and structurally stable. Signs of the coefficients meet the theoretical expectations and all are statistically significant at 1 percent level except NFA, which is significant at the 10 percent level. The inverse relationship between REER and TOT stands to mean that an improvement of TOT appreciates REER and thereby approves the view that income effect resulting from an increase in TOT falls short of the resulting substitution effect. Appreciation of REER caused by productivity growth is consistent with the Balassa-Samuelson effect. Increase in government expenditure causes depreciation of REER which means that a greater proportion of government expenditure is used for tradable goods which is in contrast to that of Edward's (1989b) argument. Increase in NFA position depreciates REER and so does the increase in ODA. It suggests that half (49.89 percent) of the gap between actual and equilibrium REER, that is, the misalignment of REER of Argentina adjusts in each period.

The fitted value of the long-run cointegrating vector represents the EREER which can be attained using the sustainable value of the fundamentals. Figure 3 compares the equilibrium REER with its actual and sustainable values of Argentina along with the misalignment series as the percentage deviation of equilibrium REERs from their observed values. Highest misalignment in REER of Argentina is reported as 99.65 percent against the least of 0.99 percent as evident from table 4. As data proceeds, there is a tendency in REERs to adjust towards its equilibrium values which is also apparent from lower variation in misalignment over succeeding episodes. REER of Argentina remains undervaluation all over the 1990s. But immediately after pegging its exchange rate to US dollar at a one-to-one rate in 1991, there is an overvaluation which continuous through the 2000s. Argentina abandons convertibility regime and adopts managed floating of its currency in response to the economic crisis in 2001 so as to achieve a stable and competitive real exchange rate (SCRER) which results in sharp fall in REER of Argentina with an undervaluation for a short period. It begins to overvalue since the mid-2010s and remains so through the period of currency control introduced in 2011. However, lifting currency control in late 2015 brings about an expected depreciation of REER in 2016.



3(a) Actual, Sustainable and Equilibrium REER   3(b) Misalignment of REER for Argentina

Figure 3 Equilibrium REER and corresponding misalignment for Argentina

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 4
Misalignment Episodes of Argentina

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Overvaluation	99.648	64.353	82.001	24.957
1982-1990	Undervaluation	-7.873	-61.062	-30.873	15.777
1991-2001	Overvaluation	50.804	1.767	30.357	13.202
2002-2005	Undervaluation	-8.023	-34.724	-21.412	10.980
2006-2015	Overvaluation	29.289	0.991	14.968	9.446
2016	Undervaluation	-5.103	-5.103	-5.103	0.000

Source: Author's estimates

4.4.2. EREER and Corresponding Misalignment: The Case of Bangladesh

The ADF and PP test results available in table 73 in appendix suggest that REER, TOT, G and NFA have a unit root at level but stationary at first difference for all possible selections at 1 percent level of significance. I is found to be stationary at first difference only by PP test both for intercept and trend and intercept at 1 percent level of significance. Both ADF and PP test indicates that PROD is stationary at first difference only for trend and intercept at 1 percent level of significance. However, visual inspection of the time series plot and its correlogram suggests that the series is stationary at first difference. Therefore, all these variables can be treated as integrated of order one, that is, I(1), and thus can be used for testing if they form any long-run cointegrating relationship.

The model selection criteria discussed in the introduction section leads us to omit ODA and OPEN though they were found to be stationary at first difference. The theoretical model finally specified takes the following form:

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, I_t, NFA_t) \qquad (4.15)$$

Table 5 reports the results of cointegration test. Trace test rejects the null hypothesis that there are at most two cointegrating vectors at a 5 percent level and thus it indicates 3 cointegrating equations. On the other hand, maximum eigenvalue test rejects the null hypothesis that there is at most one cointegrating vector at a 5 percent level which indicates that there are two cointegrating equations. The test results are thereby supportive of the view of the long-run cointegrating association between REER and its fundamentals. One can, therefore, proceed to estimate the long-run cointegrating equation which is shown in table 6.

Table 5

Cointegration Test Results for Bangladesh

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	195.2201*	0.0000	73.15216*	0.0000
r≤1	122.0680*	0.0000	54.29518*	0.0004
r≤2	67.77278*	0.0227	26.57674	0.2043
r≤3	41.19604	0.0736	19.56377	0.2690
r≤4	21.63228	0.1541	13.26759	0.3069
r≤5	8.364689	0.2233	8.364689	0.2233

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 6

Cointegration Equation for Bangladesh

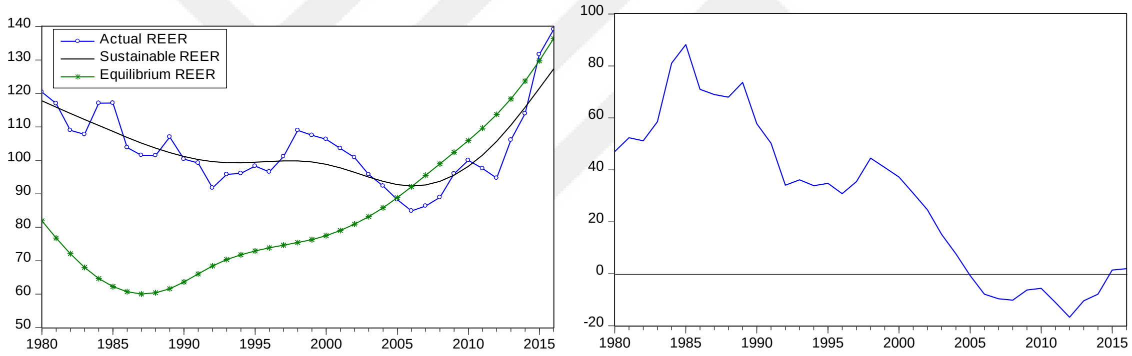
$\ln q_t^* = 1.409 +$	$1.303 lnTOT_t$	$-4.867 lnPROD_t$	$-0.540 I_t$	$+0.487 G_t$	$-0.139 NFA_t$	$+0.242 TREND$
S_e	(0.202)	(0.498)	(0.074)	(0.079)	(0.022)	(0.042)
t	[6.437]*	[−9.771]*	[−7.293]*	[6.199]*	[−6.454]*	[5.733]*

Notes: Speed of adjustment in REER (t-statistic): -0.198** (-2.16688)
LM Autocorrelation Test: p-value=0.6662 (LM (1)), 0.7597 (LM(2))
White Heteroskedasticity: p-value= 0.2158
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The normalized cointegrating equation indicates that all the coefficients are statistically significant at 1 percent level and they all carry signs that are theoretically expected except NFA. The positive sign of the coefficient of TOT refers to the depreciation of REER following an increase in TOT which implies that income effect produced from the increase in TOT steers over the substitution effect. The productivity variable has a negative coefficient which points to the rise in wage rate in the non-tradable sector following the productivity growth in the tradable sector and hence approves the Balassa-Samuelson effect. The increase in investment spending has an appreciation effect on REER indicating that domestic investment is biased towards tradable goods. Also, a greater share of government spending goes to the tradable sector as evident from its depreciating effect on REER confirmed by the positive sign of the coefficient of government expenditure variable. The only exception in the result is the sign of NFA coefficient which is negative and not theoretically agreed. It indicates that fall in NFA depreciates REER. However, being a catching-up economy in South Asia

(Arrighi, Silver, & Brewer, 2003; Radosevic & Yoruk, 2014), the finding is consistent with its level of development of Bangladesh as Horvath (2005) argues the association between NFA and REER which is initially negative for a catching up economy subsequently become positive. However, it also satisfies Koske's (2008) argument.

The robustness of results is examined employing LM autocorrelation and white heteroskedasticity test. LM test fails to reject the null hypothesis of no autocorrelation among the residuals at 5 percent significance. Moreover, the white heteroskedasticity test confirms that the residuals are homoscedastic. 19.8 percent of the deviation of actual REER from its equilibrium level adjusts at the end of each period as confirmed by the negative speed of adjustment coefficient. The error correction coefficient that measures the speed of adjustment in actual REER towards its equilibrium level Therefore, the empirical model chosen for Bangladesh is correctly specified and structurally stable.



4(a) Actual, Sustainable and Equilibrium REER 4(b) Misalignment of REER for Bangladesh

Figure 4 Equilibrium REER and corresponding misalignment for Bangladesh

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 7

Misalignment Episodes of Bangladesh

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-2004	Overvaluation	88.210	7.624	46.977	20.240
2005-2014	Undervaluation	-0.669	-16.704	-8.609	4.172
2015-2016	Overvaluation	1.994	1.455	1.725	0.381

Source: Author’s estimates

By feeding the cointegrating equation in table 6 with the sustainable values of the fundamentals, we can derive equilibrium values of REER and misalignments in REER as the difference between observed REERs and their fitted values in percent.

Panel-a in figure 4 illustrates the actual, sustainable and equilibrium REER while panel-b shows misalignments in REER for Bangladesh. It reveals that REER of Bangladesh was considerably overvalued even after the next few years it enters into the flexible exchange rate regime in May 2003. Throughout this period, actual REER adjusts towards EREER as there was a rising trend in EREER while the actual REER was on a falling trend. The results partially agree with Rahman & Basher (2001) who examine the misalignment of REER for Bangladesh for the fixed exchange rate regime (1977-1998) and find overvalued REER until the late 1980s. However, their counterfactual simulations to attain the sustainable values of fundamentals are based on certain subjective assumptions that limit the predictive power of their model. Both the EREER and actual REER continue to increase all over the floating exchange rate regime, REER remained depreciated except for the last couple of years.

As summarized in table 7, the highest degree of currency misalignment in Bangladesh was 88.21 percent during the overvaluation period 1980-2004 against the mean rate of 46.98 percent. The minimum misalignment was reported as -0.669 percent in 2005-2014 during which REER remained undervalued at a rate of -8.609 percent on average.

4.4.3. EREER and Corresponding Misalignment: The Case of Brazil

The ADF and PP test results offered in table 74 in the appendix for unit roots suggest that REER, TOT, G, OPEN and NFA are non-stationary at level but stationary at first difference. Both ADF and PP tests indicate that PROD is non-stationary at the level. Though the ADF test implies that PROD is stationary at first difference with an intercept but non-stationary with trend regression, PP test confirms its stationarity at first difference for both of the specifications. According to the ADF test, I is stationary neither at level nor at first difference, but PP test finds it stationary at first difference. ODA is trimmed as it has a unit root at the level.

Among the alternative specifications, the desired theoretical model for Brazil that best suits the selection criteria includes following I(1) variables:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, I_t, G_t, NFA_t) \tag{4.16}$$

The cointegration test is performed to identify if there prevail any cointegrating relationships between REER and its fundamentals. Results of the cointegration tests are captured in table 8. Both the trace and maximum eigenvalue test statistics rejects the null hypothesis that there is no cointegrating equation at 5 percent level of significance which points to the existence of 1 cointegrating equation for Brazil.

Table 8
Cointegration Test Results for Brazil

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	106.307*	0.0077	42.496*	0.0262
r≤1	63.811	0.1373	23.250	0.5115
r≤2	40.561	0.2030	17.796	0.5122
r≤3	22.766	0.2577	12.029	0.5448
r≤4	10.737	0.2282	7.117	0.4754
r≤5	3.619	0.0571	3.619	0.0571

Notes: r stands for number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

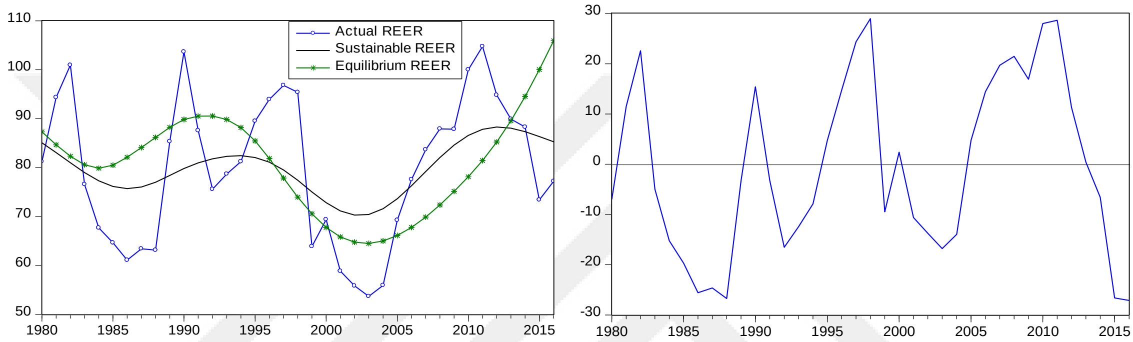
Table 9
Cointegration Equation for Brazil

$$\ln q_t^* = -\ 11.256 - 0.382 lnTOT_t - 4.660 lnPROD_t \ -\ 0.143 I_t \ +\ 0.263 G_t \ + 0.027 NFA_t$$

	lnTOT	lnPROD	I	G	NFA
S_e	(0.203)	(0.659)	(0.030)	(0.040)	(0.005)
t	$[-1.882]^{***}$	$[-7.075]^{*}$	$[-4.725]^{*}$	$[6.609]^{*}$	$[4.964]^{*}$

Notes: Speed of adjustment in REER (t-statistic): -0.271** (-2.578)*
LM Autocorrelation Test: p-value=0.1184 (LM (1)), 0.0752 (LM(2))
White Heteroskedasticity: p-value= 0.0787
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Table 9 displays the normalized cointegration vector. All the coefficients of the fundamentals carry theoretically anticipated signs. The coefficients are statistically significant at 1 percent level except for TOT, TOT is significant at a 10 percent level. The REER of Brazil is primarily determined by productivity differentials, a 1 percent increase in productivity differentials leads to appreciating REER by 4.66 percent, intensely sanctioning the Balassa-Samuelson effect. The negative sign of the coefficient of TOT indicates that an improvement in TOT by 1 percent appreciates REER of Brazil by 0.38 percent which implies that the substitution effect caused by the increase in TOT offsets its corresponding income effect. While increased domestic investment appreciates REER, increased government expenditure depreciates it. It means both domestic investment and government expenditure are biased towards tradable goods. A 1 percent rise in the position of NFA causes nearly 0.03 percent depreciation of REER. The rate at which the actual REER adjusts towards its equilibrium value in each period is 27.1 percent. LM autocorrelation test asserts that residuals are not correlated as it accepts the null hypothesis of no autocorrelation among the residuals at a 5 percent significance level for any of the orders tested. Moreover, the residuals are homoscedastic as the white heteroskedasticity test fails to reject the null hypothesis of homoscedastic residuals. Therefore, the model under consideration is specified correctly and structurally stable.



5(a) Actual, Sustainable and Equilibrium REER

5(b) Misalignment of REER fro Brazil

Figure 5 Equilibrium REER and corresponding misalignment for Brazil

Source: Actual REER is sourced from WDI and FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 10

Misalignment Episodes of Brazil

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980	Undervaluation	-6.971	-6.971	-6.971	0.000
1981-1982	Overvaluation	22.592	11.485	17.038	7.854
1983-1989	Undervaluation	-3.298	-26.719	-17.161	9.734
1990	Overvaluation	15.402	15.402	15.402	0.000
1991-1994	Undervaluation	-3.210	-16.541	-10.013	5.750
1995-1998	Overvaluation	28.976	4.746	18.211	10.753
1999	Undervaluation	-9.468	-9.468	-9.468	0.000
2000	Overvaluation	2.387	2.387	2.387	0.000
2001-2004	Undervaluation	-10.605	-16.786	-13.780	2.527
2005-2013	Overvaluation	28.646	0.425	16.180	9.629
2014-2016	Undervaluation	-6.591	-27.129	-20.115	11.715

Source: Author's Estimation

The fitted values of the long-run cointegrating equation in Table 9 for the sustainable values of the fundamentals represent the EREERs for Brazil. The EREER along with its actual and sustainable values are depicted in figure 5(a). The REER tends to stay away from the EREER. There are three relatively large episodes of undervaluation and overvaluation are apparent. The undervaluation period is associated with the adjustments of exchange rate carried out after the Mexican crisis in 1982. REER declines by 39.6 percent from 101 in 1982 to 61 in 1986 following the adjustment and remains undervalued for the period 1983-1989. The Asian and Russian financial crisis in 1998 attack the Brazilian economy and the REER is dropped by 32 percent in 1999. It enters into another undervaluation episode that spreads over the first half of the 2000s following the move to floating exchange rate regime in 1999. However, REER of Brazilian currency exceeds its equilibrium value in 2005 and overvaluation persists during the period of world economic crisis. Table 10 shows the periods of overvaluation and undervaluation. The mean rate of misalignment, as the table reports, varies from -20.12 percent to 2.39 percent. The highest degree of misalignment is registered during the overvaluation episode 1995-1998 and the least is 0.425 percent recorded in the overvaluation period 2005-2013.

4.4.4. EREER and Corresponding Misalignment: The Case of Chile

ADF and PP tests performed to examine the order of integration of the variables shown in table 75 in appendix indicate that all the variables are stationary at the level of first differencing and thus integrated of order one except NFA. NFA is non-stationary even at first difference level and therefore removed from the model. Though the ADF test indicates that ODA is non-stationary at first difference in trend regression, PP test helps overcome the ambiguity as it finds ODA stationary for all possible specification.

Among the alternative combinations of the fundamentals, TOT, I OPEN and ODA are found to be appropriate for studying the long-run behavior of REER. The theoretical model will thus be-

$$\ln q_t^* = f(\ln TOT_t, I_t, OPEN_t, ODA_t) \quad (4.17)$$

The cointegration test results that confirm the presence of cointegrating relationship among the variables in the long-run are presented in table 11. While the Trace test points to the existence of 5 cointegrating equations at a 5 percent significance level, it turns out to be 2 as per Max-eigenvalue test. Therefore, the long-run cointegrating equation between REER and its fundamentals can be estimated. The normalized cointegrating equation is given in table 12 along with necessary diagnostic checks.

Table 11
Cointegration Test Results for Chile

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	149.302*	0.0000	67.071*	0.0000
r≤1	82.232*	0.0000	41.601*	0.0004
r≤2	40.631*	0.0019	19.836	0.0751
r≤3	20.796*	0.0072	11.684	0.1231
r≤4	9.112*	0.0025	9.112*	0.0025

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

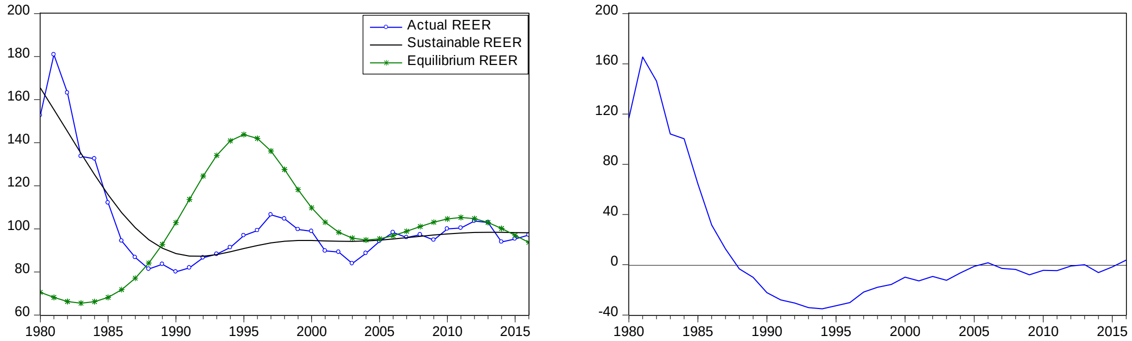
Table 12
Cointegration Equation for Chile

$$\ln q_t^* = -2.943 + 1.275 lnTOT_t + 0.130 I_t + 0.023 OPEN_t + 2.516 ODA_t$$

	$lnTOT_t$	I_t	$OPEN_t$	ODA_t
S_e	(0.215)	(0.018)	(0.005)	(0.459)
t	[5.922]*	[7.313]*	[4.858]*	[5.487]*

Notes: Speed of adjustment in REER (t-statistic): -0.168* (-4.922)
LM Autocorrelation Test: p-value=0.9973 (LM (1)), 0.8557 (LM(2)), 0.7713
White Heteroskedasticity: p-value= 0.6371
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Clearly, the signs of the coefficients firmly validate the theory. The long-run REER is mainly determined by ODA and TOT. A 1 percent increase in ODA and TOT depreciate REER by 2.52 and 1.28 percent, respectively. Domestic investment has a prejudice in favor of non-traded goods as a rise in investment spending by 1 percent brings about 0.13 percent depreciation in REER. Finally, greater trade liberalization causes REER to depreciate as 1 percent increase in OPEN leads to a rise in REER by 0.02 percent. The observed REER converges to the equilibrium value at 16.8 percent rate in each period. LM autocorrelation test and white heteroskedasticity tests confirm that the model specified for determining the EREER for Chile is correct and structurally stable as the tests accept the null hypothesis of no autocorrelation among the residuals and homoscedasticity at 5 percent level of significance.



6(a) Actual, Sustainable and Equilibrium REER 6(b) Misalignment of REER for Chile

Figure 6 Equilibrium REER and corresponding misalignment for Chile

Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 13

Misalignment Episodes of Chile

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1987	Overvaluation	165.364	12.563	92.653	53.265
1988-2005	Undervaluation	-1.219	-35.141	-18.533	11.107
2006	Overvaluation	1.558	1.558	1.558	0.000
2007-2012	Undervaluation	-1.068	-8.018	-4.141	2.298
2013	Overvaluation	0.028	0.028	0.028	0.000
2014-2015	Undervaluation	-1.765	-6.235	-4.000	3.161
2016	Overvaluation	3.667	3.667	3.667	0.000

Source: Author's calculation

The estimated values of the long-run cointegrating equation in table 12 relying on the permanent values of fundamentals are the EREER for Chile. The EREER of Chile is illustrated in figure 6(a) in comparison with its actual and sustainable counterparts. Figure 6(b) provides a picture of misalignment. As revealed, REER of Chile is highly misaligned at the beginning of the sample period, however, adjusted towards its equilibrium values over time. It is suggestive to the fact that though the actual REER does not reflect the underlying fundamentals in the short-run, they are contained in it in the long-run. A declining trend in actual REER, basically a correction on the way to the EREER, is observed during the overvaluation episodes of 1980-1987, which is associated with the fixed exchange rate (1978-1982) and the first quarter of crawling band (1984-1999) regime of Chile. The behavior of actual REER for the rest of the crawling band regime and floating exchange rate regime (from 1999 and onwards) can be characterized as steady state as its increase is continually balanced by its decrease. REER maintains a low level that fails to reflect its economic fundamentals.

The mean degree of misalignment ranges between 92.65 and 0.03. The degree of misalignment reaches to the pick to 165.36 percent in 1981 and the least is 0.028 in 2013.

4.4.5. EREER and Corresponding Misalignment: The Case of China

Order of integration of the variables examined using ADF and PP tests are reported in table 76 in the appendix. Both the tests find the REER stationary at level with intercept and only PP test suggests that ODA is stationary at level with trend regression. Otherwise, all the variables are non-stationary at the level. However, REER, G, OPEN and ODA are stationary at first difference as confirmed both by ADF and PP tests. Though ADF test does not find TOT stationary at first difference, PP tests confirm it. PROD is stationary at first difference only for intercept specification. ADF tells that I is stationary with an intercept at first difference, but PP test state that it is stationary for both of the specifications. As results are mixed for REER and ODA, the study relies on visual inspection and correlograms of time series of these two variables that confirm they are stationary at first difference. NFA is stationary neither at level nor at first difference and therefore omitted from the analysis.

All the I(1) variables are then used to perform the cointegration tests altering their combinations in order to reach a suitable combination that forms a long-run cointegrating relationship between REER and its fundamentals. The model thus obtained for China is:

$$\ln q_t^* = f(\ln TOT_t, G_t, OPEN_t, ODA_t) \tag{4.18}$$

Cointegration test results are summarized in table 14. According to trace and Max-eigenvalue test statistics, 1 cointegrating relationship between REER and the fundamentals are marked at the 0.05 level of significance. It paves the way to estimate the long-run cointegrating equation for equilibrium REER which is presented in table 15. The long-run coefficients are found to bear theoretically expected signs except for ODA. Coefficient of ODA is negative meaning that increase in ODA by 1 percent appreciates REER by 1.88 percent which is consistent with the theoretical explanation. The theory says that an increase in ODA causes an increase in capital inflows which is translated into higher domestic spending and therefore increases inflationary pressure and would cause appreciation in REER. But in contrast, foreign aid inflows will not lead to an appreciation of the real exchange rate when spent on traded goods - imported investment goods and on factors that are limited in supply (Berg & Miao, 2010). In this case, the import of capital goods will permit greater domestic investment, which then, can lead to export expansion (and increased competitiveness) and growth. EREER is primarily determined by TOT as a 1 percent rise in TOT depreciates REER by 3.42 percent meaning that income effect caused by an increase in TOT is more powerful than the substitution effect. The rise in G by 1 percent appreciates REER by 0.15. Finally, greater openness depreciates REER as confirmed by the positive coefficient of openness variable. All the coefficients are statistically significant at 1 percent level. The speed of adjustment coefficient is negative and statistically meaningful which means that 7.7 percent of the deviation of REER from the equilibrium level is covered at the end of each period.

Table 14
Cointegration Test Results for China

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	82.143*	0.0038	42.682*	0.0035
r≤1	39.461	0.2424	18.457	0.4576
r≤2	21.004	0.3574	14.901	0.2959
r≤3	6.103	0.6834	5.506	0.677
r≤4	0.596	0.44	0.596	0.44

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

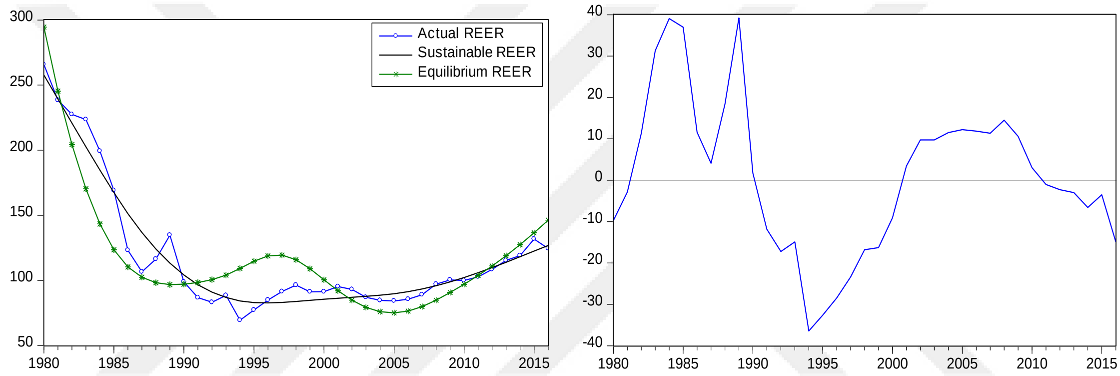
Table 15
Cointegration Equation for China

$$\ln q_t^* = -5.330 + 3.419 lnTOT_t - 0.152 G_t + 0.107 OPEN_t - 1.881 ODA_t$$

	$lnTOT_t$	G_t	$OPEN_t$	ODA_t
S_e	(0.592)	(0.023)	(0.012)	(0.407)
t	[5.777]*	[−6.567]*	[9.131]*	[−4.624]*

Notes: Speed of adjustment in REER (t-statistic): -0.077** (-2.069)
LM Autocorrelation Test: p-value=0.6565 (LM (1)), 0.8381 (LM(2))
White Heteroskedasticity: p-value= 0.1924
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

LM autocorrelation test accepts the null hypothesis of no autocorrelation among the residuals at a 5 percent significance level for any of the orders tested. Moreover, the white heteroskedasticity test accepts the null hypothesis of homoscedastic residuals. Therefore, the estimated model for the determination of equilibrium REER for China is specified correctly and structurally stable. The estimated values of the long-run cointegrating equation in table 15 based on the permanent values of the fundamentals found by HP filtering are the values of EREER for China. Figure 7(a) displays the actual, sustainable and equilibrium REER for China and the associated misalignment series is graphed in figure 7(b). Actual REER is appreciated through the 1980s.



7(a) Actual, Sustainable and Equilibrium REER 7(b) Misalignment of REER for China

Figure 7 Equilibrium REER and corresponding misalignment for China
Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 16
Misalignment Episodes of China

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Undervaluation	-2.821	-9.741	-6.281	4.893
1982-1990	Overvaluation	39.241	1.726	21.530	15.266
1991-2000	Undervaluation	-9.126	-36.440	-20.708	9.130
2001-2010	Overvaluation	14.524	3.041	9.808	3.719
2011-2016	Undervaluation	-1.015	-14.942	-5.230	5.108

Source: Author’s Estimate

The REER of China begins to depreciate following the trade and investment reform programs in the early 1990s. The de facto pegged exchange rate regime (1994-2005) that China maintained with US Dollar experienced both a period of undervaluation and overvaluation. In contrast to the expectation of appreciation due to the fastest growth of the Chinese economy during the 1990s, the REER depreciated till 2000. It started to appreciate in 2001 and continued even after China's switch to the managed peg arrangement in 2005, which is also against the conventional expectation. However, the same puzzling outcomes have been resolved by Tyers & Zhang (2014) by taking the consequences of the trade liberalizations associated with WTO accession, excess saving and tightening of rural labor markets of China into account. China halted the appreciation of its currency in 2008 due to the global financial crisis and from than the REER began to fall and come across depreciation from 2011 onward. The mean rate of misalignment lies in between 21.530 and -5.230 percent while the highest degree of misalignment was 39.24 percent in 1989 and the least was -1.02 in 2011 (Table 16).

4.4.6. EREER and Corresponding Misalignment: The Case of Colombia

Both ADF and PP tests carried out to judge the stationarity of the variables given in table 77 in appendix find none of the variables stationary at level but ODA. Thus, ODA is discarded from the analysis. Both of the tests suggest that PROD, G, I and OPEN have a unit root, that is, they are stationary at first difference. Though TOT is not stationary and REER has unit root only for intercept specification at first difference according to ADF test, PP test confirms their stationarity at first difference. Regarding NFA, while ADF test rejects the non-stationarity at level, PP test finds it non-stationary. However, it is stationary at first difference under both of the tests. Visual inspection of the time series graph and correlogram of the series convinces to regard it stationarity at first difference. As the variables are integrated at order one, different sets of them can be used to perform the cointegration test to identify the appropriate set of fundamentals that determine the long-run EREER. The theoretical model suitable for Colombia thus obtained is:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, G_t, OPEN_t, ODA_t) \qquad (4.19)$$

The cointegration test results are reported in table 17. Both the Trace and Maximum Eigenvalue test statistics identify 2 cointegrating relationships between REER and its fundamentals at 5 percent level of significance. Therefore, the long-run cointegrating relationship between REER and its fundamentals can be estimated.

Table 17
Cointegration Test Results for Colombia

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	157.593*	0.0000	67.543*	0.0000
r≤1	90.050*	0.0005	37.012*	0.0204
r≤2	53.038	0.0151	23.732	0.1444
r≤3	29.306	0.0569	16.116	0.2181
r≤4	13.189	0.1080	10.046	0.2089
r≤5	3.144	0.0762	3.144	0.0762

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

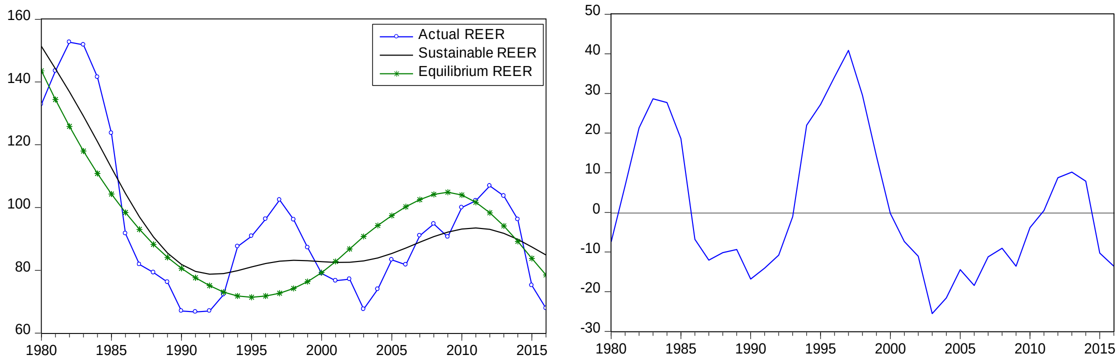
Table 18
Cointegration Equation for Colombia

$$lnq_t^* = -11.185 + 1.109 lnTOT - 4.315 lnPROD_t + 0.110\ G_t + 0.120\ OPEN_t + 1.979\ ODA_t$$

S_e	(0.250)	(0.779)	(0.032)	(0.022)	(0.299)
t	$[4.441]^*$	$[-5.543]^*$	$[3.407]^*$	$[5.384]^*$	$[6.611]^*$

Notes: Speed of adjustment in REER (t-statistic): -0.118***(-1.810)
LM Autocorrelation Test: p-value=0.7908 (LM (1)), 0.1389 (LM(2))
White Heteroskedasticity: p-value= 0.9292
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Table 18 captures the normalized cointegrating vector. All the coefficients of the variables are correctly signed and statistically significant at 1 percent level of significance. The main determinant of long-run REER is PROD, a 1 percent increase in productivity differentials appreciates REER by 4.32 percent and thus strongly support the Balassa-Samuelson hypothesis. REER is also depreciated by 1.98 percent due to a 1 percent increase in ODA. If TOT improves by 1 percent, REER is depreciated by 1.11 percent. The implication is that the income effect resulting from an increase in TOT weighs out its corresponding substitution effect. REER would be depreciated 0.11 percent due to a 1 percent increase in G and the increase in OPEN by 1 percent causes 0.12 percent depreciation of REER. The misalignment in REER disappears at the rate of 11.8 percent each year as confirmed by the significant speed of adjustment coefficient. The model is correctly specified and structurally stable as LM autocorrelation test does not reject the null hypothesis of no autocorrelation among the residuals at 5 percent significance level for any of the orders tested and the white heteroskedasticity test asserts homoscedastic residuals.



8(a) Actual, Sustainable and Equilibrium REER

8(b) Misalignment of REER for Colombia

Figure 8 Equilibrium REER and corresponding misalignment for Colombia

Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 19

Misalignment Episodes of Colombia

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1981-1985	Overvaluation	28.664	6.766	20.609	8.827
1986-1993	Undervaluation	-1.074	-16.823	-10.130	4.749
1994-1999	Overvaluation	40.867	14.204	27.999	9.310
2000-2010	Undervaluation	-0.271	-25.525	-12.393	7.476
2011-2014	Overvaluation	10.155	0.447	6.801	4.340
2015-2016	Undervaluation	-10.251	-13.581	-11.916	2.355

Source: Author's estimates

The fitted value of the cointegration equation in table 18 for the sustainable values of the fundamentals suggested by HP filtering represents EREER. The equilibrium REER in comparison with its actual and sustainable values are presented in figure 8(a) along with the misalignment series in figure 8(b). As evident, there are three distinct episodes each of undervaluation and overvaluation of REER. Colombia maintained a fixed exchange rate arrangement until 1999. During this period, REER of Colombia experienced two overvaluation and an undervaluation episodes. The overvaluation in the early years of this regime elapsed quickly and produced a relatively large undervaluation episode that lasted from 1986 to 1993. REER remains appreciated during the rest of the fixed exchange rate regime. Though Colombia accepts a floating exchange rate regime in 1999, it actually follows a managed floating system as Colombian Central Bank exercise the intervention discretion in the foreign exchange market. It leads to the depreciation of REER of Colombian currency through the 2000s. Actual REER meets the EREER in 2011 and it stayed above the equilibrium level during 2012-2014 which denotes appreciation. It reveals from table 19 that the degree of misalignment of REER reaches to its pick to 40.87 percent during 1994-1999 and bids the lowest at -0.27 percent in 2000-2010 while the mean rate lies between 28 percent and 6.8 percent.

4.4.7. EREER and Corresponding Misalignment: The Case of Egypt

Stationary test results demonstrated in table 78 in appendix indicate that REER is stationary according to the ADF test, but trend regression under the PP test suggests it non-stationary at first difference. Relying on visual inspection and correlogram of its time series, it can be taken as stationary at first difference. Only PP test suggests that ODA is stationary at first difference. Trend regression of TOT and PROD under ADF test suggests that they are non-stationary at first difference, but PP test finds them stationary at first difference both for 'intercept' and 'trend and intercept' and thus can be conferred as I(1). The level of significance to advise NFA as stationary is quite high for the tests, however, it is not a major concern as the model selection criteria abandon it. Both of the tests film the remaining variables (G, I, OPEN) non-stationary at level but stationary at first difference.

As all the variables are integrated of order one, their alternative combinations are used for test of cointegration in order to pick up a suitable combination that forms a long-run cointegrating relationship between REER and its fundamentals. The following theoretical model is found to be appropriate for Egypt:

$$lnq_t^* = f(lnTOT_t, lnPROD_t, G_t, OPEN_t, ODA_t) \tag{4.20}$$

The cointegration test results captured by table 20 indicate one cointegrating relationship between REER and selected macroeconomic fundamentals in the long-run at 5 percent significance level and therefore the long-run cointegrating equation can be estimated. Cointegration regression results are presented in table 21.

The coefficients maintain theoretically meaningful signs and statistically significant at 1 percent level. The key factor that determines the REER in the long-run is PROD. A 1 percent increase in PROD appreciates REER by 4.62 percent. Therefore, the Balassa-Samuelson effect is highly prevalent in Egypt. The other variables that appreciate REER are G and ODA, a 1 percent increase in these two variables causes depreciation of REER by 0.15 and 0.03 percent, respectively. The depreciation effect of

G on REER confirms that a greater part of government expenditure goes to tradable goods. A 1 percent increase in OPEN leads to 0.03 percent decrease in REER meaning that trade liberalization appreciates REER. The REER converges to the equilibrium level at the rate of 50.6 percent in each period. The model selected for the determination of EREER of Egypt is structurally stable and correctly specified as the LM autocorrelation test rejects the null hypothesis that there is no autocorrelation among the residuals for any of the order tested and white heteroskedasticity test accepts the null hypothesis of homoscedasticity at 5 percent level of significance.

Table 20

Cointegration Test Results for Egypt

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	105.983*	0.0082	52.111*	0.0014
r≤1	53.871	0.4671	21.375	0.6558
r≤2	32.497	0.5847	14.224	0.8069
r≤3	18.273	0.5460	10.327	0.7135
r≤4	7.946	0.4712	5.962	0.6180
r≤5	1.983	0.1590	1.983	0.1590

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

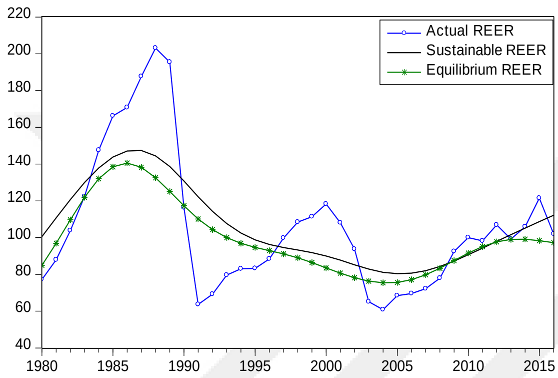
Table 21

Cointegration Equation for Egypt

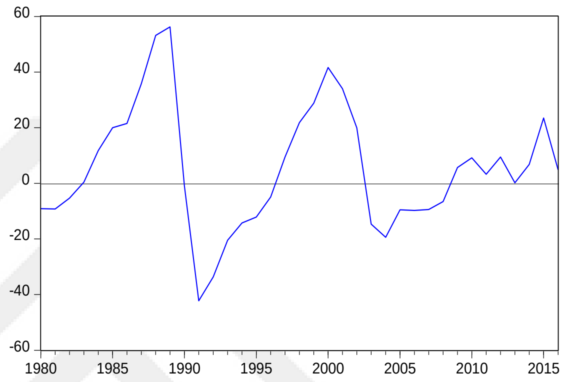
$lnq_t^* = -1.709 - 0.674 lnTOT_t$	$-4.616 lnPROD_t +$	$0.146 G_t$	$+0.028 OPEN_t$	$+0.033 ODA_t$	
S_e	(0.085)	(0.372)	(0.017)	(0.006)	(0.009)
t	$[-7.884]^*$	$[-12.417]^*$	$[8.679]^*$	$[4.475]^*$	$[3.782]^*$

Notes: Speed of adjustment in REER (t-statistic): -0.506*(-4.664)
LM Autocorrelation Test: p-value=0.9633 (LM (1)), 0.8262 (LM(2))
White Heteroskedasticity: p-value= 0.3488
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The long-run cointegration vector in table 21 is then estimated to derive the EREER of Egypt using the sustainable values of the fundamentals. Figure 9(a) demonstrates the actual, sustainable and equilibrium REER and figure 9(b) shows the misalignments of REER for Egypt. Actual REER advances with oscillation around the EREER in a converging fashion. After the initial increase till 1986, EREER decreases up to 2005 and then rises. Actual REER upholds the macroeconomic fundamentals well through 2005 and 2014, it moves around and deviates from the EREER by less than 10 percent in this period. Three major overvaluation episodes: 1983-1989, 1997-2002 and 2008-2012, and the periods of undervaluation: 1990-1996 and 2003-2008 reflect the results obtained by Riad (2008), Hosni & Rofael (2015) and Noureldin (2017) to a large extent. As captured by table 22, the mean rate of misalignment spreads between 7.84 and 28.41 percent. The utmost degree of misalignment 56.23 percent is observed in 1989 and the minimum is 0.16 percent reported in 2013.



9(a) Actual, Sustainable and Equilibrium REER



9(b) Misalignment of REER for Egypt

Figure 9 Equilibrium REER and corresponding misalignment for Egypt

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 22

Misalignment Episodes of Egypt

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1982	Undervaluation	-5.330	-9.237	-7.890	2.219
1983-1989	Overvaluation	56.234	0.393	28.412	20.904
1990-1996	Undervaluation	-0.875	-42.257	-18.353	15.010
1997-2002	Overvaluation	41.616	9.488	25.949	11.333
2003-2008	Undervaluation	-6.566	-19.378	-11.552	4.642
2009-2016	Overvaluation	23.467	0.158	7.843	7.007

Source: Author's estimates

4.4.8. EREER and Corresponding Misalignment: The Case of Greece

Both of the ADF and PP tests results presented in table 79 in appendix suggest that the variables REER, TOT, I, OPEN and NFA are stationary at first difference at 1 percent level of significance. G is non-stationary in trend regression at first difference according to ADF test, but stationary both for 'intercept' and 'trend and intercept' according to PP test and therefore accepted as I(1). Unit root test results for PROD is inconclusive as the ADF test finds it stationary at first difference for trend regression and PP test finds it stationary at first difference in intercept regression. But the visual inspection of time series graph and correlogram indicate that the variable is stationary at first difference.

Since all the variables are stationary at first difference, that is, integrated of order one, they can be used for testing cointegration among them considering alternative combinations of the fundamentals. It suggests that the behavior of REER in the long-run is explained by TOT, PROD, G, OPEN and NFA. Therefore, the theoretical model can be given as-

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, OPEN_t, NFA_t) \quad (4.21)$$

The cointegration test results summarized in table 23 shows that both the Trace and Maximum Eigenvalue test statistic indicate the existence of only one cointegrating relationship between REER and its fundamentals at a 1 percent level of significance. Therefore, the long-run cointegration equation can be estimated. The long-run cointegrating vector is presented in table 24 along with some robustness check. The coefficients of the fundamentals are found to bear signs that are theoretically meaningful and statistically significant.

The main macroeconomic fundamental that determines REER is PROD, a 1 percent increase in PROD causes the appreciation of REER by 1.69 percent which asserts the Balass-Samuelson hypothesis is in effect for Greece. TOT has also an important impact on REER, if it improves by 1 percent, REER appreciates by 0.34 percent. Government expenditure is faintly biased against non-tradable goods as its increase by 1 percent results in depreciation of REER by 0.04 percent. NFA and OPEN have a marginal and similar impact on REER, an increase in NFA and greater trade liberalization depreciates REER. The misalignment in REER in the short run is corrected at the rate of 26.1 percent annually in the long run. The LM autocorrelation test accepts the null hypothesis that there is no autocorrelation among the residuals for any of the order tested at 5 percent level of significance and therefore the specified model is appropriate in explaining the REER behavior of Greece. Moreover, white heteroskedasticity test finds that the residuals are homoscedastic at 5 percent significance level which confirms the structural stability of the model.

Table 23
Cointegration Test Results for Greece

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	134.775*	0.0027	54.259*	0.0033
r≤1	80.516	0.1706	29.738	0.3423
r≤2	50.779	0.3799	20.677	0.5982
r≤3	30.101	0.4962	17.554	0.4121
r≤4	12.547	0.7727	8.399	0.7844
r≤5	4.148	0.7206	4.148	0.7206

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

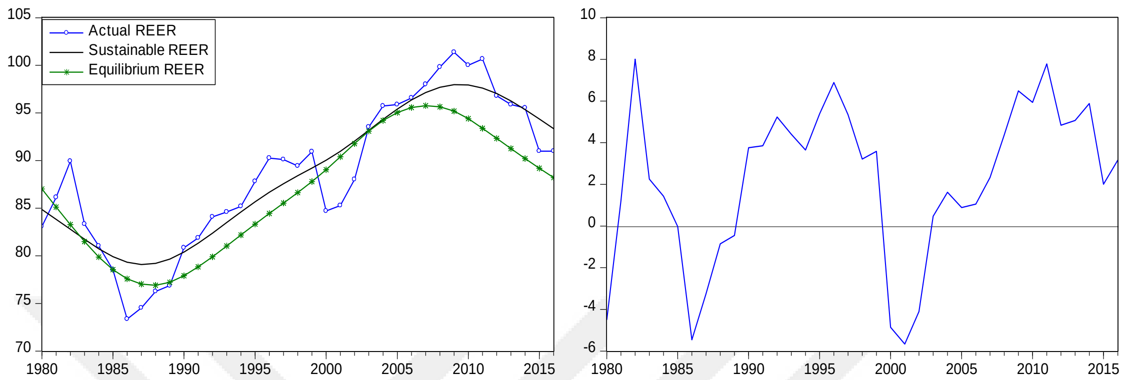
Table 24
Cointegration Equation for Greece

$$lnq_t^* = -1.934 - 0.336 lnTOT_t - 1.691 lnPROD_t + 0.036 G_t + 0.005 OPEN_t + 0.085 NFA_t + 0.023 TREND$$

	lnTOT	lnPROD	G	OPEN	NFA	TREND
S_e	(0.076)	(0.103)	(0.008)	(0.001)	(0.006)	(0.002)
t	[−4.404]*	[−16.389]*	[4.754]*	[3.850]*	[13.464]*	[12.003]*

Notes: Speed of adjustment in REER (t-statistic): -0.261*** (-1.832)
LM Autocorrelation Test: p-value=0.9163 (LM (1)), 0.7771 (LM(2))
White Heteroskedasticity: p-value= 0.7878
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

EREER of Greece can be obtained by feeding the long-run cointegrating vector in table 24 using permanent values of the fundamentals. Actual, sustainable and equilibrium values of REER are compared in figure 10(a) with the corresponding misalignment in 10(b). The actual and equilibrium REER reduces overtime in the earlier years of Greece in the EU (the 1980s) and then rises through the 1990s and 2000s. It displays a falling trend in running decade. The actual REER moves close around its equilibrium values and therefore macroeconomic fundamentals are well maintained. As evident from figure 10 and table 25, the overvaluation episodes of REER of Greece are relatively large compared to its undervaluation episodes. Two major overvaluation episodes are relatively large compared to the undervaluation episodes. REER was overvalued over the 1990s. It became undervalued during 2000-2002 following the outbreak of the Asian financial crisis in 1997. But, after adopting Euro in 2001 as a member country of European Monetary Union, REER began to increase and enter into another overvaluation episodes in 2003 that persists even during the global financial crisis in 2008 and last till the end of the sample period. In a study for the period 1999-2011, Rusek (2012) also identifies overvalued REER relative to its equilibrium values for Greece. The mean misalignment rate, as table 25 illustrates, ranges from -2.01 percent to -4.88 percent. The highest degree of misalignment was 8.01 percent in 1982 and the lowest was -0.03 percent in 1985.



10(a) Acrual, Sustainable and Equilibrium REER 10(b) Misalignment of REER for Greece

Figure 10 Equilibrium REER and corresponding misalignment for Greece

Source: Actual REER is sourced from WDI and FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 25

Misalignment Episodes of Greece

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980	Undervaluation	-4.508	-4.508	-4.508	0.000
1981-1984	Overvaluation	8.009	1.208	3.226	3.220
1985-1989	Undervaluation	-0.025	-5.458	-2.006	2.298
1990-1999	Overvaluation	6.887	3.217	4.532	1.149
2000-2002	Undervaluation	-4.102	-5.668	-4.877	0.783
2003-2016	Overvaluation	7.783	0.466	3.707	2.362

Source: Author's estimates

4.4.9. EREER and Corresponding Misalignment: The Case of Indonesia

Table 80 in appendix sums up the ADF and PP test results performed in order to identify the order of integration of the variables. Both of the tests for unit roots find that REER, G, I and ODA are non-stationary at level but stationary at first difference at 1 percent level of significance. At level, TOT is stationary at level with an intercept but non-stationary with the trend and intercept, nevertheless, stationary at first difference for both of the specifications at 1 percent significance level. The time series plot of the variable and its correlogram are examined in order to avoid ambiguity which confirms stationarity of the variable at first difference. NFA is omitted from the analysis as it is stationary at level. Though PROD and OPEN are stationary at first difference, they are set aside as their inclusion in the model halts the basic principles of model selection. The theoretical model the study finally identifies including relevant I(1) variables so as to estimate long-run EREER of Indonesia is as follows:

$$\ln q_t^* = f(\ln TOT_t, I_t, G_t, ODA_t) \tag{4.22}$$

The results of cointegration tests performed in order to check if there exist any long-run cointegrating relationship between REER and its fundamentals are given in table 26. Trace test statistic suggests the presence of two cointegrating equations, while there is one cointegrating equation according to maximum-eigenvalue test statistics. Therefore, the long-run cointegrating relationship between REER and its fundamentals can be estimated.

Table 26
Cointegration Test Results for Indonesia

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	85.603*	0.0017	36.543*	0.0235
r≤1	49.061*	0.0383	22.511	0.1953
r≤2	26.549	0.1131	12.531	0.4962
r≤3	14.018	0.0824	10.912	0.1587
r≤4	3.107	0.0780	3.107	0.0780

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

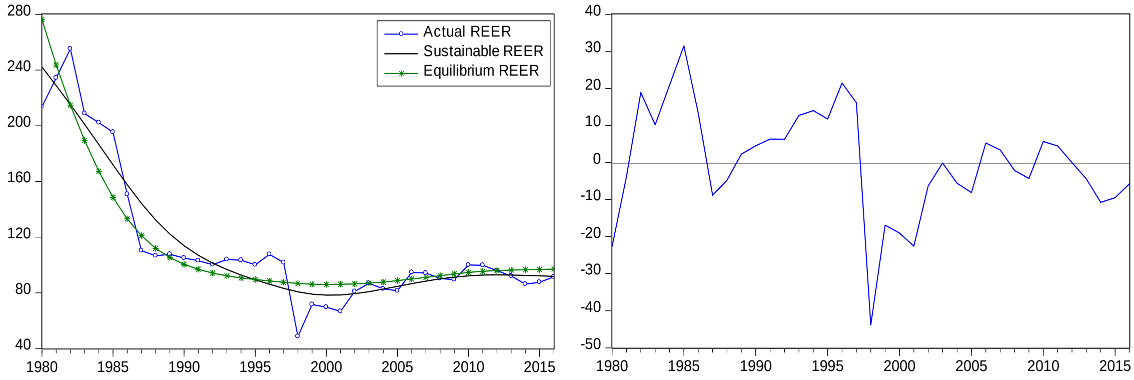
Table 27
Cointegration Equation for Indonesia

$\ln q_t^* = -3.409 + 1.816 lnTOT_t +$	$0.016\, I_t$	$-\ 0.101\, G_t$	$+\ 0.360 ODA_t$	
S_e	(0.118)	(0.003)	(0.030)	(0.042)
t	[15.459]*	[5.046]*	[−3.399]*	[8.652]*

Notes: Speed of adjustment in REER (t-statistic): -0.506** (-2.051)
LM Autocorrelation Test: p-value=0.5632 (LM (1)), 0.8342 (LM(2))
White Heteroskedasticity: p-value= 0.7570
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Table 27 states the long-run normalized cointegrating vector. All its coefficients are correctly signed and statistically significant at 1 percent level. The cointegrating vector implies that an improvement in TOT by 1 percent depreciates REER by 1.82 percent which is indicative of the substitution effect overriding income effect caused by the rise in TOT. Higher domestic investment in nontradable sectors depreciates REER of Indonesia. Domestic investment and government spending have an opposing impact on REER, a 1 percent increase in domestic investment depreciates REER by 0.016 percent while a similar change in government expenditure appreciates REER by 0.10 percent. It means that both domestic investment and government spending are biased towards nontradable goods. Finally, the increase in ODA by 1 percent depreciates REER of Indonesia by 0.36 percent. Short run deviation in REER from its equilibrium level is adjusted at 50.6 percent rate per year in the long run. The model selected for estimating EREER of Indonesia is appeared to be properly specified and free from structural instability as the LM autocorrelation test confirms that the residuals are uncorrelated for any of the orders tested and they are homoscedastic according to the white heteroskedasticity test.

The cointegrating equation in table 27 is fed by the sustainable values of the fundamentals to attain the EREER. Figure 11(a) assimilates the actual, sustainable and equilibrium REER, while figure 11(b) demonstrates the misalignment series. As the figure indicates, actual REER upholds the macroeconomic fundamentals that form the long-run relationship all over the sample period which is reflected from its closer move around the EREER. Consequently, it produces nine alternating periods of over and undervaluation. During the managed floating regime of exchange rate (1978-1997), REER encounters two distinct episodes of overvaluation and undervaluation. Both the actual and equilibrium REERs tend to decline throughout the regime. There is a relatively long period of undervaluation from 1998 to 2005 as soon as Indonesia enters into the floating exchange rate regime following the Asian financial crisis in 1997. Apart from this short period of instability, both the actual and equilibrium REER remain stable over the regime until the end of the sample period. Table 28 that offers a brief summary on misalignment reports that the average misalignment lies in between 18.938 and -3.233 percent. The high degree of misalignment of -43.875 percent is recorded during the period 1998-2005 and the minimum is -0.003 percent happens in the 2012-2016 period.



11(a) Actual, Sustainable and Equilibrium REER   11(b) Misalignment of REER for Indonesia

Figure 11 Equilibrium REER and corresponding misalignment for Indonesia

Source: Actual REER is sourced from FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 28

Misalignment Episodes of Indonesia

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Undervaluation	-3.803	-22.674	-13.238	13.343
1982-1986	Overvaluation	31.480	10.181	18.938	8.208
1987-1988	Undervaluation	-4.781	-8.856	-6.819	2.881
1989-1997	Overvaluation	21.444	2.251	10.598	6.215
1998-2005	Undervaluation	-0.132	-43.875	-15.318	13.848
2006-2007	Overvaluation	5.278	3.404	4.341	1.325
2008-2009	Undervaluation	-2.151	-4.315	-3.233	1.530
2010-2011	Overvaluation	5.654	4.471	5.063	0.836
2012-2016	Undervaluation	-0.003	-10.742	-6.077	4.276

Source: Author’s estimates

4.4.10. EREER and Corresponding Misalignment: The Case of India

The variables are tested for stationarity at their level and both the ADF and PP unit root tests result in table 81 in appendix suggest that REER, TOT, I and NFA have unit root both for intercept and intercept and trend. However, they attain stationarity at first difference either at 1 percent or 5 percent level of significance for all sorts of specifications. Though the PP test implies that PROD is stationary at first difference, the ADF test does not. But the stationarity of the series at first difference is confirmed from the visual inspection of a plot of its time series and correlogram.

Hence, REER, TOT, PROD, I and NFA are integrated at order 1 and therefore they can be used to examine the existence of long-run cointegrating relationship among the variables. G, OPEN and ODA are also I(1) series but discarded from the specified model as they do not satisfy the model selection criteria. Finally, the following model is found appropriate for India:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, I_t, NFA_t) \qquad (4.23)$$

Both the trace test and maximum eigenvalue test indicates there exist 2 cointegrating equation at 5 percent level of significance. Cointegration test results are summarized in table 29. Therefore, one can proceed to estimate the long-run cointegrating relationship between REER and its fundamentals.

Table 29
Cointegration Test Results for India

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	139.712*	0.0000	52.267*	0.0007
r≤1	87.445*	0.0002	48.433*	0.0002
r≤2	39.012	0.1164	23.982	0.0859
r≤3	15.030	0.5720	9.180	0.7058
r≤4	5.850	0.4796	5.850	0.4796

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

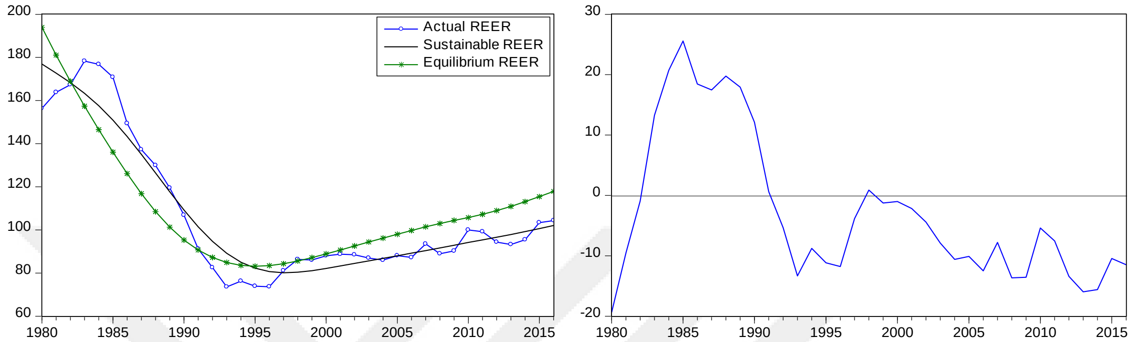
Table 30
Cointegration Equation for India

$\ln q_t^* =$ 10.513	$-1.073 lnTOT_t$	$-0.988 lnPROD_t$	$-0.044 I_t$	$+0.032 NFA_t$	$-0.030 TREND$
S_e	(0.150)	(0.199)	(0.005)	(0.005)	(0.008)
t	[−7.135]*	[−4.977]*	[−8.921]*	[6.158]*	[−3.886]*

Notes: Speed of adjustment in REER (t-statistic): -0.447* (-5.829)
LM Autocorrelation Test: p-value=0.8400 (LM (1)), 0.9693 (LM(2))
White Heteroskedasticity: p-value= 0.6229
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Table 30 shows the normalized cointegration vector. All the coefficients of the variables are statistically significant at 1 percent level and hold signs that are theoretically anticipated. Negative TOT coefficient assures the income effect disdaining the substitution effect as an increase in TOT appreciates REER. The relationship between PROD and REER turns out to be negative which is in agreement with the

Balassa-Samuelson effect. Tradable goods prone to domestic investment is evident from the negative sign of investment coefficient. Improvement in NFA position depreciates REER. Misalignment in REER of India fixes at the rate of 44.7 percent in each period. LM autocorrelation test accepts the null hypothesis that residuals are uncorrelated and the residuals are homoscedastic according to the white heteroskedasticity test. Therefore, the model selected is correctly specified and structurally stable.



12(a) Actual, Sustainable and Equilibrium REER 12(b) Misalignment of REER for India

Figure 12 Equilibrium REER and Corresponding Misalignment for India

Source: Actual REER is sourced from FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 31

Misalignment Episodes of India

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1982	Undervaluation	-0.912	-19.376	-9.945	9.238
1983-1991	Overvaluation	25.581	0.623	16.215	7.056
1992-1997	Undervaluation	-3.847	-13.329	-9.038	3.770
1998	Overvaluation	0.873	0.873	0.873	0.000
2000-2016	Undervaluation	-1.014	-15.963	-9.618	4.479

Source: Author's estimates

The sustainable values of the fundamentals produced by HP filtering are used to attain the EREER through estimating the long-run cointegrating equation in table 30. The actual, sustainable and equilibrium values of REER for India is shown in figure 12. As reported by figure 12(a), though the actual REER moves closer to the equilibrium REER throughout the sample period, two major alternating periods of appreciation and depreciation are noticeable from the misalignment series. REER of India remains appreciated over the period 1983-1991. The mean rate of appreciation in this period is over 16 percent (see table 31). But, the downward adjustments in the nominal exchange rate in 1991 causes REER to depreciate which is similar to the findings of Cheng &

Orden (2007). India launches market-oriented exchange rate system in 1993 and as a general outcome; its REER remains depreciated 8.725 percent on average over the rest of the sample period with an exception in 1998. Though there is depreciation of REER of India, figure 12(a) illustrates that there is a rising tendency both in actual and equilibrium REER during the period of depreciation. Both the maximum (25.581 percent in 1983) and minimum (0.623 percent in 1991) degree of misalignment is during the overvaluation period 1983-1991 as reported in figure 12(b) and in table 31.

4.4.11. EREER and Corresponding Misalignment: The Case of South Korea

Stationarity of the variables is tested both at the level and first difference. The variables (REER and macroeconomic fundamentals) are required to be integrated of order one, that is, stationary at first difference in order to apply the cointegration test to identify if there exists any long term relation between REER and fundamentals that form the relationship. The study employs ADF and PP tests to examine the stationarity of the variables across the specification: ‘intercept’ and ‘trend and intercept’. At the outset, stationarity of the variables is tested at the level. Variables that are stationary at a level for both of the tests are dropped from the analysis for the economies concerned. However, as the PP test is a more robust test for stationarity than ADF test, more attention is paid to the results of the PP test when the results of these two tests contradict. Suppose, at level, if a series is stationary according to ADF test but PP test suggests it non-stationary, the series is treated as non-stationary and vice versa. Variables that are non-stationary at the level are tested for unit roots at first difference with ADF and PP test and more importance is given to PP test to make a judgment when their results are opposing. When test results differ across specifications and tests, that is, when the test results vary from intercept regression to trend regression for ADF and/or PP test, visual inspection of time series plot and correlogram of that particular variable is examined to reach to a decisive decision regarding the stationarity of the variable. The significance level is predominantly set at 1 percent, increased for some instances but it never exceeds 5 percent.

The unit root test results are available in table 82 in the appendix. Following the criteria explained above, the variables are found not to have a unit root at level, but they all are stationary at first difference. That is, REER and all the macroeconomic fundamentals are integrated of order one and therefore the test of cointegration can be conducted for alternative combinations of the fundamentals in order to identify the existence of a long-run association between REER and its fundamentals.

It reveals from the cointegration test that the fundamentals that determine the behavior of long-run REER of Korea include TOT, PROD, I, G and OPEN. Hence, the theoretical model for the determination of REER of Korea in the long-run should take the following form:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, I_t, G_t, OPEN_t) \tag{4.24}$$

The cointegration test results are presented in table 32. Clearly, trace test statistic offers four cointegrating equation at 5 percent level of significance while the maximum eigenvalue test statistic indicates that the number of the cointegrating equation is one for the same level of significance. Therefore, the presence of a long-run association between REER and the fundamentals stated above are apparent. The long-run normalized cointegrating vector is given in table 33.

The coefficients of the variables maintain theoretically expected signs and statistically significant. REER is mainly explained by TOT and PROD. While the improvement in TOT depreciates REER of South Korea which is indicative to the fact that the income effect due to the rise in TOT is more powerful than the substitution effect, greater productivity differential results in appreciation of REER and thereby ascertains the Balassa-Samuelson hypothesis into effect for Korea. Domestic investment is also found to be inclined towards tradable goods as its rise by 1 percent causes 0.14 percent depreciation of REER. Factors that exercise depreciationary pressures on REER also include G and OPEN, a 1 percent increase in these fundamentals depreciates REER by 0.03 and 0.01 percent, respectively. Hence, the lion share of government expenditure goes to tradable goods. The speed of adjustment in REER towards the equilibrium value is 21.4 percent for South Korea. The LM autocorrelation test accepts the null hypothesis of no autocorrelation for any of the order tested and the white heteroskedasticity test accepts the null hypothesis of homoscedasticity at 5 percent level of significance. Therefore, the selected model is correct and structurally stable for explaining the REER of Korea.

Table 32

Cointegration Test Results for Korea

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	134.369*	0.0000	58.247*	0.0002
r≤1	76.122*	0.0144	25.629	0.3438
r≤2	50.493*	0.0277	18.797	0.4303
r≤3	31.696*	0.0299	17.267	0.1598
r≤4	14.429	0.0719	11.996	0.1108
r≤5	2.433	0.1188	2.433	0.1188

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 33

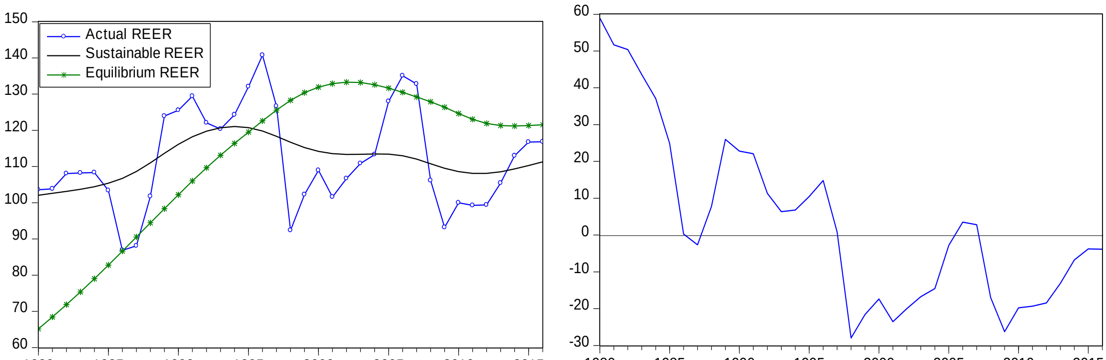
Cointegration Equation for Korea

$$lnq_t^* = -4.079 + 1.004\, lnTOT_t - 0.995\, lnPROD_t - 0.028\, I_t + 0.144\, G_t + 0.009 OPEN_t$$

S_e	(0.587)	(0.140)	(0.012)	(0.061)	(0.005)
t	[1.710]***	[−7.103]*	[−2.443]**	[2.359]**	[1.669]***

Notes: Speed of adjustment in REER (t-statistic): -0.214** (-3.365)
LM Autocorrelation Test: p-value=0.7057 (LM (1)), 0.8599 (LM(2))
White Heteroskedasticity: p-value= 0.3394
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

If we feed the long-run cointegrating vector in table 33 by the sustainable values of the fundamentals, it yields the long-run EREER of Korea. The comparison of actual, sustainable and equilibrium REER in figure 13(a) reveals that the actual REER of Korea was overvalued in the lead-up Asian financial crisis in 1997 which is also marked in Kinkyo's (2008) and Baak's (2012) analysis. The undervaluation of REER commenced rightly with the outburst of the crisis and degree of misalignment reached to -28 percent in 1998 as illustrated in figure 13(b). It took several years to restore the equilibrium values in 2005 but undervalued sharply immediately after the upsurge of the global financial crisis in 2007-2008. From 2009 onwards, the actual REER corrects towards its equilibrium value despite the obstinate undervaluation till the end of the sample period. The mean rate of misalignment was between 3.15 and 21.86 percent while the maximum misalignment was 58.9 percent in 1980 against the least of -2.67 percent in 1987 as depicted in table 34.



13(a) Actual, Sustainable and Equilibrium REER

13(b) Misalignment of REER for Korea

Figure 13 Equilibrium REER and Corresponding Misalignment for Korea

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 34

Misalignment Episodes of Korea

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1997	Overvaluation	58.910	-2.667	21.862	19.210
1998-2005	Undervaluation	-2.801	-28.003	-18.084	7.489
2006-2007	Overvaluation	3.522	2.781	3.151	0.524
2008-2016	Undervaluation	-3.778	-26.249	-14.255	7.906

Source: Author's estimates

4.4.12. EREER and Corresponding Misalignment: The Case of Malaysia

Following the ADF and PP unit root test results accessible from table 83 in the appendix, REER and all macroeconomic fundamentals are non-stationary at a level across specifications (with intercept and with the trend and intercept). Unit root test results at first difference of the variables reject the null hypothesis of having unit root for all the variables and accordingly all the variables are stationary at first difference, that is, their order of integration is one. Consequently, they can be used for the cointegration test in order to examine the presence of a long-run cointegrating relationship between REER and the macroeconomic fundamentals. The study considers different combinations of the fundamentals and performs the cointegration test to derive the combination that best describes the movement of REER in the long-run and the following theoretical model is perceived to be appropriate:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, I_t, G_t, ODA_t) \quad (4.25)$$

Cointegration test results are reported in table 35 which points to the existence of 5 cointegrating relationships between REER and the fundamentals according to the trace test statistic at 5 percent level of significance and the maximum eigenvalue test statistic suggests only one cointegrating relationship at the same significance level. Therefore, estimation of the normalized cointegrating vector is meaningful which is captured by table 36.

Table 35

Cointegration Test Results for Malaysia

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	191.935*	0.0000	75.716*	0.0000
r≤1	116.219*	0.0001	38.309	0.0503
r≤2	77.910*	0.0021	27.556	0.1631
r≤3	50.354*	0.0077	23.914	0.0875
r≤4	26.440*	0.0425	15.477	0.1691
r≤5	10.963	0.0897	10.963	0.0897

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 36

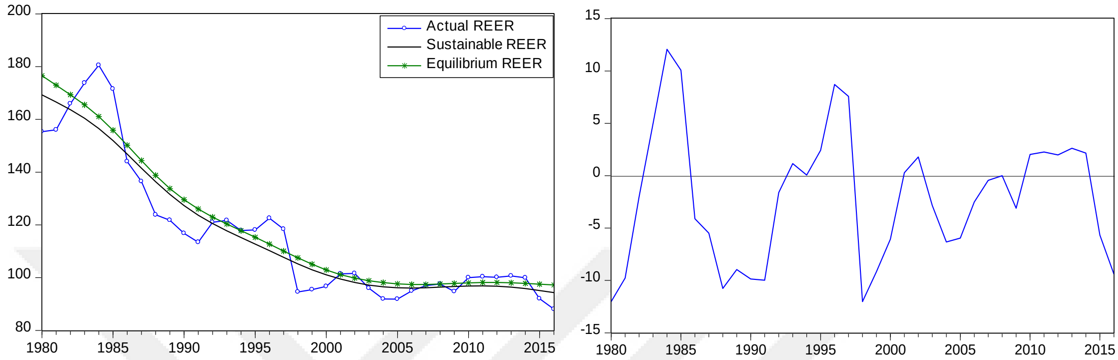
Cointegration Equation for Malaysia

$$lnq_t^* = -5.768 + 1.554 lnTOT_t - 0.709 lnPROD_t + 0.038 I_t + 0.058 G_t + 0.423 ODA_t - 0.020\, TREND$$

	lnTOT	lnPROD	I	G	ODA	TREND
S_e	(0.133)	(0.171)	(0.004)	(0.005)	(0.032)	(0.003)
t	[11.698]*	[−4.156]*	[10.349]*	[12.394]*	[13.085]*	[−6.123]*

Notes: Speed of adjustment in REER (t-statistic): -0.393** (-2.011)
LM Autocorrelation Test: p-value=0.6415 (LM (1)), 0.3772 (LM(2))
White Heteroskedasticity: p-value= 0.0993
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The statistically significant coefficients of the fundamentals possess signs that theory asserts. All the fundamentals exercise appreciationary forces on REER. TOT has appeared to be the major factor that explains the behavior of REER. Improvement in TOT by 1 percent depreciates REER by 1.55 percent which indicates that REER depreciating income effect produced due to the rise in TOT damps down the corresponding REER appreciating substitution effect. A 1 percent increase in PROD drives REER to appreciate by 0.71 percent which approves the Balassa-Samuelson effect for Malaysia. REER is depreciated by 0.04 and 0.06 percent respectively due to 1 percent increase in I and G respectively which implies that a greater proportion of I is spent on nontradable goods while G is biased towards tradable goods. A 1 percent increase in ODA depreciates REER by 0.42 percent. Misalignment in REER of Malaysia corrects at a 39.3 percent rate per annum. LM autocorrelation test accepts the null hypothesis of no autocorrelation for any of the order tested at 5 percent significance level White heteroskedasticity test finds that residuals are homoscedastic. Hence the model selected for Malaysia is correctly specified and structurally stable.



14(a) Actual, Sustainable and Equilibrium REER
14(b) Misalignment of REER for Malaysia

Figure 14 Equilibrium REER and Corresponding Misalignment for Malaysia
Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 37
Misalignment Episodes of Malaysia

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1982	Undervaluation	-2.024	-12.020	-7.939	5.244
1983-1985	Overvaluation	12.070	4.971	9.036	3.660
1986-1992	Undervaluation	-1.609	-10.764	-7.253	3.523
1993-1997	Overvaluation	8.705	0.060	3.984	3.903
1998-2000	Undervaluation	-6.062	-12.025	-9.085	2.983
2001-2002	Overvaluation	1.787	0.283	1.035	1.063
2003-2009	Undervaluation	0.000	-6.331	-3.028	2.437
2010-2014	Overvaluation	2.622	1.983	2.209	0.254
2015-2016	Undervaluation	-5.666	-9.397	-7.531	2.638

Source: Author's estimates

The EREER obtained by estimating the long-run cointegrating vector in table 36 based on the permanent values of the fundamentals is compared with the actual REER in figure 14(a). Figure 14(b) shows the degree of misalignment in percent. Table 37 captures the distinct misalignment episodes in terms of undervaluation and overvaluation. There is a declining trend in actual and equilibrium REER all over the sample period and the actual REER well reflected the macroeconomic fundamentals as it moved closely with the EREER in most part of the period under investigation. As revealed, Malaysian REER was undervalued from 1980 to 1982 and was overvalued till 1985. Following another undervaluation period during 1986-1992, REER experienced another overvaluation episode between 1993 and 1997 before the wake of the Asian financial crisis. This finding is consistent with Naseem, Tan, & Hamizah (2009) who documented the overvaluation of REER of Malaysia during 1993-1997. The regime shift from the flexible to pegged in the domain of risk management during the crisis depreciated the REER which is also evident in Wong's (2013) study. Therefore, change in exchange rate policy in response to the regional crisis drove the pre-crisis overvalued REER of Malaysia to an undervaluation in the crisis period. In contrast, actual REER stayed relatively close to the EREER and slightly overvalued on the eve of global financial crisis 2007-2008 and onwards till 2014. The expected degree of misalignments ranges from 1.04 to -9.09 percent. Degree of misalignment reached to the pick to 12.07 percent in 1984 against the least of 0 percent in 2008.

4.4.13. EREER and Corresponding Misalignment: The Case of Mexico

The stationarity test results suggest that REER, TOT, G OPEN, NFA and ODA are integrated of order one both for ADF and PP tests. On the contrary, only the PP test finds PROD and I stationary at first difference. Table 84 in appendix sums up the test results. Since all the variables are integrated of order one, different combinations of the fundamentals can be applied to test for cointegration to pick the best combination that forms the long-run relationship between REER and the fundamentals. Removing the models lacking statistically significant vector, the long-run behavior of REER of Mexico is found to be determined by the fundamentals like TOT, I, OPEN and NFA and therefore the long-run theoretical model can be given as-

$$\ln q_t = f(\ln TOT_t, I_t, OPEN_t, NFA_t) \tag{4.26}$$

Cointegration test results are summarized in table 38. The trace test statistics identifies three cointegrating equations at 5 percent level of significance while the maximum eigenvalue test statistic indicates two cointegrating equation at the same significance level. Therefore, the long-run relationship between REER and its fundamentals can be estimated. The long-run normalized cointegration vector is provided in table 39.

Table 38

Cointegration Test Results for Mexico

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	132.051*	0.0000	49.238*	0.0020
r≤1	82.813*	0.0006	36.892*	0.0120
r≤2	45.921*	0.0243	24.689	0.0700
r≤3	21.232	0.1699	14.226	0.2394
r≤4	7.006	0.3439	7.006	0.3439

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

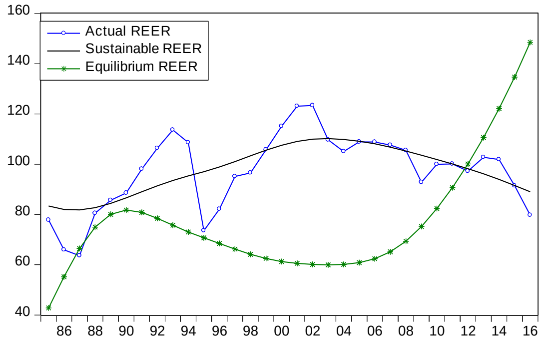
Table 39

Cointegration Equation for Mexico

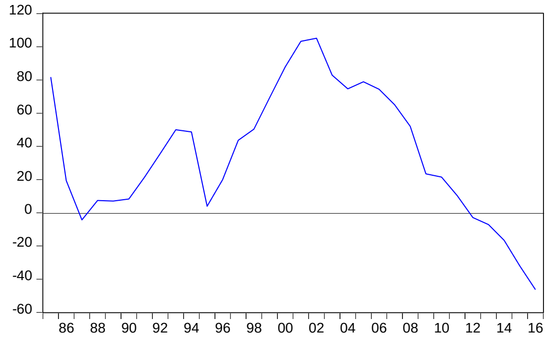
$lnq_t^* = 4.557_t$	$+1.546lnTOT_t$	$-\ 0.344I_t$	$+\ 0.022OPEN_t$	$+0.090NFA_t$	$+\ 0.022TREND$
S_e	(0.464)	(0.051)	(0.009)	(0.029)	(0.002)
t	$[3.332]^*$	$[-6.727]^*$	$[2.380]^{**}$	$[3.084]^*$	$[8.963]^*$

Notes: Speed of adjustment in REER (t-statistic): -0.042*** (-1.855)
LM Autocorrelation Test: p-value=0.1294 (LM (1)), 0.6225 (LM(2))
White Heteroskedasticity: p-value= 0.147
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level
Sample: 1980-2016

Signs of all the coefficients of fundamentals are as desired and statistically significant as well. The most important determinant of REER of Mexico is TOT, a 1 percent increase in this fundamental depreciates REER by 1.55 percent. It means that the income effect arises from the increase in TOT that depreciates REER is more powerful than the substitution effect of a rise in TOT that appreciates REER. Investment spending is the next important factor that determines Mexico's REER. A greater portion of domestic investment in Mexico goes to tradable goods and accordingly a 1 percent increase in investment spending appreciates REER by 0.34 percent. NFA and OPEN come next respectively in terms of their importance. While 1 percent increase in NFA depreciates REER of Mexico by 0.09 percent, a similar change in OPEN depreciates it by 0.02 percent. The deviation between REER and its equilibrium value in the short run corrects at a 4.2 percent rate per period in the long run. LM autocorrelation test suggests that there is no autocorrelation among the residuals for any of the order tested at 5 percent significance level and white heteroskedasticity test indicates that the model is free from heteroskedasticity problem at 5 percent level of significance. Therefore, the specification of the model is just and stable structurally.



15(a) Actual, Sustainable and Equilibrium REER



15(b) Misalignment of REER for Mexico

Figure 15 Equilibrium REER and Corresponding Misalignment for Mexico
Source: Actual REER is sourced from FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 40
Misalignment Episodes of Mexico

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1985-1986	Overvaluation	81.756	19.361	50.559	44.120
1987	Undervaluation	-4.270	-4.270	-4.270	0.000
1988-2011	Overvaluation	105.193	3.980	47.731	31.975
2012-2016	Undervaluation	-2.852	-46.287	-20.987	18.051

Source: Author’s estimates

Figure 15(a) plots the actual, sustainable and equilibrium values and figure 15(b) shows the misalignment series in percent. While the actual REER fluctuates around the sustainable values of REER, they both lie entirely above the equilibrium REER till the beginning of the 2010s. Therefore, actual REER of Mexico was overvalued for most of the sample period. The actual REER fell short of its equilibrium value and thus undervalued for the last five years of the sample period. It remained overvalued through 1985-2011 and ended with undervaluation during 2012-2016. The mean rate of misalignment, as reported in table 40, lies in between 50.56 percent and -20.99 percent. The maximum degree of misalignment is reported to be 105.19 percent in 2002 and the minimum was -46.29 percent in 2016.

4.4.14. EREER and Corresponding Misalignment: The Case of Pakistan

The ADF and PP tests results as reported in table 85 in appendix indicate that the variables are non-stationary at their levels except ODA, ODA has a unit root at the level and hence declined from the model. REER, TOT, PROD, G, OPEN and NFA are stationary at first difference for all specifications at a 1 percent level of significance with some potty exceptions. TOT and OPEN are stationary at first difference at a 5 percent significance level in the trend regression and in regression with intercept, respectively. I is stationary at first difference but cropped from the theoretical model as it does not pass the conditions of model selection.

Hence, REER, TOT, PROD, G, OPEN and NFA are integrated of order I(1) and thus can be used for cointegration test to examine if there exists any cointegrating relationship among the variables. The theoretical model to estimate EREER of Pakistan takes the following form:

$$\ln q_t^* = f(\ln TOT_t, \ln PROD_t, G_t, OPEN_t, NFA_t) \tag{4.27}$$

Cointegration test results are presented in table 41. The trace test result implies that there exists 3 cointegrating equation while the maximum eigenvalue test infers 2 at 5 percent significance level. It points to the presence of a long-run cointegrating relationship between REER and its fundamentals that let one estimate the long-run cointegrating vector as presented in table 42.

Except for the coefficient of NFA, all other coefficients are signed correctly. The substitution effect produced by a 1 percentage point improvement in TOT surpasses the accompanying income effect and hence appreciates REER by 1.63 percent point. There is also an appreciation of REER due to increased productivity differentials which indicates the strong prevalence of Balassa-Samuelson effect. The proportion of government expenditure spent on non-tradable goods is greater than that of tradable goods which appreciates the REER by 0.22 percent in response to a 1 percent rise in government expenditure. In respect of openness variable, a 1 percent increase in this variable depreciates REER by 0.13 percent reducing prices of nontradables relative to tradable goods. The negative coefficient of NFA is against the theoretical expectations, however, following Horvath's (2005) catching-up economy argument and considering the level of development of Pakistan, the negative relation between REER and NFA will subsequently be expected to become positive. The significant speed of adjustment coefficient indicates, REER of Pakistan corrects towards the equilibrium REER at a rate of 7.3 percent in each period. Regarding robustness check, residuals are uncorrelated at 5 percent significance level for any of the orders tested by LM autocorrelation test and white heteroskedasticity test also accepts the null hypothesis of homoskedasticity for the same level of significance. Hence, the model selected to estimate the EREER of Pakistan is rightly specified with structural stability.

Table 41
Cointegration Test Results for Pakistan

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	150.483*	0.000	61.396*	0.000
r≤1	89.087*	0.001	38.206*	0.014
r≤2	50.881*	0.025	22.548	0.194
r≤3	28.333	0.073	16.874	0.178
r≤4	11.459	0.185	9.516	0.246
r≤5	1.943	0.163	1.943	0.163

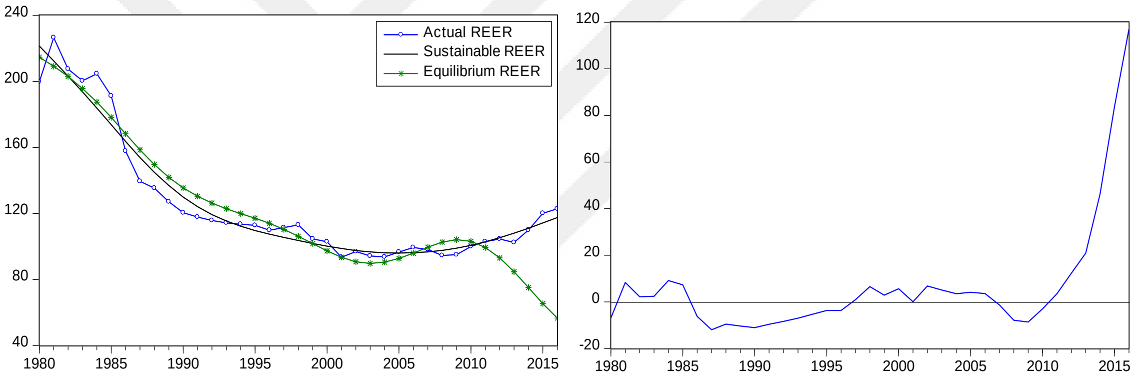
Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 42
Cointegration Equation for Pakistan

$\ln q_t^* = 14.338$	$-\ 1.638 lnTOT_t$	$-\ 2.499 lnPROD_t$	$-\ 0.218 G_t$	$+\ 0.134 OPEN_t$	$-\ 0.045 NFA_t$
S_e	(0.147)	(0.715)	(0.032)	(0.027)	(0.006)
t	$[-11.150]^*$	$[-3.495]^*$	$[-6.865]^*$	$[4.927]^*$	$[-8.013]^*$

Notes: Speed of adjustment in REER (t-statistic): -0.073** (-2.405)
LM Autocorrelation Test: p-value=0.8756 (LM (1)), 0.5901 (LM(2))
White Heteroskedasticity: p-value= 0.5005
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The EREERs are the fitted value of the long-run cointegrating equation in table 42 depending on the sustainable values of the fundamentals. The EREER of Pakistan is graphed with its actual and sustainable values in figure 16. The figure also comprises a misalignment series of REER as a percentage deviation of actual REER from its equilibrium values. Results indicate that the actual REER of Pakistan maintains the underlying macroeconomic fundamentals that form long-term equilibrium relationship with it and consequently it moves around the EREER with limited deviations until 2011. Based on similar fundamentals, Hyder & Mahboob (2006) and Janjua (2007) also find that current REER of Pakistan does not deviate much from the EREER during 1978-2005 and 1978-2006, respectively. As the graph demonstrates, both the actual and equilibrium REER continue to decline until Pakistan moves from its managed floating exchange rate regime to the floating exchange rate regime in 1999. Exchange rate was relatively stable during the 2000s of the floating exchange rate regime. However, REER fails to maintain the underlying economic fundamentals in recent years which is evident from the deviation of actual REER from its equilibrium value in a diverging manner. As table 43 illustrates, REER mostly remains overvalued during the floating exchange rate regime except for the period 2007-2010. The degree of misalignment lies between -11.991 and 117.147 percent with a minimum misalignment equals 0.068 percent.



16(a) Actual, Sustainable and Equilibrium REER

16(b) Misalignment of REER for Pakistan

Figure 16 Equilibrium REER and Corresponding Misalignment for Pakistan

Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 43

Misalignment Episodes of Pakistan

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1981-1985	Overvaluation	9.182	2.198	5.877	3.327
1986-1996	Undervaluation	-3.701	-11.991	-7.912	2.899
1997-2006	Overvaluation	6.840	0.068	3.917	2.234
2007-2010	Undervaluation	-1.335	-8.635	-5.201	3.596
2011-2016	Overvaluation	117.147	3.525	47.286	44.828

Source: Author’s estimates

4.4.15. EREER and Corresponding Misalignment: The Case of Peru

ADF and PP unit root tests carried out to identify the order of integration of the variables are summed up in table 86 in the appendix. The trend regression of NFA and ODA suggests that they are stationary at level, though the intercept specification rejects it. Both of the tests find them stationary at first difference for any of the specifications. Visual inspection of time series plot and correlogram of these two variables also allow them to use at first difference. However, the indecisiveness of stationarity for these variables is not a major concern as the test of cointegration omits them from the theoretical model in order to maintain the principles of model selection criteria. Apart from these two variables, all other variables including REER are found to have a unit root at the level. However, the unit root for these variables disappears at first difference across tests. Therefore, all the variables are integrated of order one, that is, they are I(1) series which let to test for cointegration and pick the best combination of the fundamentals that form the long-run relationship between REER and the fundamentals. Discarding the models lacking statistically significant vector, the long-run behavior of REER of Peru is found to be determined by the fundamentals like TOT, PROD, I and G and therefore the long-run theoretical model can be given as-

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, I_t, G_t) \tag{4.28}$$

Results of cointegration tests are captured by table 44. The trace test statistics identifies two cointegrating equations at a 5 percent level of significance while the maximum eigenvalue test statistic indicates one cointegrating equation at the same significance level. Therefore, the long-run relationship between REER and its fundamentals can be estimated. The long-run normalized cointegration vector is provided in table 45.

All the coefficients of the fundamentals are found to carry expected signs that are statistically significant as well. PROD is found to have the most significant impact on REER of Peru, a 1 percent increase in this fundamental brings about 5.16 percent appreciation in REER. The second most important determinant of Peru's REER is TOT. It puts forth an inverse impact on REER, that is, REER is appreciated by 2.05 percent due to 1 percent increase in TOT which means that the substitution effect of TOT improvement dominates over the corresponding income effect. A 1 percent increase in I and G appreciates REER by 0.16 and 0.70 percent, respectively, which signals to the fact that domestic investment of Peru is prone to tradable goods while government expenditure is prejudiced towards nontradables. Misalignment in REER of Peru fixes at the rate of 19.6 percent per year. The LM autocorrelation test suggests that there is no autocorrelation among the residuals for any of the order tested at 5 percent significance level and white heteroskedasticity test indicates that the model is free from heteroskedasticity problem at 5 percent level of significance. Therefore, there is no misspecification problem for the model selected for Peru, which is also structurally stable.

Table 44

Cointegration Test Results for Peru

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	95.682*	0.0001	47.049*	0.0008
r≤1	48.633*	0.0422	26.954	0.0600
r≤2	21.679	0.3167	14.244	0.3453
r≤3	7.434	0.5277	7.358	0.4476
r≤4	0.076	0.7828	0.076	0.7828

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 45

Cointegration Equation for Peru

$$lnq_t^* = 12.315 - 2.053 lnTOT_t + 5.158 lnPROD_t - 0.155 I_t - 0.699 G_t$$

$$S_e \quad (0.254) \quad (0.795) \quad (0.028) \quad (0.092)$$

$$t \quad [-8.097]^* \quad [6.489]^* \quad [-5.585]^* \quad [-7.623]^*$$

Notes: Speed of adjustment in REER (t-statistic): -0.196* (-3.427)
LM Autocorrelation Test: p-value=0.0857 (LM (1)), 0.1598 (LM(2))
White Heteroskedasticity: p-value= 0.0993/ 0.0029
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Relying on the H-P filtered sustainable values of the fundamentals, the fitted value of the cointegrating vector in table 45 produces the EREER which is compared with its actual values in figure 17(a). Figure 17(b) shows the misalignment series in percent. Actual and equilibrium REER followed a rising trend till the middle of the 1990s and then actual REER maintained a relatively stable pattern though equilibrium

REER fell during the late 1990s and early 2000s and then rose afterward. At the beginning of the 1980s, Peru's actual REER was somewhat overvalued. But it seemed to be undervalued starting from 1983 owing to the outbreak of the financial crisis in 1982 in the neighboring economy Chile. Therefore, as like Malaysia, regional crisis altered the direction of REER of Peru from pre-crisis overvaluation to undervaluation during the crisis period. It took several years to return back to its equilibrium value and fluctuated around the equilibrium value from 1989 to 1996. It remained overvalued through 1995-2014 and ended with undervaluation during 2015-2016. Mean rate of misalignment, as reported in table 46, lies in between -3.362 percent and -33.193 percent. The maximum degree of misalignment is reported to be -47.01 percent in 1985 and the minimum was 0.43 percent in 1990.

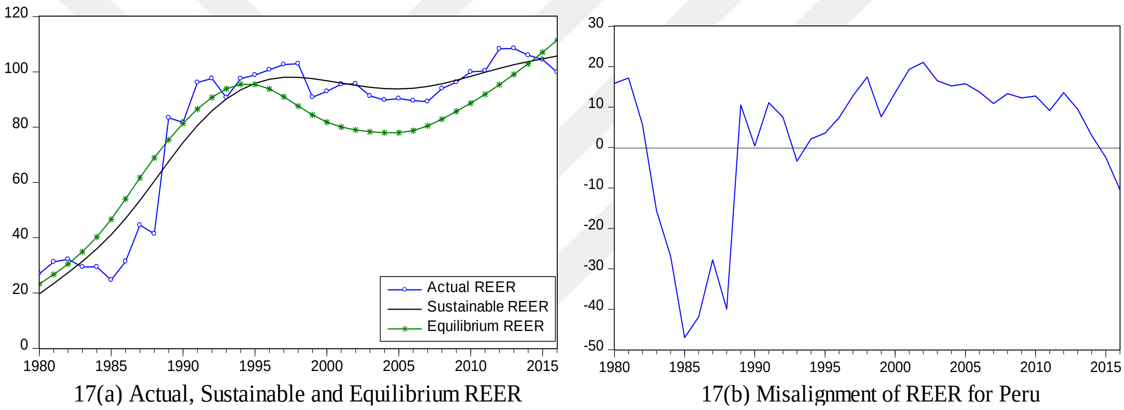


Figure 17 Equilibrium REER and Corresponding Misalignment for Peru
Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 46
Misalignment Episodes of Peru

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1982	Overvaluation	17.217	5.632	12.900	6.331
1983-1988	Undervaluation	-15.693	-47.010	-33.193	11.724
1989-1992	Overvaluation	11.106	0.427	7.397	4.906
1993	Undervaluation	-3.362	-3.362	-3.362	0.000
1994-2014	Overvaluation	21.067	2.161	11.936	5.136
2015-2016	Undervaluation	17.217	5.632	12.900	6.331

Source: Author's estimates

4.4.16. EREER and Corresponding Misalignment: The Case of Philippine

The ADF and PP unit root tests are conducted to determine the order of integration of the variables. Test results are presented in table 87 in the appendix. As the tests confirm, all the variables are non-stationary at level but stationary at first difference except PROD. PROD has a unit root with intercept regression but stationary with trend regression at first difference both for ADF and PP tests. Examination of the time series plot and correlogram of the series infers it as a stationary series at first difference. As all the variables are stationary at first difference, that is, their order of integration is one, which is the precondition to performing cointegration test to identify the existence of a long-run cointegrating relationship between REER and its fundamentals, one can proceed for possible cointegration tests considering various combinations of the fundamentals. Test result suggests that the REER of Philippine is explained by TOT, PROD, G and OPEN, and hence the theoretical model of REER determination can be given as:

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, OPEN_t) \tag{4.29}$$

Cointegration test results summarized in table 47 indicate two cointegrating equations according to Trace test statistic and one cointegrating equation according to the maximum eigenvalue test statistic at a 5 percent level of significance. Hence, the long-run relationship between REER and the above-mentioned fundamentals can be estimated.

Table 47
Cointegration Test Results for Philippine

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	88.836*	0.0007	39.229*	0.0104
r≤1	49.607*	0.0339	20.771	0.2903
r≤2	28.836	0.0642	17.879	0.1344
r≤3	10.957	0.2142	10.957	0.1564
r≤4	0.0000	0.9993	0.0000	0.9993

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 48
Cointegration Equation for Philippine

$lnq_t^* = 10.488 - 1.195 lnTOT_t - 0.574 lnPROD_t - 0.102 G_t + 0.011 OPEN_t$				
S_e	(0.233)	(0.224)	(0.038)	(0.005)
t	$[-5.128]^{*}$	$[-2.558]^{**}$	$[-2.693]^{**}$	$[2.191]^{**}$

Notes: Speed of adjustment in REER (t-statistic): -0.197* (-3.037)
LM Autocorrelation Test: p-value=0.5149 (LM (1)), 0.6187 (LM(2))
White Heteroskedasticity: p-value= 0.1012
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The long-run cointegration vector is reported in table 48. As displayed, the primary determinant of REER of Philippine is TOT. Clearly, the substitution effect caused by the improvement of TOT overshadows the income effect as the rise in TOT by 1 percent appreciates REER by 1.20 percent. PROD has a negative effect on REER and therefore the Balassa-Samuelson effect is evident for Philippine. The government expenditure variable G bears a negative signed coefficient that signifies the fact that a greater proportion of government expenditure is keen to nontradable goods owing to which a rise in government expenditure appreciates REER. With regard to the variable OPEN, greater trade liberalization depreciates REER. The REER of Philippine converges to the long run equilibrium at a rate of 19.7 percent per period. The LM autocorrelation test results indicate that residuals are uncorrelated for any of the orders tested at a 5 percent level of significance. The test for white heteroskedasticity points to the absence of heteroskedastic residuals at the same level of significance. Therefore the perceived model is well specified and structurally stable.

The EREER is the estimated value of the cointegrating vector in table 48 based on the H-P filtered sustainable values of the fundamentals. The actual, sustainable and equilibrium REER are illustrated in figure 18(a) and figure 18(b) illustrates the series of misalignment. EREER of Philippine tended to decline over the 1980s and 1990s and displayed a rising character through 2000s before the fall from the beginning of 2010s. REER stayed below the EREER and thus undervalued from the beginning of the sample period till 1993 except in 1982 and was significantly misaligned. REER of Philippine exceeds its equilibrium value in 1994, dropped sharply during the outburst of the Asian financial crisis in 1997 but still remained overvalued till 2003. During the period from

2003 to 2011, REER of Philippine was roughly in line with the fundamentals with slight misalignment. It ended with overvaluation in recent years. The degree of misalignment is reported in table 49. The misalignment on average ranged from -0.39 percent to 17.38 percent. The degree of misalignment peaked at 34 percent in 1997 and the least was 0.16 percent in 2003.

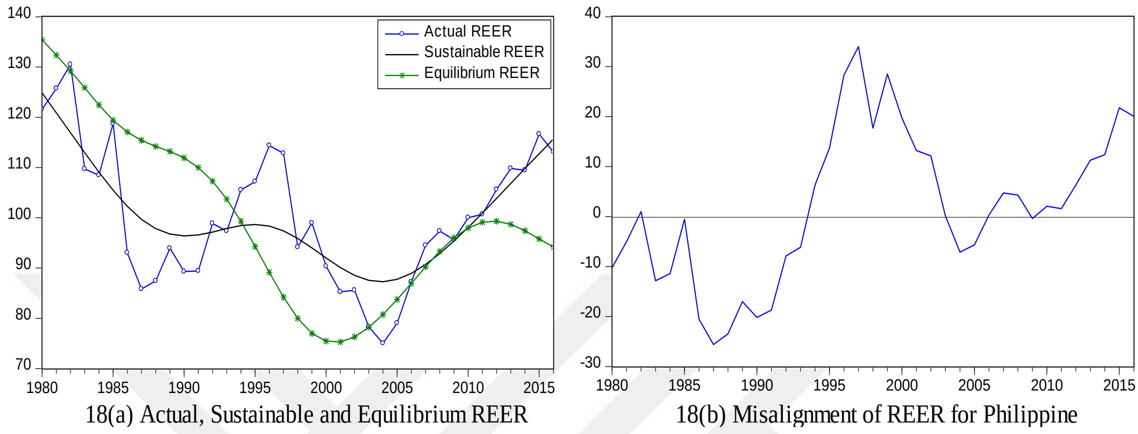


Figure 18 Equilibrium REER and Corresponding Misalignment for Philippine
Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 49
Misalignment Episodes of Philippine

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Undervaluation	-5.014	-10.204	-7.609	3.670
1982	Overvaluation	0.982	0.982	0.982	0.982
1983-1993	Undervaluation	-0.537	-25.615	-14.934	7.847
1994-2003	Overvaluation	33.999	0.161	17.380	10.557
2004-2005	Undervaluation	-5.658	-7.106	-6.382	1.024
2006-2008	Overvaluation	4.720	0.318	3.112	2.429
2009	Undervaluation	-0.389	-0.389	-0.389	-0.389
2010-2016	Overvaluation	21.767	1.584	10.777	8.058

Source: Author's estimates

4.4.17. EREER and Corresponding Misalignment: The Case of Poland

The Fundamentals like PROD and ODA are dropped due to lack of sufficient data and the NFA is discarded from the analysis as it is stationary at level. The stationary tests performed by using ADF and PP tests booked in table 88 in appendix allows to accept all other variables as stationary at the level of first differencing and hence they are I(1). These fundamentals are used to identify the long-run cointegrating relationship with REER and following combination is found to satisfy Montiel's (2007) criteria:

$$\ln q_t = f(\ln TOT_t, I_t, G_t, OPEN_t) \tag{4.30}$$

Cointegration test results summarized in table 50 indicate two cointegrating equations according to Trace test statistic and one cointegrating equation according to the maximum eigenvalue test statistic at a 5 percent level of significance. Hence, the long-run relationship between REER and the above-mentioned fundamentals can be estimated.

Table 50
Cointegration Test Results for Poland

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	127.844*	0.0000	62.701*	0.0000
r≤1	65.144*	0.0390	30.937	0.0692
r≤2	34.207	0.2791	17.891	0.3856
r≤3	16.315	0.4675	12.179	0.3987
r≤4	4.137	0.7223	4.137	0.7223

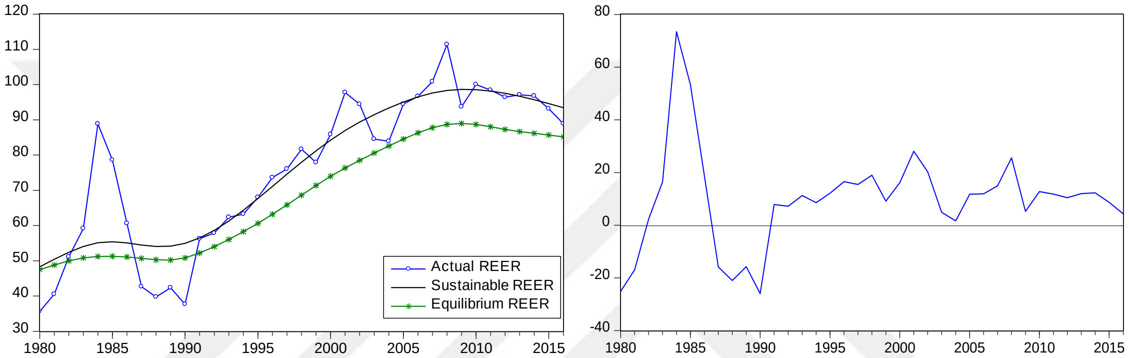
Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 51
Cointegration Equation for Poland

$lnq_t^* = -7.609 + 0.661 lnTOT_t$	$+ 0.083 I_t$	$+ 0.295 G_t$	$+ 0.008 OPEN_t$	$+ 0.083 TREND$	
S_e	(0.280)	(0.008)	(0.025)	(0.002)	(0.006)
t	[2.361]**	[10.171]*	[11.716]*	[3.097]*	[12.887]*

Notes: Speed of adjustment in REER (t-statistic): -0.368* (-2.923)
LM Autocorrelation Test: p-value=0.0194 (LM (1)), 0.4479 (LM(2))
White Heteroskedasticity: p-value= 0.076
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The long-run cointegration vector is reported in table 51. Coefficients attached to the fundamentals maintain signs conventionally anticipated and statistically significant. As displayed, the primary determinant of REER of Poland is TOT. Clearly, the positive income effect caused by the improvement of TOT eclipses its negative substitution effect as the rise in TOT by 1 percent depreciates REER by 0.66 percent. Both the increase in G and I depreciate REER. Hence government expenditure is markedly flowed into tradable goods, while investment spending is biased towards nontradable goods. Greater openness depreciates REER. Poland's REER approaches at 36.8 percent rate to the equilibrium REER per period. Though the residuals are correlated at first order, uncorrelated at second order according to the LM autocorrelation test at 5 percent level of significance. The test for white heteroskedasticity does not find heteroskedastic residuals at the same level of significance. Therefore the model specified is well specified and structurally stable.



19(a) Actual, Sustainable and Equilibrium REER

19(b) Misalignment of REER for Poland

Figure 19 Equilibrium REER and Corresponding Misalignment for Poland

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 52

Misalignment Episodes of Poland

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Undervaluation	-16.906	-25.052	-20.979	5.760
1982-1986	Overvaluation	73.463	2.306	32.847	29.452
1987-1990	Undervaluation	-15.710	-25.945	-19.633	4.873
1991-2016	Overvaluation	28.059	1.617	12.303	6.167

Source: Author's estimates

The actual, sustainable and equilibrium REER are compared in figure 19(a) and the misalignment series is shown in figure 19(b). Actual REER of Poland fluctuated around EREER for the first decades of the sample period and the rest of the period it stayed fairly overvalued. During the overvaluation phase through 1991-2016, both the actual and equilibrium REER maintain a rising trend until the global financial crisis of 2008 and then starts to decline. The rate of misalignment on average ranges in between -

20.98 and 32.85 percent. Misalignment picked at 73.46 percent during the overvaluation period 1982-1986 and the least misalignment was 25.95 percent in the undervaluation period 1987-1990 (table 52).

4.4.18. EREER and Corresponding Misalignment: The Case of South Africa

The test results for the stationarity test of the concerned variables employing the ADF and PP tests are summarized in table 89 in the appendix. According to the ADF test, REER, TOT and I have a unit root at level with trend regression while G possesses it with intercept regression at the level. PROD is stationary at level with intercept regression both for ADF and PP tests. However, the variables are non-stationary for all other specifications at the level. Accordingly, there are tested for unit roots at first difference and found stationary across tests and specifications. Results are consistent with visual inspection of the time series graph and correlogram of the series. For the remaining variables, there is no ambiguity regarding their stationarity at first difference.

Since all the variables satisfy the condition of being I(1) for conducting cointegration test in order to determine the long-run association between REER and the fundamentals, one can proceed for the test of cointegration considering alternative sets of the fundamentals in order to pick a set that best describe the REER of South Africa. Fundamentals that are found to have a significant impact on REER include TOT, PROD, G and NFA. Thus, the theoretical model that fits better to explain the long-run REER of South Africa appears as

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, NFA_t) \qquad (4.31)$$

Cointegration test results are available in table 53. The Trace test statistic suggests that there are four cointegrating equation at 5 percent level of significance while the number of the cointegrating equation is one according to the maximum eigenvalue test statistic at the same significance level. The existence of long-run cointegrating equation allows estimating the long-run association between REER and the fundamentals that explain it. The cointegration vector is presented in table 54.

Table 53

Cointegration Test Results for South Africa

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	115.497*	0.0002	50.340*	0.0014
r≤1	65.157*	0.0389	21.918	0.4997
r≤2	43.239*	0.0464	17.089	0.4503
r≤3	26.150*	0.0462	14.588	0.2170
r≤4	11.562	0.0718	11.562	0.0718

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 54

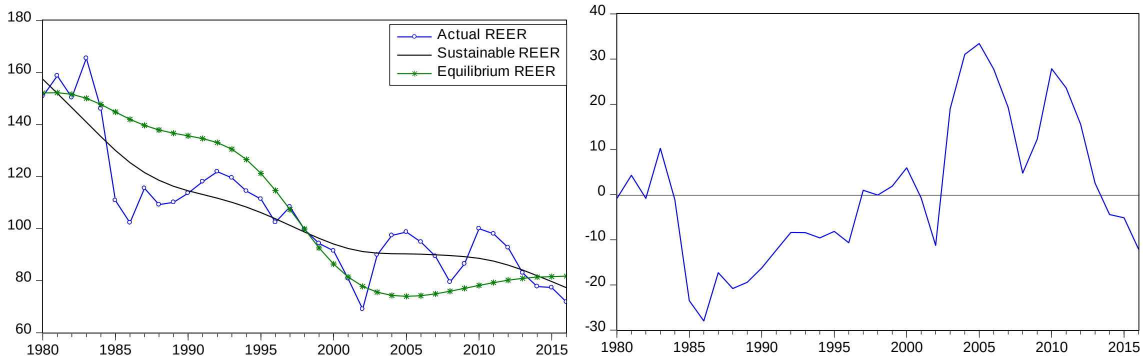
Cointegration Equation for South Africa

$$\ln q_t^* = 4.713 - 1.508 lnTOT_t - 1.587 lnPROD_t + 0.151 G_t - 0.036 NFA_t - 0.018 TREND$$

S_e	(0.191)	(0.292)	(0.018)	(0.007)	(0.008)
t	$[-7.892]^*$	$[-5.428]^*$	$[8.433]^*$	$[-4.899]^*$	$[-2.264]^{**}$

Notes: Speed of adjustment in REER (t-statistic): -0.229*** (-1.732)
LM Autocorrelation Test: p-value=0.8557 (LM (1)), 0.8339 (LM(2))
White Heteroskedasticity: p-value= 0.5624
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

All the coefficients of the fundamentals are found to bear expected signs and statistically significant. TOT and PROD play a vital role in the determination of REER of South Africa. A 1 percent rise in the former appreciates the REER by 1.51 percent while a similar change in the later appreciates REER by 1.59 percent. The appreciating effect of PROD on REER confirms the Balassa-Samuelson hypothesis is in effect for South Africa and the income effect due to TOT improvement is dwarfed by the substitution effect. Tradable goods prone government expenditure is marked by the positive coefficient of G which indicates that a 1 percent increase in G causes a depreciation of REER of South Africa by 0.15 percent. A 1 percent increase in NFA appreciates REER by 0.04 percent, again a case similar to the findings of Horvath (2005). For South Africa, the rate at which the REER approaches towards the equilibrium level, in the long run, is 22.9 percent. The LM autocorrelation test results indicate that residuals are uncorrelated for any of the orders tested at a 5 percent level of significance. The test for white heteroskedasticity also indicates that the residuals are not heteroskedastic at the same level of significance. Therefore, a well specified and structurally stable model is perceived for the determination of equilibrium REER.



20(a) Actual, Sustainabele and Equilibrium REER
20(b) Misalignment of REER for South Africa

Figure 20 Equilibrium REER and Corresponding Misalignment for South Africa

Source: Actual REER is sourced from WDI, Equilibrium and Sustainable REERs are calculated by the author.

Table 55

Misalignment Episodes of South Africa

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1984-1996	Undervaluation	-1.168	-27.984	-14.153	7.479
2003-2013	Overvaluation	33.424	2.507	19.713	10.277
2014-2016	Undervaluation	-4.416	-12.153	-7.239	4.272

Source: Author’s estimates

Estimation of the cointegrating equation in table 54 adopting the H-P filtered permanent values of the fundamentals yields EREER of South Africa. Figure 20(a) shows the actual, sustainable and equilibrium REER and figure 20(b) illustrates the REER misalignment of South Africa which is almost identical to the study conducted by MacDonald & Ricci (2004) and World Bank Group (2018). Actual REER moved around its equilibrium values during 1980-1984. It was undervalued from 1984 to 1996 with significant misalignments. Actual REER maintained the fundamentals through 1997-2002. It remained overvalued from 2003 to 2013 and ended with moderate undervaluation during 2014-2016. Table 55 shows the misalignment episodes of South Africa. The highest degree of misalignment of REER for South Africa was 33.42 percent and the least was -1.17 percent. The mean rate of misalignment lies in between -7.24 percent to -14.15 percent.

4.4.19. EREER and Corresponding Misalignment: The Case of Thailand

The unit root test results based on ADF and PP tests in order to determine the order of integration of the variables are mentioned in table 90 in the appendix. All the variables are found to have a unit root at the level. However, they are stationary at first difference except for PROD, at first difference PROD is stationary with an intercept but non-stationary with trend and intercept. Visual examination of time series plot and correlogram indicates that the series is stationary at first difference. As all the variables are stationary at first difference, that is, they are integrated of order one, cointegration test can be performed using different sets of the fundamentals to identify the set that best describes the long-run relationship between REER and the set of fundamentals. Test results suggest that the long-run REER of Thailand is better explained by TOT, PROD, G and ODA. Thus, the theoretical model for the determination of REER of Thailand takes the following form:

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, G_t, ODA_t) \quad (4.32)$$

As revealed from the cointegration test results summarized in table 56, both the trace and maximum eigenvalue test statistics indicate the presence of one cointegrating equation at 5 percent level of significance. It allows for estimating the long-run relationship between REER and its fundamentals. The normalized cointegrating vector is given in table 57. Signs of all the coefficients of the fundamentals are in line with theoretical explanations and they are statistically significant as well. All the fundamentals that determine the long run equilibrium REER of Thailand depreciate REER except PROD. TOT and PROD are the major determinants of REER and they have an opposing impact on REER. A 1 percent rise in TOT causes REER depreciation by 0.69 while for a similar change I PROD appreciates REER by 0.44 percent. The positive impact of TOT on REER approves the view that the REER depreciating income effect produced due to the improvement of TOT is relatively stronger than its corresponding REER appreciating substitution effect. REER appreciating productivity effect supports the Balassa-Samuelson effect for Thailand. Government spending is inclined towards tradable goods which is noticeable from the positive impact of G on REER stands to mean that an increase in government spending depreciates REER.

Finally, the rise in ODA by 1 percent causes 0.11 percent depreciation of REER of Thailand. The trend coefficient is negative and statistically significant. The misalignment in REER evaporates at the rate of 13.9 percent at the end of each period. The LM autocorrelation tests do not find any evidence of autocorrelation for any of the orders tested at 5 percent level of significance and homoscedastic residuals are affirmed by white heteroskedasticity test at the same level of significance, indicating that we are dealing with an appropriate model for determining the EREER of Thailand.

Table 56
Cointegration Test Results for Thailand

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	115.879*	0.0002	55.426*	0.0002
r≤1	60.453	0.0938	24.499	0.3166
r≤2	35.954	0.2079	16.627	0.4895
r≤3	19.327	0.2619	11.818	0.4323
r≤4	7.509	0.2944	7.509	0.2944

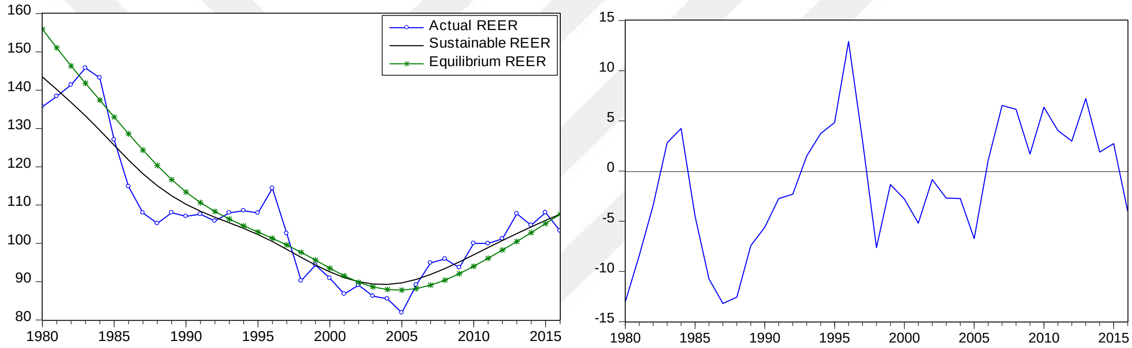
Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 57
Cointegration Equation for Thailand

$lnq_t^* = -0.252 +$	$0.692lnTOT_t$	$-0.438lnPROD_t$	$+ 0.055G_t$	$+ 0.114ODA_t$	$-0.009TREND$
S_e	(0.157)	(0.133)	(0.005)	(0.040)	(0.004)
t	[4.410]*	[−3.290]*	[10.863]*	[2.871]*	[−2.149]**

Notes: Speed of adjustment in REER (t-statistic): -0.139*** (-1.797]
LM Autocorrelation Test: p-value=0.8068 (LM (1)), 0.7753 (LM(2))
White Heteroskedasticity: p-value= 0.6074
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

Figure 21(a) matches the actual REER with its sustainable and equilibrium counterparts and figure 21(b) shows the plots of misalignment for Thailand. The EREER represents the fitted value of the cointegrating equation in table 57 backed by the sustainable values of the fundamentals derived by H-P filtering. Table 58 shows the misalignment episodes of Thailand. The actual and equilibrium REER had a falling trend till 2006 and then rose during 2007-2016. The adoption of basket regime in late 1984 led to undervaluation of REER of Thailand on an average 7.4 percent through 1985-1992. Another undervaluation was observed after the Asian financial crisis in 1997. Thailand adopted floating exchange rate regime in the outbreak of the crisis that changed the direction of REER from overvaluation in the pre-crisis period to undervaluation in the crisis period between 1998 and 2005, which was in line with Jongwanich's (2009) finding. The undervaluation was averaged around 3.74 percent during this period. REER stayed overvalued through 2006-2015. The mean rate of misalignment lay between 3.52 percent and -8.28 percent. Maximum misalignment in terms of undervaluation was -13.18 percent that took place in 1987 and the least in terms of overvaluation was 1.06 percent in 2006.



21(a) Actual, Sustainable and Equilibrium REER
21(b) Misalignment of REER for Thailand

Figure 21 Equilibrium REER and Corresponding Misalignment for Thailand

Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REERs are calculated by the author.

Table 58

Misalignment Episodes of Thailand

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1982	Undervaluation	-3.402	-13.030	-8.284	4.815
1983-1984	Overvaluation	4.247	2.802	3.524	1.022
1985-1992	Undervaluation	-2.301	-13.182	-7.377	4.322
1993-1997	Overvaluation	12.901	1.510	5.210	4.465
1998-2005	Undervaluation	-0.845	-7.619	-3.741	2.484
2006-2015	Overvaluation	7.221	1.062	4.067	2.307
2016	Undervaluation	-4.020	-4.020	-4.020	0.000

Source: Author’s estimates

4.4.20. EREER and Corresponding Misalignment: The Case of Turkey

The stationarity test results performed employing both ADF and PP tests are noted down in table 91 in the appendix. ADF test results indicate that PROD, I, OPEN and NFA are non-stationary at level but stationary at first difference at 1 percent level of significance across the two specifications- with ‘intercept’ and ‘trend and intercept’, while REER and TOT are found to be nonstationary for all specifications. However, all they are found to be stationary at first difference by PP test both for ‘intercept’ and ‘trend and intercept’ at 1 percent significance level. That is, they are integrated at order one. Therefore, they can be used for the determination of long-run cointegrating relationship. G and ODA are disregarded as they are stationary at level.

$$\ln q_t^* = f(lnTOT_t, lnPROD_t, I_t, OPEN_t, NFA_t) \quad (4.33)$$

Results of the cointegration test using trace and maximum eigenvalue tests are summarized below in table 59. Both the trace and maximum eigenvalue statistics clearly reject the null hypothesis that there exists no cointegrating vector as they both indicate 1 cointegrating equation at 5 percent level of significance. It confirms the existence of a long-run cointegrating relationship between REER and its fundamentals.

The normalized cointegration equation is shown in table 60. The cointegration results indicate that the long-run coefficients of all fundamentals bear theoretically expected sign that are statistically significant. The coefficient of TOT is negative meaning that substitution effect dominates over income effect due to the improvement in TOT which causes REER to appreciation. The appreciation of REER due to the increase in domestic investment as evident from the negative investment coefficient indicates that domestic investment is largely subjective to tradable goods. The Balassa-Samuelson effect is approved by the negative coefficient of productivity variable. The positive openness coefficient supports the view that greater trade liberalization reduces prices of nontradables relative to tradable goods and thus causes REER to depreciate. Finally, the net foreign asset position has a depreciating effect on REER as confirmed by the positive sign of its coefficient. Any of the deviations exist between actual and equilibrium REER in the short run dissolve at the rate of 17.2 percent in the long run in each period. The study conducts LM autocorrelation and white heteroskedasticity test in order to check the robustness of results. According to LM test, the null hypothesis that there is no autocorrelation among the residuals cannot be rejected at a 5 percent level of significance tested for any of the orders. Again, the white heteroskedasticity test accepts the null hypothesis that there is no heteroskedasticity, therefore, the residual term is homoscedastic. These test results confirm that the empirical model is correctly specified and structurally stable.

Table 59
Cointegration Test Results for Turkey

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	134.9339*	0.0026	63.41310*	0.0002
r≤1	71.52079	0.4483	20.15703	0.9350
r≤2	51.36376	0.3552	17.57639	0.8276
r≤3	33.78737	0.2983	14.53295	0.6761
r≤4	19.25442	0.2660	11.61632	0.4517
r≤5	7.638102	0.2827	7.638102	0.2827

Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 60
Cointegration Equation for Turkey

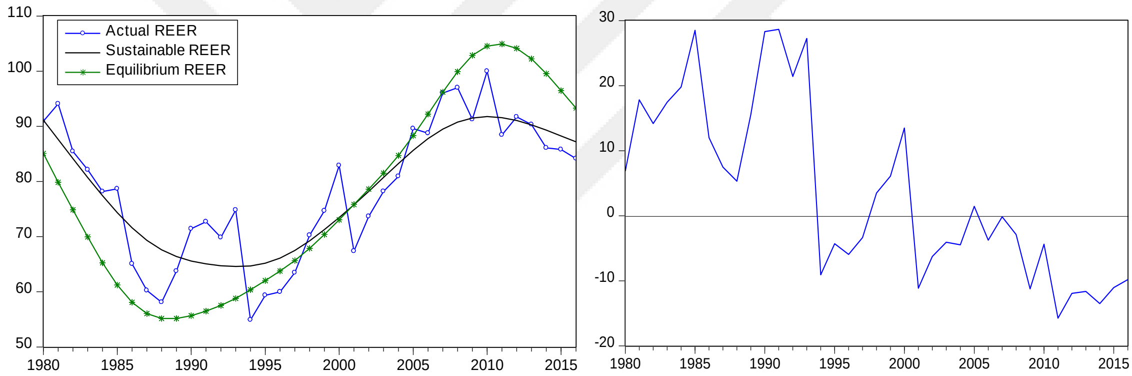
$$\ln q_t^* = 24.083 - 4.265\,lnTOT_t - 0.829\,lnPROD_t - 0.071\,\mathrm{I}_t + 0.024\,OPEN_t + 0.036\,NFA_t + 0.021\,TREND$$

	$lnTOT_t$	$lnPROD_t$	I_t	$OPEN_t$	NFA_t	$TREND$
S_e	(0.385)	(0.461)	(0.014)	(0.006)	(0.006)	(0.010)
t	[−11.070]*	[−1.797]***	[−4.913]*	[3.769]*	[5.864]*	[2.013]***

Notes: Speed of adjustment in REER (t-statistic): -0.172** (-2.252)
LM Autocorrelation Test: p-value=0.8396 (LM (1)), 0.9874 (LM(2))
White Heteroskedasticity: p-value= 0.2468
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

The existence of long-run cointegrating relationship between REER and its fundamentals directs to estimate the equilibrium REER and misalignments in REER. The equilibrium REER can be attained by substantiating the cointegration equation in table 60 with the sustainable values of the fundamentals removing short-term fluctuations of the fundamentals using HP filtering. Figure 22(a) plots equilibrium REER along with its actual and sustainable counterparts, and figure 22(b) demonstrates the REER misalignments for Turkey which indicates the deviations of EREER from its observed values in percent. Though the actual REER moves closer to the EREER for some short periods from 1994 to 2004, actual REER deviates from its equilibrium value throughout the sample period. There are six different episodes of REER misalignments that are summarized in table 61.

The summary illustrates that the degree of misalignment reached to its peak to 28.650 during 1980-1993 and was least in 2006-2016 which was -0.172. The mean value of misalignment lies between 1.448 and 17.903. As Atasoy & Saxena (2006) found, REER of turkey was remarkably overvalued during the fixed exchange rate regime (up to 2000) except for a short period after the currency crisis from 1994 to 1997. Gerek & Karabacak (2017) and Kibritçioğlu & Kibritçioğlu (2004) also found that Turkey's REER was significantly overvalued prior to its shift to floating exchange rate management. The overvalued currency comes across depreciation when it moves to floating exchange rate regime following the crisis in 2001 and remains undervalued throughout the regime which supports the findings of Dagdeviren, Ogus Binatlı, & Sohrabji (2012).



22(a) Actual, Sustainable and Equilibrium REER 22(b) Misalignment of REER for Turkey

Figure 22 Equilibrium REER and Corresponding Misalignment for Turkey
Source: Actual REER is sourced from FRED, Equilibrium and Sustainable REERs are calculated by the author.

Table 61
Misalignment Episodes of Turkey

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1993	Overvaluation	28.650	5.316	17.903	8.242
1994-1997	Undervaluation	-3.350	-9.068	-5.665	2.509
1998-2000	Overvaluation	13.476	3.485	7.683	5.183
2001-2004	Undervaluation	-4.083	-11.139	-6.496	3.240
2005	Overvaluation	1.448	1.448	1.448	0.000
2006-2016	Undervaluation	-0.172	-15.749	-8.740	5.048

Source: Author's estimates

4.4.21. EREER and Corresponding Misalignment: The Case of ARE

As revealed in table 92 in the appendix, the ADF and PP unit root test results indicate that only ODA has a unit root at the level for both of the tests and thus omitted from the analysis. Apart from this, all other variables are non-stationary at the level. But the first difference of the variables makes them stationary across tests and specifications. Therefore, these stationary variables, that is, variables that are integrated of order one can be used for cointegration test to identify the long-run relationship between REER and macroeconomic fundamentals if there exists any. Among different combinations of fundamentals, the study finds that TOT, PROD, I and G explain the behavior of REER in the long-run and thus the following long-run theoretical model is supposed to be constructed:

$$\ln q_t = f(\ln TOT_t, \ln PROD_t, I_t, G_t) \qquad (4.34)$$

The cointegration test results summarized in table 62 suggest two cointegrating equation both for trace and maximum eigenvalue test statistics at 5 percent level of significance and therefore the presence of a long-run association between REER and its fundamentals are evident. The cointegration vector is presented in table 63. All the coefficients of the fundamentals maintain signs that are theoretically meaningful and statistically significant.

Table 62
Cointegration Test Results for ARE

H_0: r	Trace Statistic	p-value**	Max-Eigen Statistic	p-value**
r=0	163.805*	0.0000	69.166*	0.0000
r≤1	94.639*	0.0000	52.066*	0.0001
r≤2	42.573	0.0541	22.431	0.1318
r≤3	20.141	0.2189	13.629	0.2800
r≤4	6.5122	0.3982	6.512	0.3982

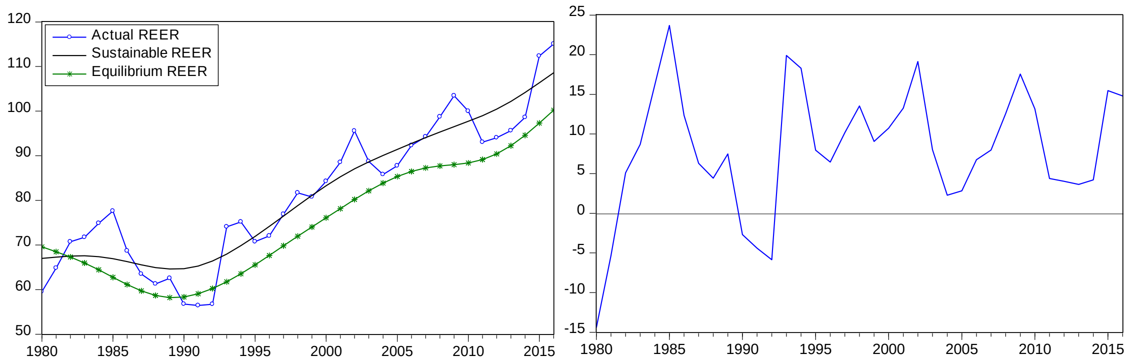
Notes: r stands for the number of cointegrating equation(s)
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-values

Table 63
Cointegration Equation for ARE

$lnq_t^* = -4.068 + 0.099\ln TOT_t$	$-1.063\ln PROD_t$	$+\ 0.036I_t$	$-\ 0.010G_t$	$+\ 0.079TREND$	
S_e	(0.051)	(0.064)	(0.003)	(0.004)	(0.004)
t	$[1.939]^{**}$	$[-16.658]^{*}$	$[10.840]^{*}$	$[-2.553]^{**}$	$[20.426]^{*}$

Notes: Speed of adjustment in REER (t-statistic): -0.594*(-5.556)
LM Autocorrelation Test: p-value=0.1412 (LM (1)), 0.5026 (LM(2))
White Heteroskedasticity: p-value= 0.0985
* Statistically significant at 1 percent level
** Statistically significant at 5 percent level
*** Statistically significant at 10 percent level

PROD tends to play the most important role in determining REER of ARE, a 1 percent rise in PROD appreciates REER by 1.06 percent which approves the Balassa-Samuelson effect to be valid for ARE. TOT is found to have a relatively light impact on REER in comparison with other economies in this study, 1 percent improvement in TOT depreciates REER by only 0.10 percent. I and G influence REER in opposite directions. REER is depreciated by 0.04 percent and appreciated by 0.01 percent due to a 1 percent rise in these two variables. It is suggestive to the fact that both domestic investment and government spending are susceptible to nontradable goods. The speed of adjustment infers that 59.4 percent of misalignment in REER disperses each year. The LM autocorrelation test accepts the null hypothesis of no autocorrelation at a 5 percent level of significance. The white heteroskedasticity test also accepts the homoscedastic residuals at a 5 percent significance level. Therefore, the selected model is correctly specified and structurally stable.



23(a) Actual, Sustainable and Equilibrium REER
23(b) Misalignment of REER for ARE

Figure 23 Equilibrium REER and Corresponding Misalignment for ARE
Source: Actual REER is sourced from BRUEGEL, Equilibrium and Sustainable REER are calculated by the author.

Table 64
Misalignment Episodes of ARE

Period	Misalignment	Maximum	Minimum	Mean	Std. Dev.
1980-1981	Undervaluation	-5.330	-14.423	-9.876	6.430
1982-1989	Overvaluation	23.685	4.420	10.529	6.613
1990-1992	Undervaluation	-2.689	-5.858	-4.317	1.586
1993-2016	Overvaluation	19.906	2.281	10.259	5.465

Source: Author's estimates

EREER, as the computed value of the cointegration equation in table 63 based on sustainable values of the fundamentals employing H-P filtering, is plotted in figure 23(a) together with the actual REER. Figure 23(b) shows the series of misalignment measured as the deviation of EREER from the actual values in percent. There are only two distinctive episodes both of overvaluation and undervaluation of REER were observed for ARE from table 64. REER of ARE was typically overvalued throughout the sample period except for two small spans of time: 1980-1981 and 1990-1992. Average misalignment ranges from -4.32 percent to 10.53 percent with the highest degree of misalignment in 1985 amounting to 23.69 percent against the minimum of 2.28 percent in 2004.

4.6. Summary

This chapter estimates the long run equilibrium REER and corresponding misalignment for each of the 21 emerging economies separately. Employing the Baffes et al.'s (1999) Single Equation approach, Johansen & Juselius' (1990) cointegration approach identifies one or more significant cointegrating relationship between REER and fundamentals that determine it. The key macroeconomic fundamentals that are found to cause equilibrium REER include terms of trade, government expenditure, productivity differentials, investment spending, trade openness, net foreign assets position and official development assistance. The estimated coefficients of the long-run cointegrating equation bear appropriate signs and also statistically significant. In other words, fundamentals bearing theoretically expected and statistically significant signs are considered to model the equilibrium REER. The estimated models pass all necessary robustness checks- they are structurally stable and correctly specified. The study suggests that the REER for each of the emerging economies were substantially misaligned throughout the sample period. Apart from graphically illustrating the REER misalignment for each of the selected EMEs in this chapter, the misalignment series for the economies are also given in appendix F. What is common for most of the emerging economies under investigation is that the REER was overvalued on the wake of national and regional financial crisis and shift in exchange rate regime from fixed to floating depreciates the REER of the concerned economy. These observations stand to mean that misalignment in REER belongs to the key indicators of an economy’s susceptibility to the financial crisis. As misalignment of REER is fairly evident in emerging economies, therefore, its impact on macroeconomic performance of these economies could be a matter of interest to researchers which will be dealt with in the next chapter. The convergence of REER towards the equilibrium value for each of the economies is guaranteed by the negative significant speed of adjustment coefficients- the quickest adjustment occurs for ARE (59.4 percent per period) which is least for Mexico (4.2 percent per period) while the average rate of adjustment is nearly 27 percent.

CHAPTER V

REER MISALIGNMENT AND MACROECONOMIC PERFORMANCE OF EMERGING ECONOMIES

5.1. Introduction

The main interest of the study is to examine the impact of REER misalignment on macroeconomic performance of selected emerging economies through 1980-2016. In this respect, the study aims to examine the impact of REER misalignment on economic growth and the key components contribute to growth, namely trade balance, domestic consumption and domestic investment. Figure 24 illustrates the average share of these components in GDP during the period 2000-2016. Domestic consumption of emerging economies contributes about 65 percent to their GDP. The size of the consumer in the emerging markets and their expenditure on final goods and services has increased during the first two decades of the 21st century. If it upholds the current trend, it will become the dominant factor in the total consumption of the world by 2025 (Kharas, 2010; Kharas & Gertz, 2010). The growing consumer base is undoubtedly a source of benefits for potential domestic investors. The average share of domestic investment and trade balance in GDP are 32% and 3% respectively. In the previous chapter, the study measures the misalignments of REER for 21 emerging economies adopting Single Equation approach. This chapter will first design and then estimate the empirical models

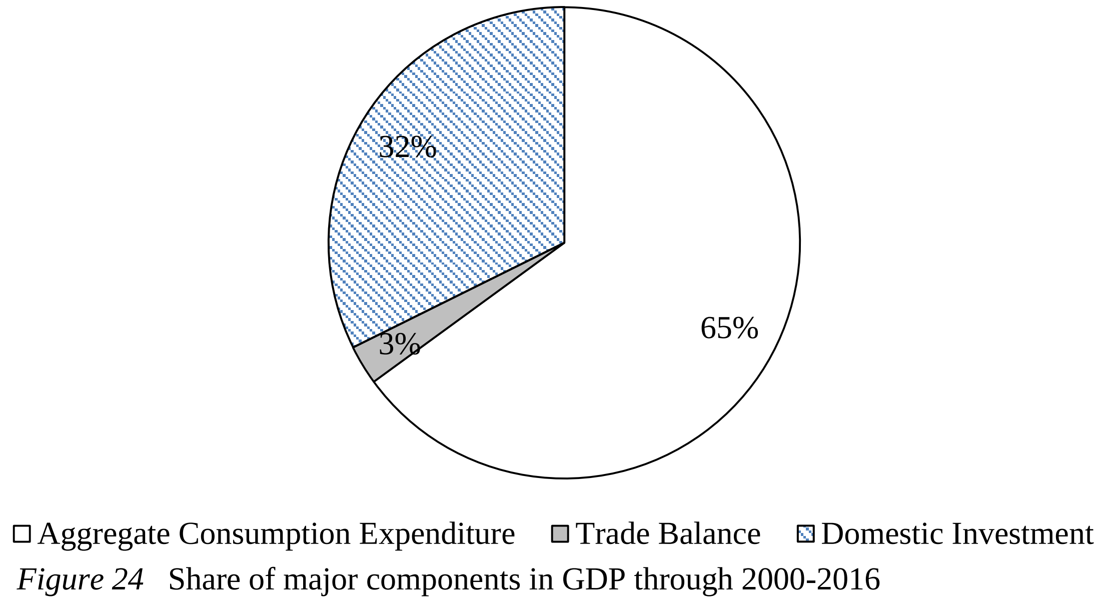


Figure 24 Share of major components in GDP through 2000-2016
Source: Compiled by Author based on UNCTAD Database, April 2019

based on theoretical counterparts for investigating how the aforesaid macroeconomic variables response towards the misalignment of REER.

5.2. Models and Methods

A critical issue in investigating the impact of misalignment on macroeconomic performance is the potential endogeneity. Endogeneity problem is encountered when some regressors are expected to be explained by unobserved common factor and must be checked to eliminate prospective bias in the estimated parameters. Consulting with available literature on this issue, the study decides to employ the dynamic panel GMM estimation approach (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998) to address the issue of endogeneity estimating the dynamic relationship between constituting components of total expenditure including growth and misalignment (Béreau et al., 2012; Habib et al., 2017; Mbaye, 2013; Nouira & Sekkat, 2012; Sallenave, 2010; Schröder, 2017; Schröder, 2013). The general form of the dynamic model is much like as follows-

$$y_{i,t} = \alpha + \beta y_{i,t-1} + \gamma X_{i,t} + \theta m_{i,t} + \varepsilon_{it} \quad (5.01)$$
$$\varepsilon_{it} = \mu_i + \lambda_t$$

where $y_{i,t}$ is the economic growth or components of real expenditure that determine the growth, performance of which will be evaluated in response to REER misalignment $m_{i,t}$, $y_{i,t-1}$ refers to the value of y at the initial period, $X_{i,t}$ is a set of control variables that explain $y_{i,t}$. The error term ε_{it} is composed of two different orthogonal elements: the country fixed effects, μ_i and the idiosyncratic time effects, λ_t. Dynamic panel model also provides superior results compared to the static models like random and fixed effect models as these static models are sensitive to the existence of correlation between lagged dependent variable and error term and therefore contain deep econometric bias (Roodman, 2006).

The standard GMM estimator proposed by Arellano & Bond (1991), also known as difference GMM, ponders first-difference transformation of all variables while explanatory variables are used at lagged levels as instrumental variables:

$$\Delta y_{i,t} = \alpha + \beta \Delta y_{i,t-1} + \gamma \Delta X_{i,t} + \theta \Delta m_{i,t} + \Delta \varepsilon_{it} \quad (5.02)$$

This eliminates the country fixed effect as it is time-invariant, but this instrumenting process works poorly in the presence of autocorrelation among errors due to which the resulting estimators could be imprecise or even biased. This swayed Arellano & Bover (1995) and Blundell & Bond (1998) to develop system GMM (SGMM) estimator. They extend the Arellano-Bond estimator based on the assumption of no correlation between instrumenting variables at first differences and fixed effects which allow them to introduce more instruments that boosts the efficiency of estimators sharply. Arellano & Bover (1995) propose to take forward orthogonal deviation transforming the regressors (instrumenting differenced regressors with levels) to obliterate fixed effects which improves control over the instrument matrix minimizing data losses and thereby results in better GMM estimator from that of the first difference model (Hayakawa, 2009). To have more precise estimator, Blundell & Bond (1998) resort the approach drawn by Arellano & Bover (1995) just by reverting the instrumentation, instrumenting regressors in levels with differences so that the instrumenting variables become uncorrelated (exogenous) to the fixed effects.[3] Bond, Hoeffler, & Temple (2001) argue that Blundell & Bond's (1998) identification technique is most suitable in order to produce more reasonable results. The study, therefore, decides to rely on Blundell & Bond's (1998) estimation approach to investigate the macroeconomic performance of the EMEs while REER misalignment is present.

The SGMM estimation approach is appropriate in situations where the number of time period (T) is small and the number of cross-section (N) is large, dependent variable is dynamic (its current realization is influenced by past ones), regressors are not strictly exogenous (correlated with past and possibly current realizations of the error), time-invariant individual fixed-effect, heteroskedasticity and autocorrelation within sections but not across sections (Roodman, 2006). Averaging data in 5 years non-intersecting interval over the sample period produces 8 observations (T) for each of the countries while the number of the cross section is 21 (N). This averaging is required to check non-seasonal components of time series variable similar to cyclical variation in order to embody the long run perspective of data. The study will perform Wooldridge test, Breusch-Pagan test and Wu-Hausman test on the data set to examine the presence of autocorrelation, heteroskedasticity and endogeneity, respectively. Furthermore, it will

[3] See Roodman (2006) for detail

conduct some suggested systematic checks following the practice of conventional econometrics that include- test for autocorrelation in error and test for the validity of instruments. The AR(1) and AR(2) test statistics examine the existence of first-order and second-order autocorrelation in error terms, respectively, and the test statistic of Hansen test and its p-value test the over-identifying restrictions that approve overall validity of instruments. Residuals should be uncorrelated in order to use the lag values of the regressors as instruments and therefore the Arellano–Bond autocorrelation test applied to the differenced residuals, particularly at second order, should accept the null hypothesis of no autocorrelation.[4] And to approve the overall validity of the instruments used, the p-value of the Hansen test statistic should be low enough to reject the null hypothesis of over-identifying restrictions.

5.3. Growth Regressions

As the interest is to examine how currency misalignment impacts economic growth, as the bulk of the literature on growth regression does, the growth variable needs to be regressed on a set of explanatory variables that also contains the misalignment series.

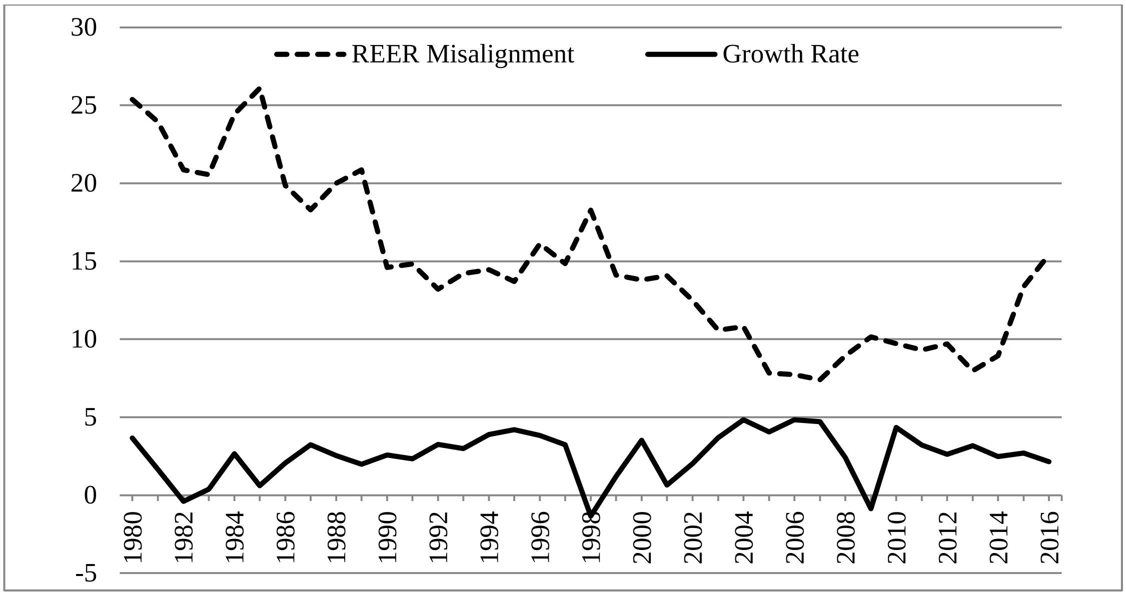


Figure 25 REER Misalignment-Economic Growth Relationship
Source: Misalignment series is computed by the author's (Chapter 4) and growth rate data are compiled from various sources (see appendix A and F)

[4] The test for AR (1) process in first differences usually rejects the null hypothesis (as the case of this study), but this is expected since $\Delta e_{it}=e_{it}-e_{i,t-1}$ and $\Delta e_{i,t-1}=e_{i,t-1}-e_{i,t-2}$ both have $e_{i,t-1}$

The primary examination of the growth-REER misalignment nexus as shown in figure 25 that averages the absolute REER misalignment and growth rate of the selected economies reveals a negative relationship between the two variables confirmed by negative correlation coefficient (-0.414). It supports the view that any distortion of REER from its equilibrium will hamper economic growth.

5.3.1. Empirical Models

The empirical specification of the growth equation derived from the Barro growth model (as employed by Razin and Collins (1997) and Couharde and Sallenave (2013) for instance) can be given as-

$$g_{i,t} = \alpha + \beta g_{i,t-1} + \gamma X_{i,t} + \theta m_{i,t} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5.03)$$

Here, $g_{i,t}$ is the real GDP per capita growth rate, $g_{i,t-1}$ is the per capita growth rate of real GDP at the initial period, $X_{i,t}$ is a set of variables explain economic growth, misalignment in REER is shown by $m_{i,t}$, μ_i is to represent country fixed effects, λ_t shows time specific effects and ε_{it} is an error term. The model is designed in a dynamic fashion confirmed by the inclusion of lagged dependent variable $g_{i,t-1}$, the per capita growth rate of real GDP at the initial period, as regressor in order to comply with Blundell & Bond's (1998) specification.

However, Schröder (2013) identifies some perceptible drawbacks of models stipulated in this manner. Most importantly, the model specified in this way ignores the corresponding growth effects of undervaluation and overvaluation. Therefore, in order to identify the respective impact of under and overvaluation of REER on growth, the study develops undervaluation and overvaluation indices and incorporates them together in the growth equation. The growth equation becomes-

$$g_{i,t} = \alpha + \beta g_{i,t-1} + \gamma X_{i,t} + \theta_1 UNDER_{i,t} + \theta_2 OVER_{i,t} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5.04)$$

where $UNDER$ and $OVER$ represent undervaluation and overvaluation, respectively. The undervaluation and overvaluation series are constructed decomposing the misalignment series of REER into its two counterparts- one incorporating the negative values or zero otherwise for the former and another incorporating the positive values or zero otherwise for the later series.

Selection of growth determinants is substantially influenced by the evolution of exogenous growth theories following the work of Barro and Lee (1994). The initial value of per capita real GDP growth rate, that is, $g_{i,t-1}$ is taken to account the initial position of the economy following the neoclassical growth theory to control for conditional convergence (Barro & Martin, 1995). Among the voluminous literature on cross-country growth regression, the study consults with the studies conducted by Domaç and Shabsigh (1999), Macdonald (2000), Rodrik (2009), MacDonald and Vieira (2010), Abida (2011), Béreau et al. (2012), Ihnatov and Căpraru (2012), Béreau et al. (2012), Schröder (2013), Habib et al., (2017) and Schröder (2017) and the factors found to have significant influence on economic growth are inflation rate, government spending as percent of GDP, human capital, institutional quality, investment as percent of GDP, terms of trade, trade openness and net foreign asset position. The study also considers the growth rate of effective labor units and the rate of depreciation by taking $\ln(n_{i,t}+g+\delta)$ into account where n is the growth rate of labor, g is the advancement in technology ($n_{i,t}+g$ defines the effective labor growth rate) and δ is the rate of depreciation. Among these factors; terms of trade, openness, net foreign assets position and government spending are equilibrium REER determining fundamentals and their inclusion in the growth regression will help remove the omitted variable bias (Schröder, 2013). Along with these determinants, the study comprises the undervaluation and overvaluation series into the model to examine their growth effects. The empirical model for growth regression can therefore be given as-

$$g_{i,t} = \alpha + \beta g_{i,t-1} + \gamma_1 INF_{it} + \gamma_2 GOV_{it} + \gamma_3 INV_{it} + \gamma_4 lnHC_{it} + \gamma_5 POLITY2_{it} + \gamma_6 ln(n_{i,t} + g + \delta) + \gamma_7 lnTOT_{it} + \gamma_8 OPEN_{it} + \gamma_9 NFA_{it} + \theta_1 UNDER_{i,t} + \theta_2 OVER_{i,t} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5.05)$$

where INF stands for the inflation rate, HC is the human capital, polity2 is a proxy of institutional quality, INV represents investment-GDP ratio, G is for government expenditure-GDP ratio, OPEN refers to openness, TOT stands for terms of trade, NFA is the net foreign assets position.

The study then considers the following regression comprising the currency misalignment ($m_{i,t}$) into the model to examine its growth effect-

$$g_{i,t} = \alpha + \beta g_{i,t-1} + \gamma_1 INF_{it} + \gamma_2 GOV_{it} + \gamma_3 INV_{it} + \gamma_4 lnHC_{it} + \gamma_5 POLITY2_{it} + \gamma_6 ln(n_{i,t} + g + \delta) + \gamma_7 lnTOT_{it} + \gamma_8 OPEN_{it} + \gamma_9 NFA_{it} + \theta m_{i,t} + \mu_i + \lambda_t + \varepsilon_{it} \quad (5.06)$$

The study necessarily deems the doubts cast on the inclusion of misalignment series of REER in growth regressions. Nouira & Sekkat (2012) raise the question on the acceptability of the results of studies on the growth effects of undervaluation as they mostly employ REER misalignment series that mightily subjugated by overvaluation episodes. Therefore, the positive association between growth and REER misalignment might be the revelation of substantial growth faltering effect of overvaluation offsetting the trivial impact of undervaluation (Mbaye, 2013). In the similar sense, studies dominated by undervaluation episodes might fail to identify the relationship between REER misalignment and growth in exact direction (see Béreau et al. (2012), Sallenave (2010), Aguirre & Calderon (2005) for instance). Schröder (2013) performs both episodic and non-episodic treatment to the REER misalignment indices to overcome such a problem. Episodic treatment on REER misalignment series is implemented taking the mean value of REER over or undervaluation during a five-year interval if the majority of the misalignment series of REER over the five year period are over or undervalued. The non-episodic treatment is performed taking mean value of absolute REER misalignment over five-year intervals throughout the sample period. The study identifies absolute REER misalignment performs better over its episodic measure in explaining growth effect of REER misalignments. This study, therefore, decides to use the absolute misalignment of REER to analyze its growth effect.

The coefficients of both undervaluation and overvaluation (θ_1, θ_2) have to be negative to support the view that undervaluation fosters economic growth while overvaluation hurts. To accept the view, sign on the REER misalignment coefficient (θ) needs to be negative. Inflation, government final consumption expenditure, the growth rate of effective labour units and the rate of depreciation ($ln(n_{i,t} + g + \delta)$) and net foreign asset are expected to deter economic growth and therefore should be associated with negative signed coefficients (that is, $\gamma_1, \gamma_2, \gamma_6, \gamma_9 < 0$). On the other hand, investment, human capital and institutional quality are expected to have favourable contribution to economic growth and therefore should be accompanied by positive signed coefficients (that is, $\gamma_3, \gamma_4, \gamma_5 > 0$). However, the impact of trade openness and terms of trade are left undetermined both in theory and empirical literature and hence their coefficients can take on both signs (that is, $\gamma_7, \gamma_8 \neq 0$).

5.3.2. Data Sources

The derivation of misalignment series of REER for 21 emerging economies in chapter four summarized in appendix F allows the study to perform the growth regression on a panel of these 21 emerging economies based on yearly data over the period 1980-2016. There is no unique source of data for the variables and hence the study relies on different sources. The growth rate of real GDP per capita data is collected from the World Development Indicator (WDI) of the World Bank (WB) for all countries except Poland for which data is collected from the UNCTAD. Inflation rate (CPI-based) and government expenditure are fiscal policy variables. Data on Inflation rate is compiled from WDI of WB for the majority of the countries. For Bangladesh, Brazil, China and ARE, inflation rate data are piled up from World Economic Outlook (WEO) of IMF. Government consumption, investment spending, terms of trade, openness and net foreign asset – all these are important fundamentals of equilibrium REER that are included in the growth regression to purge omitted variable bias. Data on these variables are compiled from WDI of WB, Penn World Table 9.0 (PWT 9.0), IFS of IMF and UNCTAD. NFA data is mainly drawn from Lane and Milesi-Ferretti (Lane & Milesi-Ferretti, 2007) that contains data for the period 1970-2014 in its updated version. The data is completed with WDI net foreign assets data of WB with necessary modification.

The study also considers human capital proxied by average years of total schooling and institutional quality proxied by polity2 variable, data for the variables are sourced from the Barro-Lee database on educational attainment and the Center for System Peace (CSP) database, respectively. Finally, in $\ln(n_{i,t}+g+\delta)$, that measures the growth rate of effective labour units and the rate of depreciation, population growth rate ($n_{i,t}$) is extracted from WDI, while the rate of advancement in technology (g) and the rate of depreciation (δ) is assumed to be fixed at 0.05 following Mankiw, Romer, & Weil (1992).[5] Table 71 in appendix describes the variables with their sources.

[5] Mankiw et al. (1992) argue that the rate of depreciation (δ) and the advancement in technology (g) is fixed at 0.03 and 0.02, respectively.

Human capital and terms of trade are measured in logarithm. Government consumption, investment spending, openness and net foreign asset are measured by their respective shares in GDP as a percent. The sample period is divided into non-intersecting 5-year interval over which the data of the variables are averaged. This averaging is required to check non-seasonal components of time series variable similar to cyclical variation in order to embody the long run perspective of data. Consequently, it produces 8 non-intersecting 5-year intervals over the sample period 1980-2016 apart from the last one that covers only two years. Outliers are identified for all of the series and excluded from the analysis so as to avoid any inconsistency.

Table 93 in appendix presents the summary statistics of the variables. The table breaks down the mean and standard deviation for overall variation into between and within variation. The between variation is much higher than within variation for growth rate, real income, government consumption, investment spending, openness, net foreign asset, polity and the growth rate of effective labor units and the rate of depreciation. The within variation is greater for the rate of inflation, undervaluation, overvaluation and misalignment series of REER. Both the between and within variations are nearly equal for terms of trade and human capital.

5.3.3. Results and Discussion

To begin with, the study estimates equation 5.05 designed to examine the impact of overvaluation and undervaluation on growth. Results are furnished in table 65. The study deals with a variant of specifications to examine the consistency of results. It gradually augments the baseline model in column 1 and 2 with human capital in column 3 and 4 and then with institutional quality in 5 and 6. The standard fixed effect estimators are reported in column 1, 3 and 5 and SGMM estimators are in column 2, 4 and 6 for alternative specifications together with the pre and post-diagnostic test results of the SGMM estimations. The Wooldridge test accepts the null hypothesis of ‘no autocorrelation’ at a 1 percent level of significance for all possible specifications and therefore the models are free from autocorrelation problem. However, the Breusch-Pagan test and Wu-Hausman test show that the regression specifications are subject to heteroskedasticity and endogeneity between GDP growth rate per capita and regressors at 1 percent significance level, which justifies the application of SGMM in examining the impact of over and undervaluation on growth.

With regard to the post-diagnostic checks, the significant AR(1) test statistic implies that residuals are correlated at first order, however, insignificant AR(2) test statistic confirms no autocorrelation among the residuals at second order which is desirable for the validity of the internal instrumentation structure SGMM uses. The study uses lagged per capita GDP growth rate as endogenous; human capital and polity2 as predetermined and the other regressors as extremely exogenous. The Hansen test statistic accepts the null hypothesis of over-identifying restrictions and hence approves the overall validity of instruments. In addition, with additional instruments (compared to the numbers of cross-sections), the augmented model in column 6 bears ‘over-fitting bias’ problem, which is efficiently addressed by other two SGMM models with sufficiently low numbers of instruments.

A negative and significant undervaluation coefficient confirms that undervaluation enhances growth.[6] The result obtained in this study is quite contrasting, as table 65 shows, the undervaluation coefficient is positive for all cases and significant for five specifications at 10 percent level of significance, meaning that undervaluation hurts growth in emerging economies. Moreover, the estimates differ slightly from baseline model to the augmented models across standard fixed effect to SGMM estimates. It implies that a 10 percent increase in undervaluation causes an annual average growth rate to fall nearly around 0.5 percent. Undervaluation, stimulating technological progress and knowledge spillovers, can promote economic growth. Again, the rise in income inequality due to the undervaluation reduces domestic consumption and thereby hurts economic growth. The income distributional effect of undervaluation is an empirical issue which is beyond the scope of this study. However, some of the recent studies suggest that undervaluation creates greater income inequality in emerging economies (Lima & Porcile, 2013; Ribeiro, McCombie & Lima, 2016) and finding of the study is alike to Ribeiro, Mccombie & Lima (2017) which suggests that undervaluation deters aggregate consumption expenditure of emerging economies.[7] With regard to overvaluation, the growth deteriorating impact of overvaluation is approved by the negative sign of the overvaluation coefficients, though, the coefficients are found to be significant only for SGMM specification. The growth rate is contracted

[6] When the undervaluation index is recoded as positive, a positive and significant undervaluation coefficient approves that undervaluation enhances growth.

[7] See consumption regression (in section 5.5) for detail

by 0.2 percent for the baseline model to 0.4 percent for the specification with human capital and institutional quality (polity2) due to a 10 percent increase in overvaluation. Thus, both undervaluation and overvaluation are injuries for the growth of emerging economies. The adverse impact of undervaluation that the study finds fairly opposite to those of Béreau et al. (2012), Berg & Miao (2010), Dubas (2012), Mbaye (2013), (Rodrik, 2008) and Vieira & MacDonald (2012), but similar to Schröder (2013). The growth contracting effect of overvaluation is approved by majority of the studies that include Béreau et al. (2012b), Berg & Miao (2010), Easterly (2005), Johnson, Ostry & Subramanian (2007), Mbaye (2013), Nouira & Sekkat (2012), Schröder (2013).

The fiscal policy variable inflation is found to bear expected negative sign for all cases but significant only for SGMM specifications of the baseline model and model that includes human capital and institutional quality. For the baseline model, a 10 percent increase in the rate of inflation hurts economic growth by 0.24 percent which is 0.66 percent for the augmented model. The estimates are consistent with those of (Habib et al., 2017; Mbaye, 2013). Another fiscal policy variable, government expenditure as a percent of GDP maintains a negative but insignificant coefficient for all variants of regression specifications which is in accordance with Schröder (2013) and Mbaye (2013) but opposite to Berg & Miao (2010).

Investment spending as a percent of GDP is got to bear expected positive coefficients that are insignificant for standard fixed effect estimation but significant for all cases of SGMM at a maximum of 5 percent significance level. Estimates also differ slightly from baseline to augmented model of the SGMM specifications showing around 1.06 to 1.32 percent increase in growth in response to a 10 percent increase in investment spending as a percent of GDP. These results are in line with the study of Mbaye (2013) Nouira & Sekkat (2012) Sallenave (2010) Schröder (2013).

The impact of terms of trade on economic growth is theoretically undetermined- it can either foster or tone down economic growth.[8] The terms of trade variable bear negative and insignificant coefficient for regression variants from 1 to 5. Such negative and statistically insignificant coefficient for terms of trade is also

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[8] Improvement in the terms of trade causes higher investment spending and thereby fosters long-run economic growth. Again, when TOT improves, it leads to an increase in demand for goods produced abroad than home which worsens economic growth developing unfavorable impact on trade balance. (Blattman, Hwang, & Williamson, 2003; Jebran, Iqbal, Rao, & Ali, 2018)

reported by Gala & Lucinda (2006) and Toulaboe (2011). The final variant of the regression also includes negative coefficient for terms of trade which is significant at a 10 percent level as obtained by Sallenave (2010) for one of the cases of regression specifications.

The coefficient of trade openness variable is negative for all estimates, significant for all five estimates at 1 to 5 percent significance level except for the most augmented SGMM estimate in column 6. Therefore, more outward orientation of emerging economies causes lower economic growth. For the standard fixed effect estimates, a 10 percent change in trade openness undermines growth by on average 0.32 percent, which is close to 0.12 percent for SGMM estimates. This result is in contrast to the findings obtained by Béreau et al. (2012b) and Sallenave (2010) but support Mbaye's (2013) estimate for developing countries.

Net foreign asset accumulation is empirically associated with the appreciation of REER (Bleaney & Tiany, 2014; Chia, Jinjarak, Rana, & Xie, 2014) and thereby it has an adverse impact on economic growth. Results of the study differ across estimates. The statistically significant standard FE estimates are in line with the empirical findings that NFA accumulation deters economic growth. However, the SGMM estimates, though significant, are turned out to be opposite. Due to a 10 percent increase in NFA position, the standard fixed effect models reveal nearly a 0.5 percent decrease in growth which is about 0.2 percent for the cases of SGMM specifications.

The polity2 variable used to proxy the institutional quality is included only in the most augmented case and its coefficient varies from standard fixed effect to SGMM estimates but insignificant for both of the situations. Human capital is expected to promote economic growth which is supported by Barro (1991) and Mbaye (2013) for developed and developing countries. But the study finds that human capital proxied by average years of total schooling has an adverse impact on economic growth as it obtains a negative coefficient of the variable for all available regressions which is significant only in one case of SGMM (in column 6) at 1 percent significance level. However, the result is not surprising as studies performed by Razin & Collins (1997), Sallenave (2010) and Toulaboe (2011) also drew similar conclusions. Again, estimates of the coefficient derived by Mbaye (2013) and Schröder (2013) very largely in terms of direction and significance across specifications which make it difficult to reach an agreement.

Table 65
Growth Regression: With Under & Overvaluation

Regressors	Dependent Variable- Real GDP per capita growth rate					
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)	FE (5)	SGMM (6)
Growth(-1)	-0.097	-0.033	-0.091	0.013	-0.089	0.211***
	(0.95)	(0.48)	(0.88)	(0.18)	(0.85)	(1.82)
Inflation	-0.033	-0.024**	-0.035	-0.018	-0.035	-0.066*
	(1.46)	(2.09)	(1.50)	(1.5)	(1.50)	(2.89)
Government Expenditure	-0.056	-0.121	-0.058	-0.154	-0.060	0.265
	(0.60)	(1.15)	(0.62)	(1.43)	(0.63)	(1.39)
Human Capital			-0.530	-1.541	-0.488	-4.044*
			(0.37)	(1.59)	(0.34)	(2.88)
Polity2					-0.010	0.115
					(0.16)	(1.24)
ln(n+g+d)	-2.632*	-1.178**	-2.689*	-2.191**	-2.680*	-1.178***
	(3.44)	(2.81)	(3.43)	(2.72)	(3.39)	(2.01)
Investment	0.058	0.132*	0.056	0.106*	0.056	0.106**
	(1.35)	(4.94)	(1.30)	(3.04)	(1.28)	(2.25)
Terms of Trade	-0.233	0.140	-0.195	-0.163	-0.183	-6.196***
	(0.24)	(0.25)	(0.20)	(0.25)	(0.19)	(1.98)
Openness	-0.033**	-0.013*	-0.031**	-0.011**	-0.031**	-0.001
	(2.45)	(3.43)	(2.17)	(2.69)	(2.14)	(0.14)
Net Foreign Assets	-0.050**	0.013**	-0.048**	0.028*	-0.048**	0.029**
	(2.53)	(2.15)	(2.29)	(2.89)	(2.28)	(2.61)
Undervaluation	0.057***	0.053***	0.058***	0.035	0.057***	0.048***
	(1.72)	(1.81)	(1.72)	(1.08)	(1.71)	(1.93)
Overvaluation	-0.021	-0.019**	-0.022	-0.017***	-0.023	-0.036**
	(1.00)	(2.3)	(1.06)	(1.97)	(1.06)	(2.30)
Hausman Test (p-value)	62.270 (0.000)*		59.730 (0.000)*		58.250 (0.000)*	
Observations	136	136	136	136	136	136
Cross Section	21	21	21	21	21	21
Adj R-Square	0.547		0.543		0.539	
AR(1) p-value		0.098		0.084		0.047
AR(2) p-value		0.835		0.903		0.13
Hansen Test (p-value)		9.85 (0.363)		8.81 (0.359)		8.14 (0.615)
Instrument		20		20		23
Wooldridge Test (p-value)		1.125 (0.3014)		1.163 (0.294)		1.359 (0.2575)
Breusch-Pagan Test (p-value)		108.57 (0.000)*		104.98 (0.000)*		104.20 (0.000)*
Wu-Hausman Test (p-value)		16.00 (0.0001)*		14.99 (0.0002)*		15.03 (0.0002)*

* Significant at 1% level of significance ** Significant at 5% level of significance *** Significant at 10% level of significance

Note: Figures below the coefficients in parentheses are t-ratios

The negative association between per capita GDP growth rate and the growth rate of effective labor units and the rate of depreciation together ($ln(n_{i,t} + g + \delta)$) suggested by Solow (1956) and Mankiw et al. (1992) is approved by this study as it has a negative coefficient for $ln(n_{i,t} + g + \delta)$ significant at 1 percent level for 3 cases, at a 5 percent level for 2 cases and at 10 percent level for the rightmost augmented SGMM specification.[9]

The study estimates equation 5.06 formulated to examine the impact of REER misalignment on economic growth and the results presented in table 66 will be explained hereafter. As before, the study takes alternative specifications to look at the consistency of findings. Again, the baseline model (in column 1 and 2) is gradually extended by introducing human capital (in column 3 and 4) and institutional quality (in column 5 and 6). Column 1, 3 and 5 report the standard fixed effect estimators while column 2, 4 and 6 presents SGMM estimators for alternative specifications. Pre and post-diagnostic checks for SGMM estimations are given at the bottom of the table. The Wooldridge test fails to reject the null hypothesis of 'no autocorrelation' at a significance level of 1 percent all variants of the estimates and therefore there is no autocorrelation problem in the models. The Breusch-Pagan test and Wu-Hausman test imply that the regression specifications suffer from heteroskedasticity and endogeneity between GDP growth rate per capita and regressors at 1 percent significance level. Therefore, the use of SGMM is appropriate to examine the impact of REER misalignment on growth. It is worth mentioning that the non-episodic absolute REER misalignment is used for the study because of its superior performance over episodic measures of REER misalignment in explaining its growth effects.

The conventional post-diagnostic econometric checks find AR(1) test statistic significant at 10 percent significance level, while AR(2) is insignificant- meaning that the residuals are correlated at first order but not at second order which is necessary for the cogency of internal instrumentation of SGMM estimation technique. The insignificant Hansen test statistic points to the overall validity of instruments by

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[9] Solow (1956) argues that the higher the growth of population, the lower the income as it reduces per capita capital. Mankiw et al. (1992) quantitatively measures it using an augmented model and prove that the combined effect of growth rate of effective labour units and the rate of depreciation ($n + g + \delta$) on income is much higher- with a one third capital share, a 1 percent increase in $n + g + \delta$ causes a 0.5 percent fall in per capita income for the Solow's taxtbook model which is 2 percent for the augmented model.

accepting the null hypothesis of over-identifying restrictions. Finally, the numbers of instruments in all of the SGMM cases are low enough to handle the ‘over-fitting bias’ problem.

A negative misalignment coefficient infers that distortion in REER from its equilibrium value erodes growth. The misalignment coefficients enter into the regressions are unanimously negative and statically significant irrespective to specifications and estimates and therefore misalignment in REER undermines growth of emerging economies and hence it confirms the findings obtained by Schröder (2013), Schröder (2017), Nouira & Sekkat (2012), Toulaboe (2011), Couharde & Sallenave (2013) and Béreau et al. (2012b) but in contrast with Dubas (2012). The REER misalignment coefficient varies marginally across the specification which can be interpreted as a 10 percent increase in REER misalignment impedes economic growth by 0.25 to 0.30 percent on average. Therefore, one can conclude that any kind of distortions in REER exerts an adverse impact on economic growth which is further warranted by the growth deteriorating effects of undervaluation and overvaluation obtained in table 65.

Government policy variable inflation bears expected coefficient in all cases which is negative, but the coefficient is significant for baseline standard fixed effect estimate and extended SGMM cases. Specifications for which the coefficient is significant implies that a 10 percent increase in the rate of inflation hinders economic growth by 0.23 to 0.36 percent. This result is identical to the studies offered by Béreau et al., (2012b), Couharde & Sallenave (2013), Habib et al., (2017), Mbaye (2013), Rodrik (2008), Toulaboe (2011) and Vieira & MacDonald (2012). Another fiscal policy variable government expenditure also poses theoretically anticipated negative coefficient irrespective to the cases and significant for all standard fixed effect estimates and baseline SGMM estimate. It predicts that growth is dismayed by 0.15 percent on average due to a 10 percent increase in government expenditure. A comprehensive government policy is necessary for economic growth. However, the negative and significant coefficient for government expenditure variable, also reported by Schröder (2017) and Toulaboe (2011), justifies the growing agreement among policymakers that the private sector can serve better for economic growth and increased government expenditure particularly borrowing from the domestic financial institutions squeezes opportunity for the private entrepreneurs and thereby hamper economic growth of emerging economies.

Table 66
Growth Regression with Misalignment

Regressors	Dependent Variable- Real GDP per capita growth rate					
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)	FE (5)	SGMM (6)
Growth(-1)	-3.852*	0.305*	-4.221*	0.358*	-4.218*	0.384*
	(6.73)	(3.42)	(6.95)	(3.70)	(6.91)	(3.85)
Inflation	-0.036***	-0.016	-0.030	-0.024**	-0.030	-0.023**
	(1.93)	(1.39)	(1.60)	(2.42)	(1.60)	(2.32)
Government Expenditure	-0.134***	-0.175**	-0.134***	-0.124	-0.135***	-0.101
	(1.68)	(2.78)	(1.70)	(1.62)	(1.69)	(1.34)
Human Capital			2.105***	-2.589*	2.132***	-2.849*
			(1.70)	(3.46)	(1.68)	(4.38)
Polity2					-0.006	0.012
					(0.11)	(0.30)
ln(n+g+d)	-2.734*	-1.735*	-2.523*	-1.798*	-2.517*	-1.764*
	(4.26)	(7.47)	(3.90)	(3.97)	(3.86)	(3.50)
Investment	0.105*	0.072*	0.113*	0.057***	0.112*	0.053
	(3.08)	(2.83)	(3.30)	(1.81)	(3.27)	(1.41)
Terms of Trade	0.589	-0.129	0.505	-0.455	0.512	-0.472
	(0.73)	(0.33)	(0.63)	(0.84)	(0.64)	(0.79)
Openness	0.002	-0.015*	-0.002	-0.003	-0.002	-0.001
	(0.17)	(5.96)	(0.17)	(0.55)	(0.16)	(0.12)
Net Foreign Assets	-0.010	0.019**	-0.016	0.023**	-0.016	0.027**
	(0.58)	(2.10)	(0.89)	(2.57)	(0.88)	(2.80)
REER misalignment	-0.030**	-0.017**	-0.025***	-0.029*	-0.025***	-0.030*
	(1.99)	(2.27)	(1.67)	(3.30)	(1.66)	(3.29)
Hausman Test (p-value)	48.887(0.000)*		56.021(0.000)*		52.271(0.000)*	
Observations	137	137	137	137	137	137
Cross Section	21	21	21	21	21	21
Adj R-Square	0.676		0.682		0.679	
AR(1) p-value		0.099		0.085		0.077
AR(2) p-value		0.655		0.722		0.735
Hansen Test (p-value)		12.2 (0.272)		10.35 (0.323)		11.75 (0.228)
Instrument		20		20		21
Wooldridge test (p-value)		1.159 (0.2945)		1.229 (0.2808)		1.336 (0.2614)
Breusch-Pagan test (p-value)		109.18 (0.0000)*		105.84 (0.0000)*		105.16 (0.0000)*
Wu-Hausman test (p-value)		15.83 (0.0001)*		14.97 (0.0002)*		15.03 (0.0002)*

* Significant at 1% level of significance ** Significant at 5% level of significance *** Significant at 10% level of significance

Note: Figures below the coefficients in parentheses are t-ratios

On the same ground, investment variable is expected to support economic growth which is empirically validated by a number of studies that include Béreau et al. (2012b), Couharde & Sallenave (2013), Mbaye (2013), Nouira & Sekkat (2012), Sallenave (2010) and Toulaboe (2011). As for this study, the investment coefficient is also positive for all regression specifications and significant for five of them. A 10 percent increase in investment spending is expected to stimulate growth by maximum of 11.3 percent as confirmed by the standard fixed effect estimate that ignores institutional quality (in column 3).

The sign of the coefficient of terms of trade variable varies across estimation methods and hence its impact on economic growth is inconclusive. However, none of the coefficients are significant which is exactly what Toulaboe (2011) obtains in his study. The negative coefficient of trade openness variable except for the baseline standard fixed effect estimate indicates that the outward orientation of emerging economies hampers their growth. The study finds only the baseline SGMM estimate of trade openness variable is significant at 1 percent level of significance which indicates that growth is faltered by 1.5 percent due to a 10 percent increase in trade openness. Some variants of Mbaye's (2013) estimate also find similar results.

Estimated results on the impact of the net foreign asset on growth approve the findings obtained for model 5.05. Results of standard FE estimates are right the opposite to the SGMM estimates in terms of directions. While the earlier sanctions the view that increase in net foreign asset position deters economic growth by appreciating domestic currency, the later draws the opposite conclusion. The coefficients associated with net foreign asset variable presented in table 66 are negative but insignificant for standard fixed effect estimators, while the SGMM estimators are positive and significant at 5 percent significance level. Based on the significant coefficient, one, therefore, commends that net foreign asset has a favorable impact on economic growth.As like the previous model, the coefficient of the polity2 variable used to represent institutional quality differs from standard fixed effect to SGMM estimates but insignificant for both of the cases. Theoretically, human capital is expected to bear a positive significant sign to be statistically meaningful (Barro, 1991). The variable enters into the augmented models with positive significant coefficients for standard fixed effect estimates is consistent with this theoretical argument. Nevertheless, the negative significant entries of the coefficients for the variable in the augmented SGMM regression specifications also have empirical support (Razin & Collins, 1997; Sallenave, 2010; and Toulaboe, 2011). As for the effect of the growth rate of effective labor units and the rate of depreciation ($ln(n_{i,t} + g + \delta)$) on economic growth, results obtained by this study conforms Solow (1956) and Mankiw et al. (1992) suggestion. Negative and significant coefficients of $ln(n_{i,t} + g + \delta)$ for all variants of regression specification confirm its anti-growth effect for emerging economies.

5.4. Trade Regression

The rising trend in trade is one of the key factors behind the resilient growth of emerging economies. The trade surplus of Emerging economies soars to a record level in recent years and it is gradually displacing the trade of developed economies. As figure 26 illustrates, the trade surplus of Emerging economies reaches to 46% in the 2010s from that of 39% in the 2000s. Over the same period, change in trade surplus in developing economies is nominal and trade surplus of transition economies rises from 6% to 8%. What determines such spark in trade surplus of Emerging Economies? Does REER misalignment have any impact on trade balance? This section will critically investigate these issues.

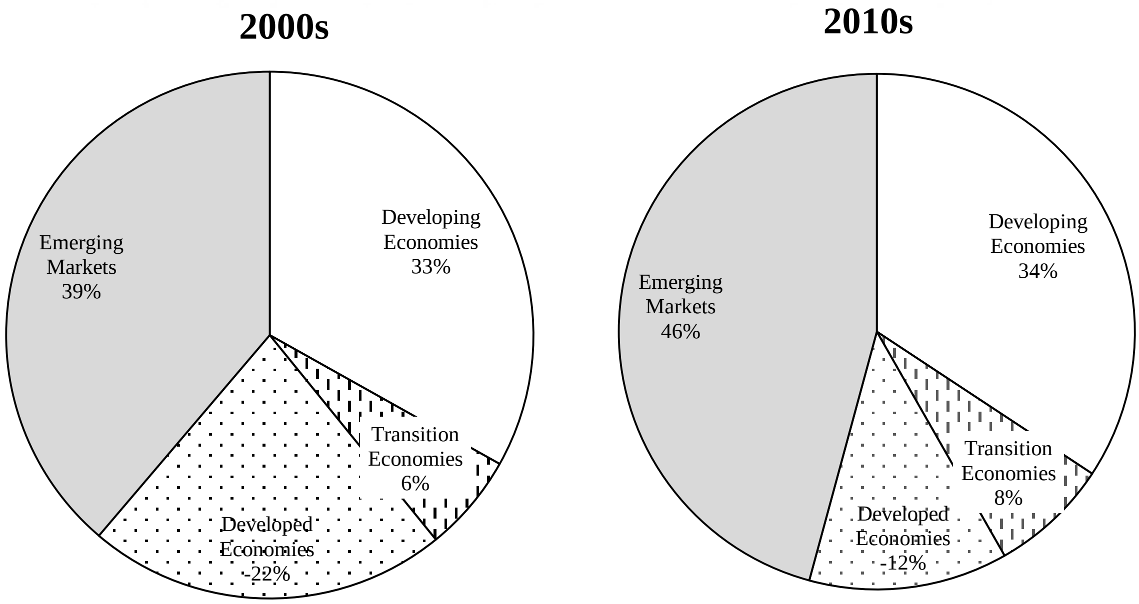

Figure 26 Development of Trade Balance during the 2000s and 2010s
Source: Compiled by author from UNCTAD Database, April 2019

Studies on the effect of exchange rate volatility on trade balance are substantially rich. Arize, Osang, & Slottje (2000), Asteriou, Masatci, & Keith (2016), Bahmani-Oskooee, Harvey, & Hegerty (2012), Byrne, Darby, & MacDonald (2008) and Himarios (1989) are just the names but a few of the recent studies that have offered empirical evidence on the impact of exchange rate volatility on trade balance of developed and developing economies. But there is limited research on the relationship between misalignment of REER and trade balance, particularly for emerging economies. In this section, the study will examine the impact of misalignment of REER on the trade balance.

5.4.1. Empirical Models

The exogenous variables in the trade model that explains the impact of exchange rate vary across the studies. Rose and Yellen (1989) in their influential work just include the exchange rate as an explanatory variable while Rose (1990) considers three factors- exchange rate and real GDP at home and abroad (GDP of OECD countries). Byrne et al. (2008) examine the impact of relative price, sectoral value added in industry, along with the volatility and misalignment in the real exchange rate. Hsiao, Pan and Wu (2012) comprise relative income growth of trading partner, bilateral exchange rate and exchange rate volatility as explanatory variables in their trade model. A common feature of the studies is that they all examine the relationship between exchange rate and trade balance from the bilateral point of view. The reason is to avoid the aggregation bias problem named by Bahmani Oskooee and Brooks (1999). It is a measurement problem earlier introduced by Rose and Yellen (1989) that appears due to the consideration of income of the rest of the world as income abroad which requires constructing proxies for both incomes of the rest of the world and a country's real exchange rate against the rest of the world. Accordingly, Bahmani-Oskooee, in a series of studies with his co-authors (see e. g., Bahmani-Oskooee and Brooks, 1999; Bahmani-Oskooee and Kantipong, 2001; Bahmani-Oskooee and Harvey, 2017) show trade balance as the function of real domestic GDP, an index of real GDP of trading partners and the real bilateral exchange rate.

As the study is interested in examining the relationship between exchange rate misalignment and international trade of emerging economies relying on panel data, based on available empirical works (see e. g., Arize, Malindretos, & Igwe, 2017; Bahmani-Oskooee & Kantipong, 2001; Himarios, 1989), it assumes the following equilibrium relationship prevails in the long-run between trade balance and REER misalignment:

$$TB_{ij,t} = f(Y_{i,t}, Y_{j,t}^{*}, REER_{i,t}, m_{it}) \tag{5.07}$$

Where, $TB_{ij,t}$ measures trade balance as the ratio between 'home country i's export to the rest of the world j' to 'home country i's import from the rest of the world j', Y_t and its asterisk are the income of home country i and rest of the world j, respectively, measured in terms of an index of respective real GDP, $REER_{i,t}$ is real effective exchange rate and $m_{i,t}$ is the misalignment of REER for home country.

Initially, the study takes account of undervaluation and overvaluation series constructed in section 5.3 (growth regression) and incorporates them in a separate trade equation to examine their corresponding impact on the trade balance. The trade equation with undervaluation ($under$) and overvaluation ($over$) series takes the following form-

$$lnTB_{ij,t} = \alpha_0 + \alpha_1 lnTB_{ij,t-1} + \alpha_2 Y_{i,t} + \alpha_3 Y_{j,t}^{*} + \alpha_4 lnREER_{i,t} + \theta_1 UNDER_{i,t} + \theta_2 OVER_{i,t} + \mu_i + \lambda_t + \upsilon_{i,t} \tag{5.08}$$

The model is designed in a dynamic fashion confirmed by the inclusion of lagged dependent variable TR_{it-1}, the trade balance at the initial period, as regressor so as to employ the dynamic panel GMM estimation approach offered by Arellano & Bond (1991) and Blundell & Bond (1998). [10] The study than comprises the non-episodic absolute REER misalignment[11] series in the regression equation to examine its impact on trade balance-

$$lnTB_{ij,t} = \alpha_0 + \alpha_1 lnTB_{ij,t-1} + \alpha_2 Y_{i,t} + \alpha_3 Y_{j,t}^{*} + \alpha_4 lnREER_{i,t} + \alpha_5 m_{i,t} + \mu_i + \lambda_t + \varepsilon_{i,t} \tag{5.09}$$

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[10] The study devices Blundell & Bond's (1998) estimator as Bond, Hoeffler, & Temple (2001) argue that its identification technique is most suitable in order to produce more reasonable results

[11] Please see section 5.3 (growth regression) for a detail explanation on non-episodic measure of REER misalignment

The effect of change in domestic real income is uncertain: an increase in domestic real income may cause deficit by reducing trade balance stimulating imports or it may lead to trade surplus if the rise in domestic real income results from an increase in production of goods that substitute imports due to which imports fall and trade balance rises. Therefore, the coefficient attached to domestic real income can both be positive and negative ($\alpha_2 \neq 0$). Traditionally, ithe ncrease in domestic real income is expected to reduce trade balance and therefore α_2 is likely to be negative. Increase in real income of the rest of the world may improve the trade balance of home country boosting demand for its exports (demand-side effect) or it may deter trade balance of home country deterring demand for exports particularly when the increase in income of the rest of the world is owing to the production of goods that substitutes home country's exports (supply-side effect). The ultimate sign of coefficient accompanying income of the rest of the world can either be positive or negative depending on the relative power of demand side and supply side factors, that is, $\alpha_3 \neq 0$.

Two possible effects of a real depreciation reflected by a rise in REER are price effect and volume effect. Due to a real depreciation, price effect worsens trade balance making exports cheaper, while volume effect improves trade balance increasing export volume. If the volume effect is strong enough to outweigh the price effect, a real depreciation will improve trade balance and α_4 will be positive. Otherwise, it will be negative. Finally, higher undervaluation refers to higher competitiveness and higher trade balance, being undervaluation negative, the resulting undervaluation coefficient should be negative as well. Conversely, higher overvaluation makes export less competitive and worsens trade balance, associated coefficient should be negative. Hence, both undervaluation and overvaluation coefficients should be negative, that is, $\theta_1, \theta_2 < 0$. Any distortions of REERs from their equilibrium values are expected to degrade trade balance and hence the coefficient of REER misalignment is anticipated to be negative, that is, $\alpha_5 < 0$.

5.4.2. Data Sources

The REER misalignment series derived in chapter four (please see appendix F) equipped us to investigate the impact of REER misalignment on trade balance of a panel of 21 emerging economies through 1980-2016. The annual frequency data on real domestic income, the income of the rest of the world, export and import are taken from the UNCTAD. Due to the absence of a unique source for comprehensive data on REER, data on the variable is compiled from various sources that include BRUEGEL[12], FRED and IFS of IMF. But the study was cautious in maintaining a common price index, namely CPI, while collecting REER data.[13] The trade balance and REER variables are transformed into natural logarithm. Detail description of the variables is presented in table 71 in the appendix. As like other regressions, the non-seasonal components of time series are skimmed averaging the variables over 5-year non-intersecting interval over the sample period that produces a total of 8 observations for each of the variables for a given country.[14] Summary statistics on the variables as shown in table 94 in appendix breaks down the overall variation into between and within variation. Between variations fall short of within variations for all variables except trade balance.

5.4.3. Results and Discussion

Table 67 reports the impact of undervaluation separated from overvaluation along with the impact of REER misalignment. The table summarizes both standard fixed effect estimators and SGMM estimators. Results of the pre and post diagnostic tests are presented below the table. Standard fixed effect estimators are found to be appropriate as the Hausman test rejects the random effect model. As far as the GMM specifications are concerned, the study initially performs the Wooldridge, Breusch-Pagan and Wu-Hausman tests in order to identify if there prevails autocorrelation, homoscedasticity and endogeneity, respectively. Statistically significant test statistic at 1 percent level of significance for all these tests indicates that there prevails autocorrelation, heteroskedasticity and endogeneity between trade balance and

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[12] The dataset is constructed following the methodology offered by Darvas (2012) which is undated on a regular basis

[13] Use of the type of price index is an important concern in constructing the REER, see chapter two for a detail

[14] The sample period is divided into non-intersecting 5 year interval over which the data of the variables are averaged. This averaging is required to check non-seasonal components of time series variable similar to cyclical variation in order to embody the long run perspective of data. Consequently, it produces 8 non-intersecting 5 year intervals over the sample period 1980-2016 apart from the last one that covers only two years.

regressors. Therefore, the chosen SGMM approach is suitable for studying the dynamic relationship between trade balance and regressors. As for post-diagnostic checks, significant AR(1) test statistic confirms autocorrelation among residuals at first order, however, autocorrelation among residuals at second order is absent as the AR(2) test statistic for all the cases are insignificant. Such an insignificant AR(2) test statistic validates the internal instrumentation structure used by SGMM. The study considers lagged trade balance as endogenous and the other regressors as extremely exogenous. The Hansen test statistics accept the null hypothesis of over-identifying restrictions for all SGMM specifications at a 5 percent significance level and therefore instruments used for the SGMM estimations are overall valid. The number of instruments lies below the number of cross sections which means the estimated SGMM models are not subject to ‘over-fitting bias’.

With regard to the estimated coefficients, most of them bear theoretically expected signs. The significant positive lagged trade balance coefficients for all specifications imply that trade balance of current period is stirred by the increase in trade balance at the initial period. Coefficients accompanying the home real income are negative for all specification but insignificant for standard FE estimates and significant for SGMM estimates that vary marginally. A 10 percent increase in home real income causes trade balance to fall by 1.3 percent stimulating imports. Except for model 1 (in column 1), the standard FE estimators asserts an insignificant positive coefficient of real income of rest of the world, however, the coefficients are significant and positive for all SGMM estimates which indicates that trade balance is increased by 1.3 percent according to the baseline model (in column 2) in response to a 10 percent increase in real income of the rest of the world.

REER bears negative significant coefficients for all cases which denote that a real depreciation brings about a fall in the trade balance. A 10 percent depreciation represented by an equivalent increase in REER increases imports of emerging markets from the rest of the world compared with their exports to the rest of the world by nearly 3% for the baseline model while the figure is 1.8 percent for the augmented model (in column 6). It implies that the price effect dominates over the volume effect of depreciation in emerging economies.

Table 67
Trade Balance Regression

Regressors	Dependent Variable: Trade Balance					
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)	FE (5)	SGMM (6)
Lagged Trade Balance	0.414*	0.689*	0.441*	0.582*	0.440*	0.651*
	(5.313)	(19.380)	(6.044)	(9.970)	(6.100)	(17.010)
Home Real Income	-0.019	-0.139*	-0.069	-0.131*	-0.081	-0.136*
	(0.251)	(5.530)	(0.974)	(4.350)	(1.155)	(5.490)
Real Income of Rest of the World	-0.077	0.136**	0.017	0.210*	0.048	0.171*
	(0.636)	(2.270)	(0.142)	(2.950)	(0.413)	(3.200)
REER	-0.214*	-0.295*	-0.134**	-0.265*	-0.126***	-0.180**
	(2.744)	(3.690)	(1.775)	(4.500)	(1.683)	(2.220)
Undervaluation			-0.009*	-0.010*	-0.015*	-0.017*
			(3.994)	(5.400)	(3.705)	(4.800)
Overvaluation			-0.002	-0.001***	0.005	0.005
			(1.338)	(2.020)	(1.338)	(1.610)
REER misalignment	-0.002	-0.001***			-0.007**	-0.007***
	(1.274)	(1.710)			(2.039)	(1.960)
Hausman Test (p-value)	26.57 (0.0001)*		41.3 (0.0000)*		54.25 (0.0000)*	
Observations	143	143	143	143	143	143
Cross Section	21	21	21	21	21	21
Adj R-Square	0.780		0.815		0.815	
AR(1) p-value		0.005		0.006		0.009
AR(2) p-value		0.216		0.499		0.466
Hansen Test (p-value)		15.29 (0.054)		11.89 (0.219)		15.02 (0.090)
Instrument		14		16		17
Wooldridge Test (p-value)		31.517 (0.000)*		41.314 (0.0000)*		33.274 (0.0000)*
Breusch-Pagan Test (p-value)		121.09 (0.0000)*		116.31 (0.0000)*		115.63 (0.0000)*
Wu-Hausman Test (p-value)		434.93 (0.000)*		358.43 (0.0000)*		356.33 (0.0000)*

* Significant at 1% level of significance
** Significant at 5% level of significance
*** Significant at 10% level of significance
Note: Figures below the coefficients in parentheses are t-ratios

The undervaluation coefficients are highly significant and negative for all specifications. The SGMM estimates indicate that the trade balance increases by 0.1 percent to 0.17 percent due to a 10 percent increase in undervaluation. The only case for which the overvaluation coefficient is significant maintains theoretically expected sign which is negative indicating that a 10 percent increase in overvaluation deters trade balance by 0.01 percent. Finally, the REER misalignment coefficients are negative for all specifications and insignificant only for baseline standard FE model. The negative significant coefficient for all three other variants of analysis signifies the adverse impact of REER misalignment on trade balance, a distortion of REER from its equilibrium value by 10 percent causes trade balance to fall by 0.01 percent as evident from the baseline model which is 0.07 percent for the extended model (in column 6).

5.5. Consumption Regression

Domestic consumption of emerging economies contributes over 65 percent to their GDP.[15] The vigorous growth in consumption expenditure on final goods and services is mainly driven by population and income growth. As evident from figure 27, emerging and developing economies are gradually concealing the developed economies' consumption. Such a compelling growth in consumption expenditure is pointing to the dominance of Emerging economies in global consumption by 2025.

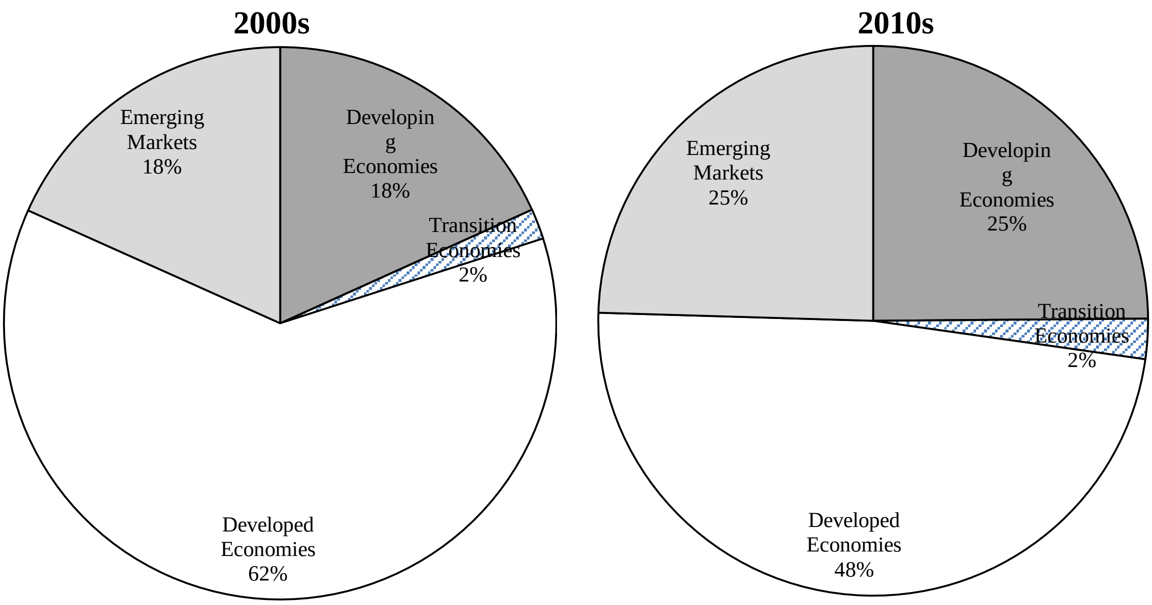

Figure 27 Development of consumption expenditure during the 2000s and 2010s
Source: Compiled by author from UNCTAD Database, April 2019

[15] Author's estimate based on UNCTAD (United Nations Conference on Trade and Development) data retrieved from https://unctadstat.unctad.org on 12 February, 2019.

Exchange rate movements may exert inflationary pressure to their domestic economy through import and export channels. To be exact, depreciation of domestic currency will impose an additional burden by increasing production costs of goods produced by many of the economies as they largely depend on imported materials. Moreover, their reliance on exports to different foreign destinations for sustainable medium and long-term growth will also increase their prices in the domestic market. The literature review on the relationship between exchange rate misalignment and aggregate consumption plainly illustrates how currency misalignments affect domestic consumption through its impact on inflation.

There is solidarity among the studies modelling aggregate consumption behavior as they commonly include a measure of income and a measure of the cost of borrowing upholding the view of Keynesians and Classicalists, respectively (Bahmani-Oskooee & Xi, 2012). As a measure of income, majority of the studies interchangeably consider disposable income or real GDP, while it is interest rate for cost of borrowing (see e. g., Bahmani-Oskooee and Xi, 2011, 2012; Bahmani-Oskooee and Hajilee, 2012; Verter and Osakwe, 2014; Bahmani-Oskooee, Kutan and Xi, 2015; Ezeji and Ajudua, 2015). Villagómez (1994), Jin (1995), Verter and Osakwe (2014), Varlamova and Larionova (2015) and Oseni (2016) take inflation into account as a major determinant of consumption expenditure as it has control over purchasing capacity of households and governments. Empirical studies suggest that public consumption has a crowding-out effect on private consumption (Aristei & Pieroni, 2008; Varlamova & Larionova, 2015). However, such decomposition is not necessarily important since examining the aggregate consumption behavior is of particular interest in this study.

5.5.1. Empirical Model

Consulting with the available literature on the consumption-REER misalignment relationship, the study takes up a measure of income, interest rate, rate of inflation and REER as fundamental determinants of aggregate consumption. In order to examine the impact of currency misalignment on aggregate consumption, the REER misalignment variable is inserted into the function of aggregate consumption that takes the following form:

$$C_{i,t} = f(Y_{i,t}, r_{i,t}, INF_{i,t}, REER_{i,t}, m_{i,t}) \quad (5.10)$$

where C stands for aggregate consumption expenditure, Y is the real GDP as a measure of income, r shows real interest rate, INF refers to the inflation rate, $REER$ denotes real effective exchange rate, $m_{i,t}$ indicates currency misalignment, i stands for country and t for time. The study applies dynamic panel GMM estimators offered by Arellano & Bond (1991) and Blundell & Bond (1998). More specifically, the study will be based on Blundell & Bond's (1998) estimator as its identification technique is most efficient.[16]

The study initially takes a look into the effects of undervaluation and overvaluation on the aggregate level of consumption introducing them into the empirical model for consumption regression with the following form-

$$lnC_{i,t} = \delta_0 + \delta_1 lnC_{i,t-1} + \gamma X_{i,t} + \theta_1 UNDER_{i,t} + \theta_2 OVER_{i,t} + \mu_i + \lambda_t + \upsilon_{it} \qquad (5.11)$$

The dynamic panel regression model to apprehending the relationship between aggregate consumption expenditure and REER misalignment can be given as

$$lnC_{i,t} = \delta_0 + \delta_1 lnC_{i,t-1} + \gamma X_{i,t} + \rho m_{it} + \mu_i + \lambda_t + \upsilon_{it} \qquad (5.12)$$

Here, X is the set of variables explain aggregate consumption that include real GDP (Y), real interest rate (r), rate of inflation (INF), a real effective exchange rate (REER), μ_i is to represent country fixed effects, λ_t shows time specific effects and υ_{it} is an error term. The empirical models will, therefore, take the follow forms-

$$lnC_{it} = \delta_0 + \delta_1 lnC_{it-1} + \gamma_1 lnY_{it} + \gamma_2 r_{it} + \gamma_3 INF_{it} + \gamma_4 \, lnREER_{it} + \theta_1 UNDER_{i,t} + \theta_2 OVER_{i,t} + \varepsilon_{it} \qquad (5.13a)$$

$$lnC_{it} = \delta_0 + \delta_1 lnC_{it-1} + \gamma_1 lnY_{it} + \gamma_2 r_{it} + \gamma_3 INF_{it} + \gamma_4 \, lnREER_{it} + \rho m_{it} + \varepsilon_{it} \qquad (5.13b)$$

Friedman's (1955) permanent income hypothesis of consumption asserts that present consumption is positively influenced by past consumption and therefore coefficient associated with lagged consumption expenditure should be positive, that is, $\delta_1 > 0$. Consumption-income relationship, according to Ando & Modigliani (1963), is positive, that is, $\gamma_1 > 0$. The conventional view recommends that higher interest rate

[16] Bond, Hoeffler, & Temple (2001) argue that Blundell & Bond's (1998) identification technique is most suitable in order to produce more reasonable results.

drives away aggregate consumption expenditure. Campbell & Mankiw (1989) argue that change in interest rate affects consumer spending through income and substitution effects. With a higher interest rate, consumers' might substitute their consumption by saving if they feel their current consumption have become more expensive than saving (substitution effect) or they might spend more from increased income on saving (income effect).[17] Hence, the coefficient attached to the interest rate can either be positive or negative depending on the relative power of these two effects, that is, $\gamma_2 \neq 0$. Inflation, by taking away the purchasing capacity from consumers, is expected to exert negative impact of aggregate consumption, meaning that inflation rate coefficient is negative and hence $\gamma_3 < 0$. A rise in REER refers to a real depreciation that reduces consumption expenditure and accordingly $\gamma_4 < 0$. Undervaluation potentially has a positive impact on aggregate consumption which is negative for overvaluation, that is, $\theta_1 < 0$ (assuming negative undervaluation series) and $\theta_2 < 0$. A negative REER misalignment coefficient (that is, ρ<0) indicates that deviation of REER from its equilibrium value tones aggregate consumption expenditure down. There is consensus in earlier empirical studies that public consumption crowds out private consumption (see Apere, 2014; Aristei & Pieroni, 2008; Varlamova & Larionova, 2015 for instances). Consequently, many of the studies take account of public investment in the regressors (Apere (2014) and Oseni (2016), for example). The study is particularly interested in examining the impact of REER misalignment on aggregate consumption that includes both public and private consumptions and therefore such decomposition is deemed to be unnecessary.

5.5.2. Data

Based on misalignment series of REER derived in chapter four, the study attempt to investigate the link between REER misalignment and aggregate consumption using panel data from 21 emerging economies during 1980-2016. Appendix F compiles the REER misalignment series for individual economies. The annual frequency data on

[17] There is another effect named 'wealth effect' introduced by Wilcox (1993), according to which higher interest rate, by reducing the discounted present value of expected future income, drives consumers' to consume less and save more to smooth their consumption in long periods. Therefore, both substitution effect and wealth effect of higher interest rate is negative on consumption expenditure while income effect is positive. The net effect of higher interest rate is therefore determined by which of the effects dominates over another. aggregate consumption expenditure falls if the negative substitution and wealth effect due to the rise in interest rate together dominates over the positive income effect.

the rest of the variables come from different sources. Data on aggregate consumption expenditure and GDP at constant prices as a measure of income are collected from the UNCTAD. Interest rate data are taken from the IFS of IMF.

The CPI-based inflation rate data are gathered from the World Development Indicator (WDI) of the World Bank (WB) for most of the economies. For Bangladesh, Brazil, China and ARE, inflation rate data are sourced from WEO of IMF. Due to the absence of a unique source for comprehensive data on REER, data on the variable is compiled from various sources. But the study was cautious in maintaining a common price index in collecting REER data.[18] The REER indices collected from various source are formulated based on CPI. The study also pays attention to maintain a common base year for REER irrespective to countries.

Countries for which data at least 25 years are sequentially available for the variables over the sample period are included in the study. Outliers are prudently treated to avoid the imprecise result. Particularly, distant observations are found for interest rate, inflation rate and REER variables for some of the countries. Using z-scores, the outliers are detected and omitted from the dataset. 20 of the 21 emerging economies considered for the study retain data of at least 25 consecutive years for the variables even after excluding the distant observations. However, only for ARE, interest rate data are not found and therefore observations for the country are omitted altogether. Hence, finally, the panel data include observations of 20 countries. Detail description of the variables is presented in table 71 in the appendix.

Aggregate consumption expenditure, real GDP and REER are transformed into logarithm. As like growth regression, the long run perspective of data is retained skimming the non-seasonal components of time series by averaging the variables over 5-year non-intersecting interval over the sample period that produces a total of 8 observations for each of the variables for a given country. Some summary statistics of these variables are presented in table 95 in the appendix. Variation within countries over time is plainly higher than the variation between countries for most of the variables except for aggregate consumption expenditure and real income.

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[18] Use of the type of price index is an important concern in constructing the REER, see chapter two for a detail

5.5.3. Results and Discussion

Along with investigating the relationship between misalignment of REER and aggregate consumption expenditure, the study extricates the undervaluation series (negative value of misalignment series and zero otherwise) from its overvaluation counterpart (positive value of misalignment series and zero otherwise) and introduces them in the consumption regression equation to extract their respective impact on aggregate consumption. The non-episodic absolute REER misalignment is used for estimating the regression models as it is perceived to perform better over episodic measures of REER misalignment. Table 68 summarizes the respective impact of under and overvaluation on aggregate consumption expenditure together with other explanatory variables while table 69 reports the impact of REER misalignment. The tables summarize both standard FE estimators and SGMM estimations accompanying the pre and post-diagnostic test results of the SGMM estimations.

The null hypotheses of no autocorrelation, homoscedasticity and non-endogeneity between consumption expenditure and regressors are rejected by the Wooldridge, Breusch-Pagan and Wu-Hausman tests, respectively for both of the SGMM specifications at 1 percent level of significance and, therefore, the specified models are not free from the problems of autocorrelation, heteroskedasticity and endogeneity. Consequently, the chosen approach, that is, the SGMM approach in investigating the dynamic relationship between aggregate consumption expenditure and regressors is appropriate. According to the post-diagnostic test results, first-order autocorrelation among residuals are accepted by significant AR(1) test statistic, but autocorrelation among residuals at second order is not found owing to the insignificant AR(2) test statistic for all the cases meaning that internal instrumentation structure used by SGMM is valid. The study considers lagged consumption expenditure as endogenous; inflation rate as predetermined and the other regressors as extremely exogenous. The overall validity of instruments is approved through accepting the null hypothesis of over-identifying restrictions by the Hansen test statistic. Clearly, the number of instruments falls short from that of the number of cross sections which imply that the estimated SGMM models are free from ‘over-fitting bias’.

The last two models in table 68 are different from the first two for the reason that they ignore REER. Column 1 and 3 summarize the results of standard FE estimators whereas column 2 and 4 present SGMM estimators for two alternative specifications. The most important determinant of aggregate consumption expenditure is income (real GDP). The income coefficient, the measure of marginal propensity to consume (MPC), is positive and highly significant for all cases. MPC is around 0.52 for SGMM estimate and 0.57 for standard FE estimate, and hence the corresponding marginal propensity to save (MPS) lies between 0.43 and 0.48.

Table 68

Consumption Regression with Over and Undervaluation

Regressors	Dependent Variable- Aggregate Consumption Expenditure			
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)
Lagged Consumption	0.3835*	0.4260*	0.3973*	0.4375*
	(8.0600)	(8.1700)	(8.4400)	(8.9700)
Real GDP	0.5815 *	0.5317*	0.5669*	0.5199*
	(12.2100)	(12.0300)	(11.9400)	(12.6600)
Interest Rate	-0.0004	0.0021**	-0.0005	0.0021*
	(0.6900)	(3.2300)	(0.7800)	(2.9700)
Inflation	-0.0005	-0.0031*	0.0000	-0.0028**
	(0.5700)	(3.1000)	(0.0600)	(2.5300)
REER	-0.0495	-0.0356***		
	(1.5300)	(1.9200)		
Undervaluation	0.0019**	0.0021*	0.0017***	0.0020*
	(2.1300)	(4.2200)	(1.8800)	(4.3300)
Overvaluation	0.0010***	0.0009***	0.0011**	0.0009**
	(1.9600)	(2.0600)	(2.2200)	(2.2300)
Hausman Test	21.130(0.004)*		20.477(0.002)*	
R-squared	0.998		0.998	
Adjusted R-squared	0.998		0.998	
Observations		129		131
Cross Section		20		20
Adj R-Square				
AR(1) p-value		0.252		0.322
AR(2) p-value		0.059		0.062
Hansen Test (p-value)		11.90 (0.156)		10.67 (0.221)
Instrument		16		15
Wooldridge Test (p-value)		123.873(0.000)*		121.921(0.0000)*
Breusch-Pagan Test (p-value)		118.74 (0.000)*		120.21 (0.0000)*
Wu-Hausman Test (p-value)		447.77 (0.000)*		443.11 (0.0000)*

* Significant at 1% level of significance
** Significant at 5% level of significance
*** Significant at 10% level of significance
Note: Figures below the coefficients in parentheses are t-ratios

The regression results also assert Friedman's (1957) ‘The Permanent Income Hypothesis’ of consumption which states that individuals’ present consumption decision is positively influenced by their past consumption. Clearly, the coefficients of lagged consumption expenditure are positive and highly significant across specifications which differ slightly. It implies that individuals’ present consumption is increased nearly by 4.3 percent due to a 10 percent increase in consumption in the previous year according to the SGMM estimates.

Interest rate coefficients bear expected signs for standard FE estimators that are insignificant. Though marginal, the theoretically unanticipated positive relationship between interest rate and aggregate consumption expenditure offered by SGMM estimates are statistically significant at a maximum of 5 percent confidence level, which is not startling as Bahmani-Oskooee, Kutan, & Xi (2015) and Varlamova & Larionova (2015) also find a positive interest rate coefficient for a number of EMEs and OECD countries, respectively. The positive coefficient of interest rate means that the positive income effect caused by higher interest rate governs over the joint negative substitution and wealth effect.

The coefficient of the inflation rate is zero for the reduced standard FE estimate in column 3. All other estimates are negative as expected and the SGMM estimates are significant. The baseline SGMM model suggests that a 10 percent increase in the inflation rate reduces aggregate consumption expenditure by 0.03 percent. The REER coefficient is negative for both of the cases but significant for SGMM specification at 10 percent level of significance according to which a rise in REER, that is, undervaluation leads to lower aggregate consumption expenditure which is inconsistent with the theoretical expectation. The result endorses Alexander's (1952) argument.[19] In recent times, in a series of studies, Bahmani-Oskooee and his co-authors (see e.g. Bahmani-Oskooee & Hajilee, 2010; Bahmani-Oskooee & Xi, 2011; Bahmani-Oskooee & Hajilee, 2012; Bahmani-Oskooee, Kutan, & Xi, 2015) also find evidence in favor of Alexander's (1952) argument.

Finally, the undervaluation and overvaluation coefficients are positive and significant for all variants of regression specification. The undervaluation series itself is negative and thus a direct relationship between undervaluation and consumption expenditure confirmed by positive undervaluation coefficient might be indicative to the fact that higher undervaluation lowers aggregate consumption expenditure which is contrary to the expectations but can be defended when we take the income distributional consequences of undervaluation into account. Undervaluation reduces aggregate

[19] Alexander (1952), in one of his seminal works, probably first familiarize exchange rate as one of the fundamental influencing factors of domestic consumption. His argument goes as follows. A long time lag of adjustment in wages to inflation attributed to currency depreciation causes wage increase to fall short of inflation, which put forth a negative impact on workers consumption while it is positive for producers. As the marginal propensity to consume (MPC) for workers is higher than that of the producers, there will be a fall in aggregate consumption.

consumption expenditure by augmenting the inequality of income distribution. The reason is that the propensity to consume of lower-income households is higher than the households lying at the upper tail of income distribution. Emerging economies, countries characterized by the higher disparity in income distribution, are experiencing an increase in income inequality throughout the last three decades (Derviş & Qureshi, 2016). Ribeiro et al. (2017) also find that undervaluation causes greater income inequality of emerging economies that drives aggregate consumption to fall, which enables us to explain the anti-growth effect of undervaluation in EMEs that we observed in growth regression. With regard to overvaluation, positive overvaluation coefficients stand to mean higher overvaluation leads to a higher level of consumption expenditure. As undervaluation hurts aggregate consumption expenditure which is indicative of adverse income distributional consequence of undervaluation, overvaluation may correct it and thereby can promote aggregate domestic consumption. Therefore, the result is not surprising.

Turning to the relationship between misalignment of REER and aggregate consumption expenditure as shown in table 69, lagged consumption expenditure and income (measured by real GDP) is had to have positive and highly significant coefficients for all variants and the coefficients differ marginally from their earlier estimates shown in table 68. A positive relationship between consumption expenditure with its lagged value is exactly what Friedman (1957) enunciates in his ‘The Permanent Income Hypothesis’ of consumption. The MPC is 0.51 according to the baseline SGMM in column 2, for which the corresponding MPS is 0.49.

Signs of the interest rate coefficients are as before that varies from standard FE estimators to SGMM estimators. The expected negative coefficients derived for standard FE models are insignificant while the positive coefficients found for SGMM are significant. In terms of significant coefficients, aggregate consumption expenditure rises due to an increase in interest rate. A rise in the rate of interest can affect consumption expenditure in two possible ways- through income and substitution effect. When the interest rate rises, it makes current consumption more expensive in relation to saving and households substitute their current consumption by saving. On the other hand, higher interest rate refers to higher income which induces the consumers to spend more on consumption goods and services. Hence, when the substitution effect associated with higher interest rate reduces consumption expenditure, income effect stimulates it. The conventional view suggests that the substitution effect due to a rise in interest rate dominates over the corresponding income effect and accordingly higher interest rate leads to lower consumption expenditure. But for the case of EMEs, the income effect outweighs substitution effect resulting from the higher interest rate that causes aggregate consumption expenditure to rise.

The inflation rate takes on anticipated negative significant coefficients for three of the specifications, but insignificant and about to be zero for the reduced standard FE estimate in column 3. As the baseline SGMM model suggests, aggregate consumption expenditure falls by 0.02 percent due to a 10 percent increase in the price level. Though the REER bears negative signed coefficient, they are not statistically significant.

Table 69

Consumption Regression with Misalignment

Regressors	Dependent Variable- Aggregate Consumption Expenditure			
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)
Lagged Consumption	0.3970*	0.4522*	0.4053*	0.4337*
	(8.0500)	(8.2800)	(8.3981)	(7.8800)
Real GDP	(0.5686) *	(0.5048) *	0.5591*	0.5174*
	(11.5600)	(10.7000)	(11.5402)	(10.8100)
Interest Rate	-0.0007	0.0016**	-0.0007	0.0017**
	(1.0200)	(2.5300)	(1.1608)	(2.6600)
Inflation	-0.0002	-0.0024**	0.0001	-0.0024**
	(0.2300)	(2.5400)	(0.1546)	(2.4800)
REER	-0.0313	-0.0002		
	(0.9500)	(0.0100)		
REER misalignment	0.0009***	0.0005***	0.0011**	0.0007***
	(1.7600)	(1.8000)	(2.3351)	(1.8900)
Hausman Test	17.302(0.0082)		16.510(0.0055)	
R-squared	0.998		0.998	
Adjusted R-squared	0.997		0.997	
Observations		130		132
Cross Section		20		20
Adj R-Square				
AR(1) p-value		0.239		0.375
AR(2) p-value		0.051		0.071
Hansen Test (p-value)		11.31 (0.185)		10.94 (0.205)
Instrument		15		14
Wooldridge Test (p-value)		113.529(0.000)		103.224(0.000)
Breusch-Pagan Test (p-		110.81 (0.000)*		112.13 (0.000)*
Wu-Hausman Test (p-value)		479.87 (0.000)*		467.36 (0.000)*

* Significant at 1% level of significance

** Significant at 5% level of significance

*** Significant at 10% level of significance

Note: Figures below the coefficients in parentheses are t-ratios

Last but not the least, the REER misalignment variable takes on positive signs unanimously that are statistically significant for all variants of regression equations, meaning that deviation of REER from equilibrium compels aggregate consumption expenditure.

5.6. Investment Regression

Owing to the growing consumer base and soaring trade surplus, the investment share of Emerging economies reaches to 32% of their GDP during 2000-2016. Most importantly, investment process enhancements in emerging and developing economies are steadily relocating investment from developed economies (see figure 28). Most of the emerging markets actively intervene in their foreign exchange markets in order to maintain competitiveness which also boosts their domestic consumption expenditure and thereby likely to draw more domestic investment creating new opportunities for potentials entrepreneurs. Such interventions often result in currency misalignment. Therefore, REER misalignment- domestic investment nexus is far larger phenomenon than addressed in earlier studies.

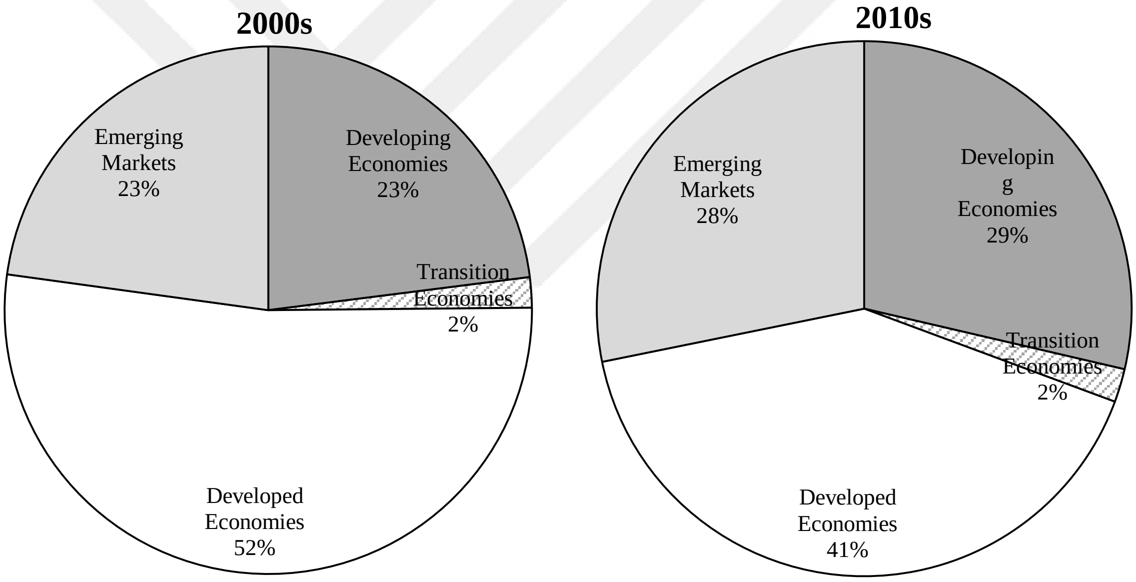

Figure 28 Development of investment spending during the 2000s and 2010s
Source: Compiled by author from UNCTAD Database, April 2019

The study relies both on theory and empirical evidence on demand for capital in order to delineate the investment demand function for the study. Traditional theory regards investment as a function of the rental cost of capital and output level. Again, the rental cost is deliberated as the sum of real interest rate (r) and capital consumption allowance (CCA) while real GDP measures output level (Dornbusch, Fisher, & Startz, 2011). Evaluation of earlier cross-country experiences of developing countries on investment finds some more factors to be important for investment decision making. Harrison & McMillan (2003) and Markusen & Venables (1999) accept FDI as one of the crucial factors of domestic investment while Dixit & Pindyck (1994), Campa & Goldberg (1995), Darby et al., (1999), Bleaney & Greenaway (2001), Bahmani-Oskooee & Hajilee (2013), Iyke & Ho (2017) and the study itself argue to include REER as a determinant of domestic investment. As the study is interested to examine the impact of misalignment of REER, it has been added to the regressors to delineate the investment function.

5.6.1. Empirical Model

Following the above discussion, the theoretical model for estimating the investment demand function can be given as-

$$I_{it} = I(RC_{it}, Y_t, FDI_{it}, REER_{it}, m_{it}) \tag{5.14}$$

where RC is the rental cost of capital. Here, $RC = r + \delta$, where r is the rate of interest and δ stands for the rate of depreciation. Y is the level of output or real GDP, FDI is the foreign direct investment, $REER$ stands for the real effective exchange rate, m means currency misalignment, i denotes country and t for time. The long-run empirical aggregate domestic investment demand function will therefore take the following form:

$$lnI_{it} = \theta_0 + \theta_1 lnI_{it-1} + \theta_2 lnRC_{it} + \theta_3 lnY_t + \theta_4 lnFDI_{it} + \theta_5 lnREER_{it} + \theta_6 m_{it} + \mu_i + \lambda_t + \upsilon_t \tag{5.15}$$

Where, μ_i is to represent country fixed effects, λ_t shows time specific effects and υ_{it} is an error term.

To identify the respective impact of undervaluation and overvaluation on domestic investment, the undervaluation and overvaluation series generated for growth regression (in section 5.3) is supplemented in a separate regression as follows-

$$lnI_{it} = \theta_0 + \theta_1 lnI_{it-1} + \theta_2 lnRC_{it} + \theta_3 lnY_t + \theta_4 lnFDI_{it} + \theta_5 lnREER_{it} + \gamma_1 UNDER_{it} + \gamma_2 OVER_{it} + \mu_i + \lambda_t + \varepsilon_{i,t} \tag{5.16}$$

Current investment is expected to be accelerated by past investment and hence θ_1 should be positive. Conventionally, an increase in the rental cost decreases investment spending and therefore θ_2 is negative. Investment spending is stimulated by an increase in GDP and therefore θ_3 is positive. Depending on whether FDI crowds-out or crowds-in domestic investment, θ_4 can either be positive or negative. The sign of θ_5 can also be positive or negative following Alexander's (1952) argument.[20] The study assumes that any distortions of REER from its equilibrium values reflected by REER misalignment have an adverse impact on domestic investment and hence the REER misalignment coefficient θ_6 is expected to be negative. Regarding the impact of depreciation on domestic investment, based on the discussion in the literature review, the associated coefficient is expected to be negative (being the undervaluation series negative). Overvaluation hurts domestic investment and the accompanying coefficient is negative as well.

5.6.2. Data Sources

Countries for which data at least 25 years are sequentially available for the variables over the sample period are included in the study. Outliers are prudently treated to avoid the imprecise result. Particularly, distant observations are found for interest rate and REER variables for some of the countries. Using z-scores, the outliers are detected and omitted from the dataset. 20 of the 21 emerging economies considered for the study retain data of at least 25 consecutive years for the variables even after excluding the distant observations. However, only for ARE, interest rate data are not found and therefore observations for the country are omitted altogether. Finally, the panel data include observations of 20 countries.

The misalignment series of REER initially derived in chapter four employing Single Equation approach compiled in appendix F are used to examine the REER misalignment- aggregate investment relationship based on panel data from 21 emerging economies between 1980 and 2016. The annual frequency data come from different sources. Aggregate investment is proxied by real gross capital formation. Income variable is measured by real GDP. Data on these two variables and of FDI at constant prices are derived from the UNCTAD. Interest rate data come from the IFS of IMF. The

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[20] As Alexander (1952) argues, currency depreciation brings about inflationary effect in an economy through wage adjustment which redistributes income from workers to producers in terms of profit and motivates producers to produce more. On the other hand, high cost of imported material resulting from depreciation repels profits. Consequently, strength of these two opposing effects determines the direction to which domestic investment changes.

rate of depreciation (δ) is supposed to be constant at 0.03 following Mankiw et al. (1992).[21] Due to the absence of a unique source for comprehensive data on REER, data on the variable is compiled from various sources. Data on this variable is mostly collected from the IFS of IMF. Countries like Egypt, Turkey and South Africa for whom observations for this variable are not available are supplemented with data from BRUEGEL database. However, the study was cautious in keeping a common price index in collecting REER data.[22] The REER indices formulated based on CPI are collected from these two sources. The study also takes care of maintaining a common base year for REER regardless of countries. A detail description on the variables is presented in table 71 in appendix and table 96 in appendix offers the summary statistics of the variables separating the overall variation into between and within variation. As evident, aggregate investment and real income variables have higher variation between countries than within variation while it is opposite for the rest.

5.6.3. Results and Discussion

The study isolates the undervaluation series of REER misalignment from its overvaluation counterpart and introduces them in the investment regression in order to estimate equation 5.15 to examine their separate impact on domestic investment. The undervaluation series contains the negative values of the misalignment series and zero otherwise. Similarly, overvaluation series is comprised of positive values of misalignment series and zero otherwise. Later, the non-episodic absolute REER misalignment is used for estimating equation 5.16 as it is supposed to work better over episodic measures of REER misalignment.

Table 70 illustrates the standard fixed effect estimators and SGMM estimators for alternative specifications of investment regression. Model 1 and 2 show the estimated coefficients of equation 5.15, while model 3 and 4 report the coefficients for equation 5.16. Results shown in column 5 and 6 include misalignment of REER with undervaluation and overvaluation series. Model 1, 3 and 5 offer standard fixed effect estimators, while model 2, 4 and 6 provide SGMM estimators. The Hausman test

[21] Mankiw et al. (1992) argue that the rate of depreciation (δ) and the advancement in technology (g) is fixed at 0.03 and 0.02, respectively.

[22] Use of the type of price index is an important concern in constructing the REER, see chapter two for a detail

(reference) reported below of the table finds standard FE models are appropriate for all specifications. However, this method does not consider the endogeneity issue. More specifically, the standard FE estimator of a dynamic panel data model offers inconsistent estimators for a fixed number of time series observations (T) despite the number of cross sections (N) tends to infinity (Nickell, 1981). Moreover, regressors in investment regression are expected to be affected by the investment.

The dynamic panel GMM estimation approach offered by Arellano & Bond (1991), Arellano & Bover (1995) and Blundell & Bond (1998) is suitable to address the issues. We are, in particular, interested in Blundell & Bond, 1998) estimator as its identification technique is most efficient.[23] The dynamic panel GMM estimation produces more robust estimates in the presence of autocorrelation, heteroskedasticity and endogeneity. Results of the traditional systematic checks are presented below of the table. The Wooldridge, Breusch-Pagan and Wu-Hausman tests find autocorrelation among errors, the heteroskedastic variance of residuals and endogeneity between domestic investment and regressors at 1 percent level of significance and hence justify the use of the SGMM approach in estimating the dynamic relationships for the specified model. As far the post diagnostic tests are concerned, first-order autocorrelation among residuals are accepted by significant AR(1) test statistic, but autocorrelation among residuals at second order is not found as AR(2) test statistic is insignificant at 5 percent level of significance for all the cases meaning that instrumentation structure that SGMM uses internally is valid. The study considers lagged domestic investment as endogenous; rental cost as predetermined and the other regressors as extremely exogenous. The p-value of the Hansen test statistic accepts the null hypothesis of over-identifying restrictions and thereby approves the overall validity of instruments. Clearly, the number of instruments lies below the number of cross sections which indicate that the estimated SGMM models are free from 'over-fitting bias'.

The lagged investment variable maintains positive coefficients for all cases that are highly significant meaning that past investment accelerates investment of current period. This finding is consistent with the Neoclassical theory of investment which asserts that the intention of firms to achieve the desired stock of capital from its existing level drives them to invest more.

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[23] Bond, Hoeffler, & Temple (2001) argue that Blundell & Bond's (1998) identification technique is most suitable in order to produce more reasonable results.

Table 70

Investment Regression

Regressors	Dependent Variable- Aggregate Domestic Investment					
Model	FE (1)	SGMM (2)	FE (3)	SGMM (4)	FE (5)	SGMM (6)
Lagged Investment	0.384*	0.729*	0.397*	0.775*	0.395*	0.755*
	(4.438)	(6.910)	(4.500)	(7.110)	(4.384)	(6.700)
Rental Cost	0.058***	0.188**	0.059***	0.196**	0.059***	0.199**
	(1.713)	(2.120)	(1.744)	(2.090)	(1.739)	(2.070)
Income	-2.487**	-0.919***	-2.654**	-1.057**	-2.647**	-1.225**
	(2.046)	(1.770)	(2.147)	(2.130)	(2.129)	(2.280)
FDI	1.715*	1.863*	1.736*	1.898*	1.734*	2.032*
	(3.323)	(3.170)	(3.342)	(3.160)	(3.321)	(3.300)
REER	3.420***	9.404*	3.588***	9.138*	3.663***	8.436**
	(1.701)	(3.120)	(1.701)	(2.850)	(1.667)	(2.700)
Undervaluation			0.044	0.082	0.076	-0.348**
			(0.700)	(1.160)	(0.295)	(2.140)
Overvaluation			-0.032	-0.040	0.001	-0.476*
			(0.845)	(1.350)	(0.003)	(3.290)
REER misalignment	-0.010	-0.009			-0.032	0.429*
	(0.443)	(0.330)			(0.129)	(3.170)
Hausman Test (p-value)	45.482 (0.000)*		45.654 (0.000)*		48.277 (0.000)*	
Observations	130	130	129	129	129	129
Cross Section	20	20	20	20	20	20
Adj R-Square	0.790		0.789		0.787	
AR(1) p-value		0.011		0.009		0.009
AR(2) p-value		0.078		0.077		0.084
Hansen Test (p-value)		12.29 (0.139)		12.51 (0.130)		13.02 (0.111)
Instrument		15		16		17
Wooldridge Test (p-value)		33.159 (0.000)*		34.122 (0.000)*		38.193 (0.000)*
Breusch-Pagan Test (p-value)		72.79 (0.000)*		88.79 (0.000)*		89.97 (0.000)*
Wu-Hausman Test (p-value)		179.13 (0.000)*		166.62 (0.000)*		173.83 (0.000)*

* Significant at 1% level of significance

** Significant at 5% level of significance

*** Significant at 10% level of significance

Note: Figures below the coefficients in parentheses are t-ratios

The signs of the coefficients attached to the rental cost of capital are positive which is right the opposite to the theoretical standpoint and statistically significant. Typically, lower rental cost expedites domestic investment. However, in situations where the expected profit rate falls far below the rental cost, a fall in rental cost fails to bring about any stimuli to investment. According to the estimate, a 1 percent fall in the rental cost of capital slows down domestic investment by 0.06 (according to standard FE estimate) to 0.2 (according to SGMM estimate) percent. Income does have an adverse impact on domestic aggregate investment confirmed by negative significant coefficients for all specifications which is in contrast to the theoretical expectation. According to the accelerator theory of investment, an increase in income accelerates the level of aggregate investment spending. However, the theoretical underpinning of such adverse relationship is also straightforward. Increase in income tones down domestic investment through the rise in interest rate by stimulating consumption expenditure.

The associated coefficients of FDI are positive as expected and highly significant for all variants of the estimates. Therefore, domestic investment provoking FDI is evident meaning that FDI plays a complementary role for the establishment of local industry that Markusen & Venables (1999) found true for Newly Industrialized Countries most of which are currently representing EMEs. The attendant coefficient of REER is positive and significant for all cases. Therefore, currency depreciation revealed through the rise in REER induces domestic investment offsetting its profit repelling impact of high cost imported materials by its profit hailing impact resulting from redistribution of income from workers to producers through incomplete wage change in response to the inflationary effect of depreciation.

The model that contains undervaluation, overvaluation and misalignment of REER together (in column 6) produces statistically significant coefficients for the variables only for the SGMM specification. According to the significant coefficients, both the undervaluation and overvaluation have expected impact on the aggregate level of investment. The undervaluation coefficient is negative, meaning that higher undervaluation, being undervaluation negative, tempts domestic investment to rise. In contrast, higher overvaluation dries out domestic investment confirmed by negative overvaluation coefficient. The positive significant SGMM estimate of REER misalignment coefficient implies that any distortion of REER from equilibrium level promotes aggregate investment which is in contrast to the theoretical explanation.

5.7. Summary

This chapter examines the impact of REER misalignment on macroeconomic performance of emerging economies employing Blundell & Bond's (1998) SGMM estimation approach. The components for evaluating the macroeconomic performance of emerging economies include growth rate, trade balance, domestic consumption and domestic investment and hence it performs four separate regressions. It first outlines the econometric model based on theoretical and empirical justifications. In order to examine the impact of REER misalignment on economic growth and the components of total spending, the REER misalignment variable is inserted into the set of control variables identified from a thorough literature survey for respective regressions. However, models specified in this way ignore the corresponding effects of undervaluation and overvaluation and hence the undervaluation and overvaluation indices are formulated separately and incorporated into the set of regressors to identify their respective impacts on growth and selected components of aggregate expenditure. Results suggest that REER misalignment and its two opposing components- undervaluation and overvaluation hurt growth of EMEs. The anti-growth effect of undervaluation is later supported by consumption regression as it finds that undervaluation dries up aggregate consumption. Higher overvaluation conceivably leads to a higher level of consumption expenditure and REER misalignment promotes consumption expenditure as well. Undervaluation improves trade balance while overvaluation erodes it as like the overall REER misalignment does. The impacts of undervaluation and overvaluation on domestic investment are in line with theoretical claims- undervaluation draws more domestic investment whereas overvaluation dries it up. However, REER misalignment accelerates aggregate investment.

CHAPTER VI

CONCLUSION

6.1 Key Findings and Policy Implications

Misalignment of REER and its role in open economies is one of the widely researched topics in open economy macroeconomics and its impacts on different macroeconomic variables are well documented in the literature. But there were hardly any studies found in recent years evaluating the macroeconomic performance of emerging economies following REER misalignment though they have been able to raise their contribution to global growth through the last few decades dealing with frequent currency crisis by managing their exchange rate policies appropriately in accordance with the macroeconomic challenges they faced (Damill & Frenkel, 2017; Ghosh, Ostry, & Tsangarides, 2010; R. S. Rajan, 2012). Very few of the studies that evaluate the macroeconomic performance of emerging economies with regard to REER misalignment predominantly consider its impact on economic growth; some of them look into its effects on export performance. Misalignment series the studies use are of their own and therefore differ across studies. Some of the reasons for diverse findings on REER misalignment by the studies are- the disparity in fundamentals they accept, dissimilarity of the time period they cover and disagreement on the methodology they use to determine the equilibrium REER. Macroeconomic performance of the economies cannot be explained by economic growth alone as the growth of the economies are determined by the performance of some other components of total spending like aggregate consumption expenditure, aggregate investment spending and trade balance. Therefore, identical misalignment series of REER should be used to learn its impact on all these components including growth to have a complete idea about the impact of REER misalignment on macroeconomic performance of emerging economies. To date, no such studies are performed on emerging economies. Hence, the study will first derive the misalignment series of REER based on a common analytical framework and then examine its impact on growth and major components of GDP so as to offer more comprehensive decision regarding the role of REER misalignment in determining the macroeconomic performance of selected emerging economies.

The study explains some of the approaches typically used for the determination of equilibrium REER. The approaches include the Purchasing Power Parity (PPP)

Approach, Balassa-Samuelson Approach, Uncovered Interest Parity (UIP) Approach, the Monetarist Approach, Capital Enhanced Equilibrium Exchange Rate (CHEER), the Macroeconomic/ Internal-External Balance Approach, Behavioral Equilibrium Exchange Rate Approach (BEER), Permanent Equilibrium Exchange Rate (PEER) and Single Equation Approach. The study chooses to employ the single equation approach that estimates the long-run equilibrium REER directly drawing a vector of sustainable values for the fundamentals. Fundamentals used in this study to model equilibrium REER are terms of trade, government spending on nontradables, government spending on tradable goods, investment, trade openness, net financial assets position, the relative productivity in the tradable sector to non-tradable sector, real interest rate differentials and official development assistance to model the equilibrium REER.

The study estimates the Equilibrium REER empirically for each of the 21 emerging economies separately adopting Single Equation approach offered by Edwards (1989a), Elbadawi (1994) and Baffes et al. (1999). In this approach, fundamentals that form a long-run cointegrating relationship with REER are used to feed the long-run relationship by their sustainable values derived by H-P filtering process in order to arrive at the equilibrium REER and corresponding REER misalignment.

A unique combination of fundamentals is inconceivable to form long-run cointegrating relationship with REER regardless of countries and accordingly the study considers alternative combinations of the fundamentals. Specifications that pass all necessary diagnostic checks and the fundamentals bear theoretically expected signs and statistically significant are finally picked to estimate the long run equilibrium REER. A summary of underlying fundamentals that determine the equilibrium REER is given in Appendix H.

Among the underlying factors that determine EREER, terms of trade are common for all economies. The next most common fundamentals in terms of their inclusion in the normalized cointegration equation are government expenditure (17), productivity differentials (16), investment spending (12), openness (11), net foreign assets (9) and official development assistance (8), respectively where figures in brackets show the number of countries.

Specifications for which estimated parameters are signed in line with economic theory and significant are considered for estimating long-run EREER. Hence, negative productivity differentials coefficients for all countries approve the Balassa-Samuelson effect which states that productivity growth appreciates REER. Productivity growth in emerging economies is expected to be more intense in the tradable sectors which increase the demand for labor in these sectors and thereby persuades wage rate to rise in the non-tradable sectors (Jongwanich, 2009). Such an increase in wage rate in the non-tradable sectors of the selected emerging economies appreciates REER causing inflation. The positive signs associated with coefficients of openness variable for eleven emerging economies approve Dufrénot & Yehoue's (2005) argument that greater liberalization depreciates REER by increasing demand for foreign currency through reducing prices of importable goods nationally.

An increase in the rest of the fundamentals can influence REER in either direction. Following conclusions can be drawn based on the number of times the fundamentals are included in the normalized cointegration equation. For about half of the countries, the REER depreciating income effect due to TOT improvement appears to be more powerful than its corresponding REER appreciating substitution effect. For the rest of the countries, the substitution effect dominates over income effect. For about two-thirds of the economies, domestic investment and government expenditure markedly flow into tradable goods. Theory anticipates that increase in net foreign asset depreciates REER, which is found true for two-thirds of the economies under study. However, Horvath (2005) gives more emphasis on a country’s level of development and argues that the relationship between NFA and REER that appears to be primarily negative for countries catching-up subsequently become positive. The reason is that capital inflows to these countries (mainly in the form of FDI) that result in REER appreciation in early periods due to higher domestic spending and the higher relative price of non-tradable goods turn out to be REER depreciation as the countries begin to pay the interest on their net foreign liabilities. Hence, the negative coefficients of NFA found for some of the emerging economies are also justified. The Dutch Disease phenomena is documented by Uneze (2011) for West African Economic and Monetary Union (WAEMU) and Magud & Sosa (2013) in their survey of over 60 theoretical and empirical papers. However, the study finds that the way official development assistance affects REER is consistent with theory, an increase in official development assistance depreciates REER of most of the economies except China and hence supports the existence of Dutch Disease phenomena for China.

The misalignment of REER in emerging economies allows proceeding for evaluating its impact on macroeconomic performance of the economies. To this end, the study takes economic growth and three major components of total spending of the selected economies into account and employ the Blundell & Bond's (1998) dynamic panel SGMM estimation approach to estimate the dynamic relationship between the fundamentals and REER misalignment. As like other studies, the study also accepts the view that REER misalignment has substantial impact on macroeconomic performance of the economies by influencing the fundamentals such as economic growth, trade balance, aggregate consumption and aggregate investment.

In line with the traditional view, the present study also argues that any deviation of REER from its equilibrium value impairs economic growth. The view that overvaluation erodes growth is customarily accepted. While a good number of recent empirical researches identify the beneficial effects of a real undervaluation on economic growth, the study stands against it as no such evidence is observed for emerging economies. Rather a real undervaluation hampers growth of emerging economies. To justify the growth deteriorating impact of undervaluation, the study looks into its income distributional consequences by performing consumption regression. Undervaluation may hurt economic growth exerting an adverse impact on domestic consumption through creating income inequality. Lima & Porcile (2013) and Ribeiro, et al. (2016), just to name but a few of recent studies, find undervaluation creates greater income inequality in emerging economies. The income redistribution effect of undervaluation is theoretically linked to a decline in domestic consumption. The study also suggests that undervaluation deters aggregate consumption expenditure of emerging economies which is alike to the finding of Ribeiro et al. (2017). Therefore, the anti-growth phenomenon of real undervaluation in emerging economies is valid. A higher level of consumption expenditure is associated with higher overvaluation and REER misalignment lifts consumption expenditure up as well.

Literature on the determinants of aggregate investment traditionally focus on various measures of income and interest rate. Some of the recent studies have emphasized the impacts of currency depreciation, impacts of currency misalignment on aggregate investment are largely ignored till date. However, the study argues to include a measure of currency misalignment in the aggregate investment function. Results are in line with conventional expectations: undervaluation attracts more investment while overvaluation undermines it. However, currency misalignment spurs domestic aggregate investment. The study includes the currency misalignment in the trade regression in a similar fashion and finds that higher REER misalignment helps recover trade imbalances. Currency depreciation is supposed to increase the competitiveness of a country and is expected to escalate exports and curb imports and thereby improve the trade balance. The study also comes to the same conclusion as it identifies that undervaluation improves trade balance while overvaluation cuts it down.

The findings have important implications for policymakers, households, business firms and traders. Being the key factor of aggregate demand, currency undervaluation that causes aggregate consumption to fall also tones down economic growth of emerging economies. The lower trade balance effect of REER misalignment of these economies REER also subside economic growth. Competitiveness achieved through undervaluation promotes trade balance, however, income distributional consequences of this undervaluation is much severe and adverse on consumption at the aggregate level that offsets the benefits of competitiveness reflected through lower growth. As competitiveness doesn't guaranty economic growth despite the positive trade balance effect of undervaluation, more importance should be given on how exchange rate policies alter the consumption preferences of households. Therefore, avoiding distortion in REER from its long term equilibrium value is a crucial policy concern for emerging economies not only for the costs it imposes on these economies through various channels but also for the role it plays in circumscribing the success of demand management policies in fighting unemployment and inflation. Exchange rate policies that confirm a facilitating condition rather than a competitive condition is much preferable for emerging economies. By the same token, exchange rate policy accommodation with demand management policies is necessary so as to achieve the desired Macroeconomic goals.

6.3 Limitations of the Study

The study is not beyond limitations. The REER misalignment estimates can be criticized from three grounds. Firstly, as the study relies on time series data of annual frequency, it limits the size of the sample of the work particularly in deriving the series of REER misalignment. The misalignment series could be more conclusive if we were able to manage a larger sample size for which data on the variables at a higher frequency, e. g., quarterly or monthly, were necessary. But data at a higher frequency for all the fundamentals used to estimate equilibrium REER were not readily available. Secondly, the inclusion of structural factors in the REER determinants as Macdonald & Ricci (2004) suggest could generate more representational estimates of REER. Thirdly, the study finds REER misalignment series only for 21 EMEs. Variables for which data at least 25 years are sequentially available over the sample period even after excluding the distant observations (outliers) are included in the study. This along with the inaccessibility of data on some variables restricts the study to attain the REER misalignment estimates for some other EMEs. It has an important impact on the precision of results obtained in different regressions performed for evaluating macroeconomic performance. The dynamic panel SGMM estimation approach used to evaluate macroeconomic performance of emerging economies requires the number of time period (T) has to be smaller than the number of countries (N). Averaging data of the variables in 5-year non-intersecting interval over the sample period in order to eliminate the cyclical component of time series to embody the long run perspective of data helps achieve this condition. However, due to the limited number of countries, the number of observations becomes smaller. Inclusion of more countries could improve the precision of the regression results by raising the number of observations.

6.4 Scope for Future Research

Apart from addressing the above limitations for further extensions, the study opens up some other promising avenues for future research. Despite the contribution of EMEs to the most part of global growth, the contrasts underscored within emerging economies are noteworthy. In terms of emerging markets perspective, the second half of the twentieth century can be characterized as a period during which emerging Asian economies have been able to score an incredible growth through deliberate management of their exchange rate policies, emerging Latin American economies endured persistent currency crisis owing to poor manipulation of the exchange rate regime.

Though the emerging American economies were relatively stable in the last two, but still within the EMEs the growth performance of emerging Asian economies outperforms its other counterparts. As the study indicates that REER misalignment and the underlying over and undervaluation do matter for macroeconomic performance of emerging economies, a cross-regional assessment on the impact of REER misalignment on macroeconomic performance within EMEs could guide the policymakers to suggest policy measures that best suit a country, group or region within or outside the EMEs. The study focuses on economic growth and key components of GDP that determine the growth to evaluate the macroeconomic performance of emerging economies due to currency misalignment, but it can be extended by including more fundamentals to get a more inclusive picture on this issue.

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APPENDICES

Appendix A: Data Sources

Table 71
Variables and Data Sources

Variable	Explanation	Sources
Growth Rate	Real GDP per capita growth rate at constant prices	WDI of WB UNCTAD
Inflation Rate	The CPI-based inflation rate	WDI of WB WEO of IMF
Government Expenditure	Government consumption as percent of GDP	WDI, PWT 9.0 UNCTAD
Investment Spending	Proxied by real gross capital formation as a percent of GDP	Compiled from WDI PWT 9.0 UNCTAD
Terms of Trade	The ratio between the export and import price index	WDI of WB UNCTAD IFS of IMF
Openness	The sum of exports and imports as percent of GDP at constant prices	WDI of WB PWT 9.0, UNCTAD
Net Foreign Assets	Net foreign assets as a percent of GDP at constant price	Lane & Milesi-Ferretti (2007) Database WDI of WB
PROD	Productivity Differentials- have been proxied by the relative productivity between emerging economies and Group of Seven (G-7) countries	UNCTAD
Human Capital	Average years of total schooling	Barro-Lee database on educational attainment
Polity2	Institutional quality	the Center for System Peace (CSP) database

(Continued on next page)

Variable	Explanation	Sources
ln(n+g+d)	The rate of population growth (n) The rate of depreciation (δ)= 0.03 The advancement in technology (g)= 0.02	WDI of WB Mankiw et al. (1992)
Real Domestic Income	Gross domestic product (GDP) in US Dollars at constant prices (2010) in millions	UNCTAD
Income of The Rest of The World	World GDP over the GDP of selected emerging economies in US Dollars at constant prices (2010) in millions	UNCTAD
Exports	Exports of goods and services in US Dollars at constant prices (2010) in millions	UNCTAD
Imports	Imports of goods and services in US Dollars at constant prices (2010) in millions	UNCTAD
Consumption Expenditure	Aggregate final consumption expenditure in US Dollars at constant prices (2010) in millions	UNCTAD
Interest Rate	- For consumption regression, long-term rate of interest measured by government bond rates is used - For investment regression, domestic interest rate measured in terms of T-bill rate or money market rate is used	IFS of IMF
Rate of Depreciation	The rate of depreciation (δ) is set at 0.03	Mankiw et al. (1992)
FDI	Foreign Direct Investment in US Dollars at constant prices (2010) in millions	UNCTAD
REER	Real Effective Exchange Rate Data on the variable is compiled from various sources, but the study cautiously maintains a common price index (CPI) and common base year while collecting REER data	Compiled from BRUEGEL Datasets[24], FRED, WDI of WB

(Continued on next page)

[24] The dataset is constructed following the methodology offered by Darvas (2012) which is undated on a regular basis

Variable	Explanation	Sources
REER Misalignment	Mean value of absolute misalignment	Author's calculations
Undervaluation & Overvaluation	The undervaluation and overvaluation series are constructed decomposing the misalignment series into its two counterparts- one incorporating the negative values or zero otherwise for the former and another incorporating the positive values or zero otherwise for the later series.	Author's calculations

Appendix B: ADF and PP Stationarity Test

Table 72

ADF and PP Test Results for Argentina

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.060	0.2615	-2.192	0.2124
		Trend, Intercept	-2.185	0.4829	-2.360	0.3932
	First Difference	Intercept	-6.071*	0.0000	-6.071*	0.0000
		Trend, Intercept	-5.970*	0.0001	-5.970*	0.0001
TOT	Level	Intercept	-0.558	0.8677	-0.555	0.8683
		Trend, Intercept	-3.589**	0.0450	-3.600**	0.0439
	First Difference	Intercept	-4.113*	0.0031	-6.625*	0.0000
		Trend, Intercept	-4.181**	0.0147	-6.985*	0.0000
PROD	Level	Intercept	-2.703	0.0836	-2.750	0.0758
		Trend, Intercept	-2.593	0.2856	-2.502	0.3255
	First Difference	Intercept	-2.890	0.0592	-4.062*	0.0033
		Trend, Intercept	-4.037**	0.0200	-3.969**	0.0193
G	Level	Intercept	-0.940	0.7636	-0.919	0.7708
		Trend, Intercept	-2.407	0.3701	-2.465	0.3425
	First Difference	Intercept	-1.912	0.3220	-6.155*	0.0000
		Trend, Intercept	-3.976**	0.0228	-6.064*	0.0001
NFA	Level	Intercept	-2.032	0.2725	-1.467	0.5388
		Trend, Intercept	-3.184	0.1040	-2.837	0.1940
	First Difference	Intercept	-4.543*	0.0009	-4.585*	0.0008
		Trend, Intercept	-4.452*	0.0060	-4.440*	0.0061
ODA	Level	Intercept	-1.577	0.4835	-2.539	0.1150
		Trend, Intercept	-6.268*	0.0001	-3.193	0.1018
	First Difference	Intercept	-4.740*	0.0005	-8.574*	0.0000
		Trend, Intercept	-8.537*	0.0000	-8.537*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 73

ADF and PP Test Results for Bangladesh

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.083	0.2525	-1.090	0.7092
		Trend, Intercept	-0.893	0.9446	-0.104	0.9928
	First Difference	Intercept	-4.036*	0.0035	-4.041*	0.0035
		Trend, Intercept	-4.578*	0.0043	-4.438*	0.0062
TOT	Level	Intercept	-2.184	0.2152	-1.861	0.3464
		Trend, Intercept	-1.260	0.8813	-1.593	0.7760
	First Difference	Intercept	-9.017*	0.0000	-9.166*	0.0000
		Trend, Intercept	-9.485*	0.0000	-10.146*	0.0000
PROD	Level	Intercept	4.581	1.0000	2.549	1.0000
		Trend, Intercept	0.608	0.9992	0.364	0.9983
	First Difference	Intercept	-1.432	0.5551	-2.016	0.2790
		Trend, Intercept	-4.936*	0.0017	-4.936*	0.0017
G	Level	Intercept	-3.100**	0.0357	-2.392	0.1511
		Trend, Intercept	-3.273	0.0873	-2.324	0.4113
	First Difference	Intercept	-4.106*	0.0030	-5.129*	0.0002
		Trend, Intercept	-4.086**	0.0149	-6.077*	0.0001
I	Level	Intercept	0.613	0.9875	0.170	0.9667
		Trend, Intercept	-3.123	0.1194	-1.637	0.7576
	First Difference	Intercept	-1.743	0.4004	-6.352*	0.0000
		Trend, Intercept	-2.343	0.3996	-6.519*	0.0000
NFA	Level	Intercept	-0.360	0.9055	-0.261	0.9210
		Trend, Intercept	-1.888	0.6399	-2.039	0.5608
	First Difference	Intercept	-5.703*	0.0000	-5.715*	0.0000
		Trend, Intercept	-5.603*	0.0003	-5.611*	0.0003

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 74
ADF and PP Test Results for Brazil

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.888	0.0569	-2.199	0.2102
		Trend, Intercept	-2.955	0.1588	-2.185	0.4831
	First Difference	Intercept	-5.008*	0.0002	-5.008*	0.0002
		Trend, Intercept	-4.938*	0.0017	-4.936*	0.0017
TOT	Level	Intercept	-2.646	0.0937	-2.391	0.1514
		Trend, Intercept	-2.822	0.1993	-2.491	0.3302
	First Difference	Intercept	-4.211*	0.0022	-3.992*	0.0040
		Trend, Intercept	-4.086**	0.0146	-3.743**	0.0324
PROD	Level	Intercept	-2.480	0.1291	-2.689	0.0857
		Trend, Intercept	-2.571	0.2947	-2.299	0.4240
	First Difference	Intercept	-3.430**	0.0169	-3.891*	0.0052
		Trend, Intercept	-3.065	0.1310	-3.774**	0.0302
G	Level	Intercept	-1.211	0.6548	-2.135	0.2330
		Trend, Intercept	-3.655**	0.0423	-2.097	0.5301
	First Difference	Intercept	-8.432*	0.0000	-5.655*	0.0000
		Trend, Intercept	-7.260*	0.0000	-5.694*	0.0002
I	Level	Intercept	-2.069	0.2579	-2.158	0.2246
		Trend, Intercept	-3.189	0.1062	-2.809	0.2034
	First Difference	Intercept	-1.815	0.3660	-6.165*	0.0000
		Trend, Intercept	-1.739	0.7067	-6.066*	0.0001
NFA	Level	Intercept	-1.473	0.5315	-1.438	0.5530
		Trend, Intercept	-4.042**	0.0176	-3.190	0.1025
	First Difference	Intercept	-5.654*	0.0001	-8.799*	0.0000
		Trend, Intercept	-5.579*	0.0006	-9.122*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 75
ADF and PP Test Results for Chile

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.794*	0.0078	-2.379	0.1545
		Trend, Intercept	-3.043	0.1380	-1.939	0.6133
	First Difference	Intercept	-4.040*	0.0046	-5.124*	0.0002
		Trend, Intercept	-4.192**	0.0143	-5.624*	0.0003
TOT	Level	Intercept	-1.571	0.4866	-1.727	0.4096
		Trend, Intercept	-1.778	0.6947	-1.778	0.6947
	First Difference	Intercept	-4.607*	0.0007	-4.618*	0.0007
		Trend, Intercept	-4.772*	0.0026	-4.793*	0.0025
I	Level	Intercept	-1.434	0.5545	-1.847	0.3525
		Trend, Intercept	-2.037	0.5613	-2.640	0.2659
	First Difference	Intercept	-7.905*	0.0000	-7.916*	0.0000
		Trend, Intercept	-6.874*	0.0000	-7.799*	0.0000
OPEN	Level	Intercept	-0.575	0.8638	-0.575	0.8638
		Trend, Intercept	-2.762	0.2194	-2.709	0.2392
	First Difference	Intercept	-7.082*	0.0000	-7.082*	0.0000
		Trend, Intercept	-7.024*	0.0000	-7.024*	0.0000
ODA	Level	Intercept	-2.036	0.2709	-2.504	0.1228
		Trend, Intercept	-3.727**	0.0376	-2.570	0.2955
	First Difference	Intercept	-9.876*	0.0000	-9.514*	0.0000
		Trend, Intercept	-3.030	0.1397	-9.884*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 76

ADF and PP Test Results for China

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.113**	0.0356	-2.883	0.0572
		Trend, Intercept	-1.643	0.7553	-2.448	0.3502
	First Difference	Intercept	-4.598*	0.0008	-4.601*	0.0008
		Trend, Intercept	-5.354*	0.0006	-8.360*	0.0000
TOT	Level	Intercept	-1.837	0.3556	-2.388	0.1520
		Trend, Intercept	-1.957	0.5983	-3.043	0.1351
	First Difference	Intercept	-2.242	0.1972	-6.729*	0.0000
		Trend, Intercept	-3.227	0.1003	-6.537*	0.0000
PROD	Level	Intercept	0.411	0.9806	0.667	0.9897
		Trend, Intercept	-2.470	0.3398	-1.950	0.6081
	First Difference	Intercept	-3.274**	0.0245	-3.288**	0.0232
		Trend, Intercept	-2.938	0.1636	-3.168	0.1072
G	Level	Intercept	-0.741	0.8227	-0.171	0.9333
		Trend, Intercept	-1.862	0.6521	-1.294	0.8734
	First Difference	Intercept	-3.659*	0.0095	-3.075**	0.0378
		Trend, Intercept	-3.714**	0.0349	-3.051	0.1335
I	Level	Intercept	0.051	0.9565	0.069	0.9588
		Trend, Intercept	-1.590	0.7744	-2.050	0.5553
	First Difference	Intercept	-3.007**	0.0449	-4.779*	0.0005
		Trend, Intercept	-2.955	0.1600	-4.627*	0.0038
OPEN	Level	Intercept	0.511	0.9847	0.328	0.9766
		Trend, Intercept	-2.607	0.2795	-2.487	0.3324
	First Difference	Intercept	-7.851*	0.0000	-7.851*	0.0000
		Trend, Intercept	-7.904*	0.0000	-7.971*	0.0000
ODA	Level	Intercept	-0.901	0.7766	-1.126	0.6946
		Trend, Intercept	-4.108**	0.0155	-3.082	0.1259
	First Difference	Intercept	-4.839*	0.0004	-4.839*	0.0004
		Trend, Intercept	-4.723*	0.0030	-4.727*	0.0030

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 77
ADF and PP Test Results for Colombia

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-4.214*	0.0023	-1.902	0.3278
		Trend, Intercept	-4.225*	0.0109	-1.962	0.6015
	First Difference	Intercept	-2.771**	0.0738	-3.497**	0.0140
		Trend, Intercept	-2.696	0.2447	-3.454	0.0605
TOT	Level	Intercept	-1.447	0.5464	-1.539	0.5030
		Trend, Intercept	-1.916	0.6224	-1.990	0.5868
	First Difference	Intercept	-1.980	0.2938	-6.099*	0.0000
		Trend, Intercept	-1.656	0.7465	-6.008*	0.0001
PROD	Level	Intercept	-1.316	0.6106	-0.319	0.9122
		Trend, Intercept	-1.783	0.6907	-0.975	0.9350
	First Difference	Intercept	-2.152	0.2266	-3.180**	0.0298
		Trend, Intercept	-3.714**	0.0345	-3.729**	0.0334
G	Level	Intercept	-0.588	0.8611	-0.730	0.8263
		Trend, Intercept	-2.691	0.2463	-1.820	0.6740
	First Difference	Intercept	-2.692	0.0858	-5.551*	0.0001
		Trend, Intercept	-2.649	0.2628	-5.480*	0.0004
OPEN	Level	Intercept	1.982	0.9998	2.260	0.9999
		Trend, Intercept	-2.258	0.4448	-2.482	0.3345
	First Difference	Intercept	-4.399*	0.0014	-7.184*	0.0000
		Trend, Intercept	-5.639*	0.0003	-13.983*	0.0000
NFA	Level	Intercept	-3.424**	0.0167	-1.776	0.3861
		Trend, Intercept	-4.103**	0.0156	-2.656	0.2599
	First Difference	Intercept	-3.419**	0.0185	-3.512**	0.0135
		Trend, Intercept	-3.446	0.0648	-3.975**	0.0191
ODA	Level	Intercept	-3.290**	0.0228	-3.319**	0.0213
		Trend, Intercept	-3.781**	0.0294	-3.834**	0.0260

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 78
ADF and PP Test Results for Egypt

Variable	Test in	Includes	ADF		PP	
			t -statistic	p-value	t-statistic	p-value
REER	Level	Intercept	2.719	0.0816	-2.110	0.2420
		Trend, Intercept	-3.275	0.0880	-2.365	0.3906
	First Difference	Intercept	-4.166*	0.0026	-2.915**	0.0437
		Trend, Intercept	-4.285**	0.0117	-2.866	0.1853
TOT	Level	Intercept	-2.318	0.1725	-3.065	0.0584
		Trend, Intercept	-2.657	0.2596	-3.656	0.0589
	First Difference	Intercept	-2.751	0.0768	-7.640*	0.0000
		Trend, Intercept	-2.691	0.2467	-7.544*	0.0000
PROD	Level	Intercept	-0.779	0.8128	-0.420	0.8951
		Trend, Intercept	-1.924	0.6203	-1.479	0.8185
	First Difference	Intercept	-3.453**	0.0156	-3.528**	0.0130
		Trend, Intercept	-2.357	0.3924	-3.502	0.0547
G	Level	Intercept	-1.374	0.5799	-1.142	0.6882
		Trend, Intercept	-1.585	0.7785	-2.473	0.3388
	First Difference	Intercept	-8.417*	0.0000	-7.943*	0.0000
		Trend, Intercept	-8.857*	0.0000	-8.363*	0.0000
I	Level	Intercept	-3.264**	0.0247	-1.559	0.4927
		Trend, Intercept	-2.428	0.3595	-1.337	0.8621
	First Difference	Intercept	-3.810*	0.0064	-3.740*	0.0076
		Trend, Intercept	-3.994**	0.0182	-3.916**	0.0218
OPEN	Level	Intercept	0.528	0.9849	-2.031	0.2729
		Trend, Intercept	-2.028	0.5664	-1.938	0.6141
	First Difference	Intercept	-6.150*	0.0000	-6.153*	0.0000
		Trend, Intercept	-7.180*	0.0000	-7.180*	0.0000
NFA	Level	Intercept	-2.342	0.1660	-1.958	0.3032
		Trend, Intercept	-2.141	0.5063	-1.294	0.8735
	First Difference	Intercept	-2.989**	0.0458	-2.966**	0.0481
		Trend, Intercept	-3.291	0.0844	-3.211	0.0988
ODA	Level	Intercept	-2.250	0.1932	-1.775	0.3865
		Trend, Intercept	-3.419	0.0651	-2.486	0.3325
	First Difference	Intercept	-2.156	0.2258	-7.034**	0.0000
		Trend, Intercept	-2.127	0.5087	-6.838**	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 79
ADF and PP Test Results for Greece

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-1.157	0.6820	-1.382	0.5800
		Trend, Intercept	-1.572	0.7841	-1.921	0.6226
	First Difference	Intercept	-4.704*	0.0006	-4.759*	0.0005
		Trend, Intercept	-4.625*	0.0038	-4.682*	0.0033
TOT	Level	Intercept	-1.965	0.3002	-2.250	0.1930
		Trend, Intercept	-3.088	0.1277	-2.655	0.2603
	First Difference	Intercept	-5.816*	0.0000	-6.612*	0.0000
		Trend, Intercept	-5.804*	0.0002	-7.655*	0.0000
PROD	Level	Intercept	-2.149	0.2285	-1.643	0.4510
		Trend, Intercept	-2.242	0.4498	-1.758	0.7038
	First Difference	Intercept	-2.105	0.2443	-2.994**	0.0463
		Trend, Intercept	-4.492*	0.0068	-2.855	0.1887
G	Level	Intercept	-1.874	0.3403	-1.974	0.2965
		Trend, Intercept	-2.197	0.4771	-2.465	0.3424
	First Difference	Intercept	-7.497*	0.0000	-7.529*	0.0000
		Trend, Intercept	-2.125	0.5105	-7.451*	0.0000
I	Level	Intercept	-0.994	0.7452	-1.157	0.6819
		Trend, Intercept	-1.279	0.8772	-1.421	0.8375
	First Difference	Intercept	-5.817**	0.0000	-5.819*	0.0000
		Trend, Intercept	-5.846**	0.0001	-5.847*	0.0001
OPEN	Level	Intercept	1.147	0.9971	0.814	0.9929
		Trend, Intercept	-2.327	0.4093	-2.103	0.5268
	First Difference	Intercept	-6.269**	0.0000	-7.541*	0.0000
		Trend, Intercept	-6.671**	0.0000	-8.981*	0.0000
NFA	Level	Intercept	-1.770	0.3889	-1.895	0.3311
		Trend, Intercept	-3.065	0.1316	-1.906	0.6305
	First Difference	Intercept	-6.707**	0.0000	-6.649*	0.0000
		Trend, Intercept	-6.717**	0.0000	-6.657*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 80
ADF and PP Test Results for Indonesia

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.081	0.2530	-2.047	0.2666
		Trend, Intercept	-1.899	0.6343	-1.689	0.7355
	First Difference	Intercept	-5.202*	0.0001	-7.050*	0.0000
		Trend, Intercept	-5.805*	0.0002	-7.260*	0.0000
TOT	Level	Intercept	-3.105**	0.0351	-3.170**	0.0302
		Trend, Intercept	-2.982	0.1509	-3.056	0.1321
	First Difference	Intercept	-5.482*	0.0001	-5.731*	0.0000
		Trend, Intercept	-5.413*	0.0005	-5.566*	0.0003
G	Level	Intercept	-2.271	0.1868	-1.532	0.5061
		Trend, Intercept	-2.347	0.3988	-1.537	0.7978
	First Difference	Intercept	-5.013*	0.0002	-5.116*	0.0002
		Trend, Intercept	-4.980*	0.0015	-5.060*	0.0012
I	Level	Intercept	-1.864	0.3448	-1.897	0.3298
		Trend, Intercept	-2.196	0.4771	-2.220	0.4647
	First Difference	Intercept	-6.161*	0.0000	-6.162*	0.0000
		Trend, Intercept	-6.083*	0.0001	-6.083*	0.0001
ODA	Level	Intercept	-1.554	0.4954	-1.551	0.4968
		Trend, Intercept	-2.646	0.2635	-2.753	0.2229
	First Difference	Intercept	-6.273*	0.0000	-6.480*	0.0000
		Trend, Intercept	-6.202*	0.0001	-6.710*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 81
ADF and PP Test Results for India

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.381**	0.0190	-1.632	0.4564
		Trend, Intercept	-0.375	0.9848	-0.862	0.9495
	First Difference	Intercept	-3.250**	0.0253	-3.193**	0.0289
		Trend, Intercept	-3.696**	0.0359	-3.696**	0.0359
TOT	Level	Intercept	-1.826	0.3624	-1.828	0.3614
		Trend, Intercept	-1.749	0.7082	-1.749	0.7082
	First Difference	Intercept	-5.881*	0.0000	-5.881*	0.0000
		Trend, Intercept	-6.063*	0.0001	-6.060*	0.0001
PROD	Level	Intercept	4.486	1.0000	4.109	1.0000
		Trend, Intercept	-0.207	0.9904	-0.211	0.9903
	First Difference	Intercept	-1.940	0.3108	-3.569**	0.0117
		Trend, Intercept	-3.533	0.0557	-5.753*	0.0002
I	Level	Intercept	-0.932	0.7663	-0.935	0.7654
		Trend, Intercept	-2.331	0.4063	-2.312	0.4171
	First Difference	Intercept	-6.636*	0.0000	-6.595*	0.0000
		Trend, Intercept	-6.538*	0.0000	-6.504*	0.0000
NFA	Level	Intercept	-1.016	0.7366	-0.665	0.8430
		Trend, Intercept	-2.381	0.3820	-1.852	0.6582
	First Difference	Intercept	-3.846*	0.0058	-3.826*	0.0061
		Trend, Intercept	-3.756**	0.0314	-3.736**	0.0329

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 82
ADF and PP Test Results for South Korea

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.748*	0.0075	-2.590	0.1043
		Trend, Intercept	-3.690**	0.0364	-2.556	0.3013
	First Difference	Intercept	-4.245*	0.0027	-5.209*	0.0001
		Trend, Intercept	-4.206**	0.0135	-5.076*	0.0012
TOT	Level	Intercept	-3.021**	0.0447	0.027	0.9550
		Trend, Intercept	-2.463	0.3432	-2.027	0.5674
	First Difference	Intercept	-3.585**	0.0113	-3.585**	0.0113
		Trend, Intercept	-3.732**	0.0332	-3.732**	0.0332
PROD	Level	Intercept	-3.687*	0.0086	-6.074*	0.0000
		Trend, Intercept	-1.097	0.9157	-0.867	0.9490
	First Difference	Intercept	-4.714*	0.0006	-4.754*	0.0005
		Trend, Intercept	-6.387*	0.0000	-7.037*	0.0000
I	Level	Intercept	-1.761	0.3932	-1.761	0.3932
		Trend, Intercept	-2.223	0.4630	-1.915	0.6263
	First Difference	Intercept	-4.888*	0.0004	-5.533*	0.0001
		Trend, Intercept	-4.966*	0.0017	-5.588*	0.0003
G	Level	Intercept	0.155	0.9656	0.044	0.9565
		Trend, Intercept	-2.390	0.3782	-2.390	0.3782
	First Difference	Intercept	-5.558*	0.0001	-5.588*	0.0000
		Trend, Intercept	-6.062*	0.0001	-6.068*	0.0001
OPEN	Level	Intercept	-0.864	0.7839	0.500	0.9844
		Trend, Intercept	-2.099	0.5287	-2.101	0.5281
	First Difference	Intercept	-1.407	0.5637	-5.503*	0.0001
		Trend, Intercept	-2.463	0.3418	-9.733*	0.0000
NFA	Level	Intercept	-0.646	0.8475	-0.670	0.8416
		Trend, Intercept	-2.590	0.2870	-2.779	0.2137
	First Difference	Intercept	-5.673*	0.0000	-5.724*	0.0000
		Trend, Intercept	-3.336	0.0812	-5.583*	0.0003

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 83
ADF and PP Test Results for Malaysia

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-1.067	0.7182	-1.081	0.7127
		Trend, Intercept	-2.426	0.3606	-1.987	0.5883
	First Difference	Intercept	-4.103*	0.0030	-4.291*	0.0018
		Trend, Intercept	-4.142**	0.0130	-4.347*	0.0077
TOT	Level	Intercept	-2.292	0.1800	-2.529	0.1173
		Trend, Intercept	-2.978	0.1525	-2.637	0.2672
	First Difference	Intercept	-5.111*	0.0002	-5.105*	0.0002
		Trend, Intercept	-5.044*	0.0013	-5.034*	0.0013
PROD	Level	Intercept	-0.028	0.9496	-0.243	0.9236
		Trend, Intercept	-3.462	0.0615	-2.265	0.4413
	First Difference	Intercept	-4.218*	0.0022	-4.189*	0.0024
		Trend, Intercept	-4.194**	0.0113	-4.158**	0.0123
I	Level	Intercept	-1.988	0.2906	-1.988	0.2906
		Trend, Intercept	-2.094	0.5314	-2.094	0.5314
	First Difference	Intercept	-5.437*	0.0001	-5.429*	0.0001
		Trend, Intercept	-5.350*	0.0006	-5.341*	0.0006
G	Level	Intercept	-2.141	0.2307	-1.356	0.5927
		Trend, Intercept	-1.265	0.8806	-1.250	0.8843
	First Difference	Intercept	-3.456**	0.0157	-5.791*	0.0000
		Trend, Intercept	-6.245*	0.0000	-6.273*	0.0000
OPEN	Level	Intercept	-1.605	0.4683	-0.792	0.8094
		Trend, Intercept	-3.019	0.1434	-2.129	0.5127
	First Difference	Intercept	-1.398	0.5705	-6.409*	0.0000
		Trend, Intercept	-2.137	0.5050	-6.272*	0.0000
NFA	Level	Intercept	-2.073	0.2562	-1.589	0.4777
		Trend, Intercept	0.027	0.9949	-2.660	0.2580
	First Difference	Intercept	-5.768*	0.0000	-7.886*	0.0000
		Trend, Intercept	-6.566*	0.0000	-12.60*	0.0000
ODA	Level	Intercept	-1.775	0.3851	-2.403	0.1480
		Trend, Intercept	-2.207	0.4694	-3.783**	0.0293
	First Difference	Intercept	-2.891	0.0583	-8.908*	0.0000
		Trend, Intercept	-3.229	0.0986	-8.746*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 84
ADF and PP Test Results for Mexico

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.082**	0.037	-2.403	0.1480
		Trend, Intercept	-3.733**	0.033	-2.828	0.197
	First Difference	Intercept	-5.750*	0.000	-5.751*	0.000
		Trend, Intercept	-4.799*	0.003	-5.668*	0.000
TOT	Level	Intercept	-4.860*	0.001	-2.233	0.199
		Trend, Intercept	-4.637*	0.005	-2.861	0.187
	First Difference	Intercept	-4.615*	0.001	-4.500*	0.001
		Trend, Intercept	-4.572*	0.004	-4.414*	0.007
PROD	Level	Intercept	-2.652	0.092	-2.705	0.083
		Trend, Intercept	-1.665	0.746	-1.612	0.769
	First Difference	Intercept	-2.659	0.093	-5.101*	0.000
		Trend, Intercept	-3.335	0.079	-5.989*	0.000
I	Level	Intercept	-0.964	0.754	-2.214	0.205
		Trend, Intercept	-5.212*	0.001	-3.747**	0.032
	First Difference	Intercept	-3.171**	0.032	-5.636*	0.000
		Trend, Intercept	-3.078	0.129	-5.917*	0.000
G	Level	Intercept	-0.873	0.785	-1.017	0.737
		Trend, Intercept	-3.322	0.080	-2.746	0.226
	First Difference	Intercept	-5.950*	0.000	-5.950*	0.000
		Trend, Intercept	-6.114*	0.000	-6.112*	0.000
OPEN	Level	Intercept	0.068	0.959	0.093	0.961
		Trend, Intercept	-4.008**	0.020	-1.959	0.603
	First Difference	Intercept	-5.918*	0.000	-5.919*	0.000
		Trend, Intercept	-5.942*	0.000	-5.944*	0.000
NFA	Level	Intercept	-1.264	0.632	-0.279	0.918
		Trend, Intercept	-4.454*	0.007	-0.245	0.9233
	First Difference	Intercept	-3.202**	0.031	-6.806*	0.000
		Trend, Intercept	-3.654**	0.043	-6.438*	0.000
ODA	Level	Intercept	-2.777	0.072	-2.786	0.070
		Trend, Intercept	-3.165	0.108	-3.165	0.108
	First Difference	Intercept	-6.647*	0.000	-7.502*	0.000
		Trend, Intercept	-3.484	0.058	-7.321*	0.000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 85

ADF and PP Test Results for Pakistan

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-3.596**	0.011	-2.045	0.2671
		Trend, Intercept	0.095	0.9960	0.095	0.9960
	First Difference	Intercept	-4.663*	0.0006	-4.727*	0.0005
		Trend, Intercept	-6.742*	0.0000	-12.084*	0.0000
TOT	Level	Intercept	-1.537	0.5036	-1.392	0.5755
		Trend, Intercept	-1.559	0.7881	-1.305	0.8707
	First Difference	Intercept	-3.987*	0.0041	-7.204*	0.0000
		Trend, Intercept	-4.059**	0.0191	-7.804*	0.0000
PROD	Level	Intercept	-0.204	0.9290	-0.544	0.8706
		Trend, Intercept	-0.894	0.9458	-1.246	0.8851
	First Difference	Intercept	-4.384*	0.0014	-4.368*	0.0014
		Trend, Intercept	-4.464*	0.0058	-4.437*	0.0062
G	Level	Intercept	-1.456	0.5438	-1.947	0.3081
		Trend, Intercept	-1.481	0.8172	-2.038	0.5617
	First Difference	Intercept	-8.288*	0.0000	-8.305*	0.0000
		Trend, Intercept	-5.033*	0.0014	-8.187*	0.0000
OPEN	Level	Intercept	1.898	0.9997	-0.391	0.9002
		Trend, Intercept	-1.717	0.7167	-1.353	0.8577
	First Difference	Intercept	-3.225**	0.0290	-5.753*	0.0000
		Trend, Intercept	-4.490*	0.0068	-6.250*	0.0000
NFA	Level	Intercept	-1.429	0.5574	-1.517	0.5135
		Trend, Intercept	-2.227	0.4609	-2.327	0.4096
	First Difference	Intercept	-5.438*	0.0001	-5.429*	0.0001
		Trend, Intercept	-5.349*	0.0006	-5.328*	0.0006

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 86
ADF and PP Test Results for Peru

Variable	Test in	Includes	ADF		PP	
			t-statistic	**p-value**	**t-statistic**	**p-value**
REER	Level	Intercept	-1.868	0.3427	-2.027	0.2745
		Trend, Intercept	-3.180	0.1095	-1.531	0.7997
	First Difference	Intercept	-3.095**	0.0364	-6.549*	0.0000
		Trend, Intercept	-3.291	0.0849	-6.747*	0.0000
TOT	Level	Intercept	-2.711	0.0848	-3.171**	0.0301
		Trend, Intercept	-2.608	0.2797	-2.965	0.1555
	First Difference	Intercept	-6.118*	0.0000	-10.407*	0.0000
		Trend, Intercept	-5.999*	0.0001	-10.080*	0.0000
PROD	Level	Intercept	-1.905	0.3265	-1.405	0.5691
		Trend, Intercept	-2.058	0.5500	-1.205	0.8943
	First Difference	Intercept	-3.160**	0.0312	-3.164**	0.0309
		Trend, Intercept	-2.499	0.3263	-3.656**	0.0392
I	Level	Intercept	-1.348	0.5965	-1.428	0.5577
		Trend, Intercept	-2.296	0.4255	-2.331	0.4077
	First Difference	Intercept	-5.494*	0.0001	-5.499*	0.0001
		Trend, Intercept	-5.589*	0.0003	-5.589*	0.0003
G	Level	Intercept	-2.118	0.2390	-2.120	0.2383
		Trend, Intercept	-1.168	0.9021	-1.168	0.9021
	First Difference	Intercept	-6.107*	0.0000	-6.092*	0.0000
		Trend, Intercept	-6.370*	0.0000	-6.347*	0.0000
OPEN	Level	Intercept	1.885	0.9996	1.296	0.9981
		Trend, Intercept	-1.424	0.8303	-2.199	0.4760
	First Difference	Intercept	-2.403	0.1495	-7.045*	0.0000
		Trend, Intercept	-4.245**	0.0123	-12.425*	0.0000
NFA	Level	Intercept	0.370	0.9777	-0.183	0.9307
		Trend, Intercept	-4.556*	0.0071	-3.583**	0.0479
	First Difference	Intercept	-4.910*	0.0007	-9.706*	0.0000
		Trend, Intercept	-4.442*	0.0095	-9.289*	0.0000
ODA	Level	Intercept	-0.656	0.8448	-1.244	0.6443
		Trend, Intercept	-4.270*	0.0098	-3.790**	0.0288
	First Difference	Intercept	-9.368*	0.0000	-9.388*	0.0000
		Trend, Intercept	-9.344*	0.0000	-9.344*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 87
ADF and PP Test Results for Philippine

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.521	0.1199	-2.114	0.2407
		Trend, Intercept	-2.319	0.4128	-1.762	0.7021
	First Difference	Intercept	-5.817*	0.0000	-5.822*	0.0000
		Trend, Intercept	-3.879**	0.0280	-6.104*	0.0001
TOT	Level	Intercept	-2.710	0.0824	-2.173	0.2190
		Trend, Intercept	-2.729	0.2319	-2.261	0.4436
	First Difference	Intercept	-4.168*	0.0026	-3.937*	0.0046
		Trend, Intercept	-4.175**	0.0121	-3.900**	0.0227
PROD	Level	Intercept	0.160	0.9649	-1.494	0.5253
		Trend, Intercept	-1.936	0.6141	-0.118	0.9925
	First Difference	Intercept	-1.315	0.6087	-2.325	0.1702
		Trend, Intercept	-6.355*	0.0000	-4.663*	0.0035
I	Level	Intercept	-2.482	0.1280	-2.592	0.1039
		Trend, Intercept	-2.214	0.4678	-2.105	0.5259
	First Difference	Intercept	-4.803*	0.0004	-4.653*	0.0007
		Trend, Intercept	-4.906*	0.0019	-4.856*	0.0021
G	Level	Intercept	-1.686	0.4286	-1.531	0.5069
		Trend, Intercept	-3.770**	0.0312	-1.910	0.6286
	First Difference	Intercept	-2.701	0.0856	-6.333*	0.0000
		Trend, Intercept	-1.755	0.7033	-6.250*	0.0000
OPEN	Level	Intercept	1.356	0.9983	-0.245	0.9233
		Trend, Intercept	-3.930**	0.0226	-1.721	0.7211
	First Difference	Intercept	-1.912	0.3224	-5.234*	0.0001
		Trend, Intercept	-2.063	0.5431	-5.482*	0.0004
NFA	Level	Intercept	-0.204	0.9290	-0.405	0.8977
		Trend, Intercept	-3.662**	0.0388	-2.993	0.1481
	First Difference	Intercept	-4.113*	0.0029	-4.077*	0.0032
		Trend, Intercept	-3.060	0.1357	-4.012**	0.0175
ODA	Level	Intercept	-0.810	0.8007	-1.355	0.5930
		Trend, Intercept	-3.526	0.0552	-2.637	0.2671
	First Difference	Intercept	-2.076	0.2551	-7.290*	0.0000
		Trend, Intercept	-2.003	0.5747	-7.310*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 88

ADF and PP Test Results for Poland

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-2.246	0.195	-2.240	0.196
		Trend, Intercept	-3.036	0.137	-2.352	0.397
	First Difference	Intercept	-4.704*	0.001	-4.581*	0.001
		Trend, Intercept	-5.162*	0.001	-4.615*	0.004
TOT	Level	Intercept	-1.679	0.433	-1.889	0.334
		Trend, Intercept	1.815	1.000	-1.803	0.682
	First Difference	Intercept	-2.762	0.075	-6.233*	0.000
		Trend, Intercept	-4.637*	0.004	-11.290*	0.000
I	Level	Intercept	-3.545	0.013	-2.292	0.180
		Trend, Intercept	-2.935	0.166	-2.304	0.421
	First Difference	Intercept	-4.401*	0.002	-3.890*	0.005
		Trend, Intercept	-4.556*	0.005	-3.793**	0.029
G	Level	Intercept	0.419	0.980	-0.773	0.815
		Trend, Intercept	-4.480	0.006	-3.434	0.063
	First Difference	Intercept	-5.061*	0.000	-12.348*	0.000
		Trend, Intercept	-5.016*	0.002	-11.949*	0.000
OPEN	Level	Intercept	1.951	1.000	1.052	0.996
		Trend, Intercept	-3.063	0.135	-1.984	0.590
	First Difference	Intercept	-2.172	0.221	-5.223*	0.000
		Trend, Intercept	-4.621*	0.005	-5.910*	0.000
NFA	Level	Intercept	-4.455*	0.001	-4.484	0.001
		Trend, Intercept	-1.664	0.741	-4.419	0.006

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 89
ADF and PP Test Results for South Africa

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-1.453	0.5457	-1.133	0.6919
		Trend, Intercept	-3.633**	0.0413	-2.476	0.3371
	First Difference	Intercept	-5.169*	0.0002	-5.819*	0.0000
		Trend, Intercept	-5.101*	0.0011	-6.053*	0.0001
TOT	Level	Intercept	-0.651	0.8449	-1.949	0.3072
		Trend, Intercept	-3.883**	0.0247	-3.099	0.1218
	First Difference	Intercept	-4.205*	0.0025	-7.409*	0.0000
		Trend, Intercept	-4.443*	0.0069	-7.379*	0.0000
PROD	Level	Intercept	-3.744*	0.0075	-2.614	0.0995
		Trend, Intercept	-2.588	0.2875	-1.272	0.8790
	First Difference	Intercept	-2.761	0.0744	-2.860*	0.0604
		Trend, Intercept	-4.159*	0.0123	-4.298*	0.0088
G	Level	Intercept	-3.202**	0.0283	-2.088	0.2504
		Trend, Intercept	-3.004	0.1454	-1.963	0.6010
	First Difference	Intercept	-4.233*	0.0021	-4.307*	0.0017
		Trend, Intercept	-4.295*	0.0088	-4.372*	0.0073
I	Level	Intercept	-1.584	0.4801	-1.702	0.4217
		Trend, Intercept	-4.036**	0.0165	-2.832	0.1958
	First Difference	Intercept	-5.422*	0.0001	-5.449*	0.0001
		Trend, Intercept	-5.882*	0.0001	-5.882*	0.0001
OPEN	Level	Intercept	1.324	0.9982	0.354	0.9780
		Trend, Intercept	-2.143	0.5055	-1.784	0.6915
	First Difference	Intercept	-3.509**	0.0140	-6.796*	0.0000
		Trend, Intercept	-3.690**	0.0413	-11.927*	0.0000
NFA	Level	Intercept	-0.443	0.8902	-0.580	0.8629
		Trend, Intercept	-1.801	0.6807	-3.048	0.1340
	First Difference	Intercept	-3.733*	0.0079	-6.380*	0.0000
		Trend, Intercept	-3.603**	0.0445	-6.541*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 90

ADF and PP Test Results for Thailand

Variable	Test in	Includes	ADF		PP	
			t-statistic	p-value	t-statistic	p-value
REER	Level	Intercept	-1.766	0.3905	-1.787	0.3805
		Trend, Intercept	-1.096	0.9158	-1.218	0.8916
	First Difference	Intercept	-4.775*	0.0005	-4.776*	0.0005
		Trend, Intercept	-5.011*	0.0014	-4.949*	0.0017
TOT	Level	Intercept	-2.500	0.1240	-2.476	0.1295
		Trend, Intercept	-1.975	0.5946	-2.356	0.3948
	First Difference	Intercept	-5.914*	0.0000	-6.049*	0.0000
		Trend, Intercept	-5.973*	0.0001	-6.085*	0.0001
PROD	Level	Intercept	-1.146	0.6862	-1.059	0.7212
		Trend, Intercept	-2.773	0.2166	-1.860	0.6542
	First Difference	Intercept	-3.152**	0.0318	-3.167**	0.0307
		Trend, Intercept	-3.145	0.1120	-3.196	0.1017
I	Level	Intercept	-1.656	0.4440	-1.369	0.5863
		Trend, Intercept	-2.365	0.3903	-2.000	0.5814
	First Difference	Intercept	-4.414*	0.0013	-4.399*	0.0013
		Trend, Intercept	-4.377*	0.0072	-4.358*	0.0075
G	Level	Intercept	-2.246	0.1946	-1.518	0.5131
		Trend, Intercept	-2.152	0.4999	-1.285	0.8758
	First Difference	Intercept	-4.087*	0.0031	-4.087*	0.0031
		Trend, Intercept	-4.588*	0.0042	-4.616*	0.0039
OPEN	Level	Intercept	-1.135	0.6913	-1.128	0.6940
		Trend, Intercept	-1.277	0.8777	-1.239	0.8868
	First Difference	Intercept	-6.152*	0.0000	-6.152*	0.0000
		Trend, Intercept	-4.998*	0.0015	-6.209*	0.0001
NFA	Level	Intercept	-1.026	0.7332	-0.803	0.8063
		Trend, Intercept	-2.593	0.2857	-2.130	0.5122
	First Difference	Intercept	-4.305*	0.0017	-4.289*	0.0018
		Trend, Intercept	-4.241**	0.0101	-4.225**	0.0105
ODA	Level	Intercept	-1.446	0.5485	-1.682	0.4318
		Trend, Intercept	-2.910	0.1715	-2.936	0.1639
	First Difference	Intercept	-8.206*	0.0000	-8.326*	0.0000
		Trend, Intercept	-8.182*	0.0000	-8.678*	0.0000

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 91

ADF and PP Test Results for Turkey

Variable	Test in	Includes	ADF		PP	
			t-statistic	**p-value**	**t-statistic**	**p-value**
REER	Level	Intercept	-1.869	0.3427	-1.887	0.3347
		Trend, Intercept	-2.510	0.3213	-2.451	0.3488
	First Difference	Intercept	-2.688	0.0886	-6.817*	0.0000
		Trend, Intercept	-1.431	0.8288	-6.890*	0.0000
TOT	Level	Intercept	-1.978	0.2942	-2.115	0.2403
		Trend, Intercept	0.004	0.9942	-2.394	0.3762
	First Difference	Intercept	-1.606	0.4664	-6.732*	0.0000
		Trend, Intercept	0.543	0.9989	-6.636*	0.0000
PROD	Level	Intercept	-0.689	0.9902	0.775	0.9922
		Trend, Intercept	-1.016	0.9290	-1.016	0.9290
	First Difference	Intercept	-5.843*	0.0000	-5.843*	0.0000
		Trend, Intercept	-6.170*	0.0001	-6.184*	0.0001
I	Level	Intercept	-2.499	0.1242	-2.461	0.1331
		Trend, Intercept	-2.734	0.2299	-2.607	0.2797
	First Difference	Intercept	-8.701*	0.0000	-8.702*	0.0000
		Trend, Intercept	-8.747*	0.0000	-8.995*	0.0000
OPEN	Level	Intercept	-1.91	0.3239	-1.910	0.3243
		Trend, Intercept	-1.728	0.7180	-1.724	0.7196
	First Difference	Intercept	-5.592*	0.0000	-5.589*	0.0000
		Trend, Intercept	-5.762*	0.0002	-5.761*	0.0002
NFA	Level	Intercept	-2.410	0.1467	-2.100	0.2457
		Trend, Intercept	-1.441	0.8312	-1.707	0.7276
	First Difference	Intercept	-5.072*	0.0002	-5.102*	0.0002
		Trend, Intercept	-5.094*	0.0011	-5.093*	0.0011

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Table 92
ADF and PP Test Results for ARE

Variable	Test in	Includes	ADF		PP	
			t-statistic	**p-value**	**t-statistic**	**p-value**
REER	Level	Intercept	-0.757	0.8191	-0.820	0.8014
		Trend, Intercept	-4.156**	0.0150	-2.313	0.4165
	First Difference	Intercept	-3.825*	0.0064	-5.201*	0.0001
		Trend, Intercept	-3.866**	0.0252	-5.954*	0.0001
TOT	Level	Intercept	-1.558	0.4902	-2.509	0.1218
		Trend, Intercept	-1.030	0.9232	-2.795	0.2083
	First Difference	Intercept	-5.266*	0.0001	-7.631*	0.0000
		Trend, Intercept	-5.247*	0.0008	-9.125*	0.0000
PROD	Level	Intercept	-1.766	0.3900	-2.200	0.2098
		Trend, Intercept	-3.689	0.0383	-2.165	0.4938
	First Difference	Intercept	-3.566**	0.0118	-3.648*	0.0096
		Trend, Intercept	-3.924**	0.0214	-4.028**	0.0168
G	Level	Intercept	-1.489	0.5277	-1.570	0.4871
		Trend, Intercept	-1.949	0.6085	-2.061	0.5491
	First Difference	Intercept	-5.718*	0.0000	-5.724*	0.0000
		Trend, Intercept	-5.669*	0.0002	-5.678*	0.0002
I	Level	Intercept	-1.195	0.6658	-1.000	0.7430
		Trend, Intercept	-4.070**	0.0152	-3.844**	0.0254
	First Difference	Intercept	-4.977*	0.0003	-8.850*	0.0000
		Trend, Intercept	-4.805*	0.0026	-8.334*	0.0000
OPEN	Level	Intercept	1.821	0.9996	1.902	0.9997
		Trend, Intercept	-1.480	0.8156	-1.931	0.6178
	First Difference	Intercept	-2.787	0.0711	-4.256*	0.0020
		Trend, Intercept	-5.440*	0.0005	-5.423*	0.0005
NFA	Level	Intercept	-1.939	0.3114	-2.210	0.2063
		Trend, Intercept	-4.443*	0.0065	-2.604	0.2808
	First Difference	Intercept	-4.881*	0.0003	-4.975*	0.0003
		Trend, Intercept	-4.886*	0.0020	-4.992*	0.0015
ODA	Level	Intercept	-3.978*	0.0058	-3.955*	0.0061
		Trend, Intercept	-4.042**	0.0210	-3.984**	0.0237

Notes: * and ** indicate rejection of the Null hypothesis of having a unit root at 1% and 5% level of significance respectively

Appendix C: Optimal Lag Selection

Argentina

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-95.721	NA	1.35E-05	5.812629	6.07926	5.90467
1**	71.86183	268.1325*	7.56e-09*	-1.70639	0.160027*	-1.062103*
2	108.4588	46.00756	8.84E-09	-1.740500*	1.725704	-0.543967

Bangladesh

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-57.12431	NA	1.49E-06	3.607103	3.873734	3.699144
1	175.0411	371.4647	2.08E-11	-7.60235	-5.735932*	-6.958062
2**	222.0184	59.05716*	1.34e-11*	-8.229623*	-4.763419	-7.033090*

Brazil

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-208.0562	NA	0.008268	12.23178	12.49841	12.32382
1	-53.54606	247.2162	9.78E-06	5.459775	7.326192*	6.104062*
2**	-11.63934	52.68273*	8.45e-06*	5.122248*	8.588452	6.318781

Chile

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-159.1021	NA	0.008131	9.377261	9.599453	9.453961
1	-18.91818	232.3047	1.15E-05	2.795324	4.128480*	3.255529
2**	21.19189	55.00810*	5.30e-06*	1.931892*	4.37601	2.775601*

China

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-168.1354	NA	0.013625	9.893451	10.11564	9.970152
1	-0.617898	277.6004	4.03E-06	1.749594	3.082750*	2.209799
2**	36.43599	50.81676*	2.22e-06*	1.060801*	3.504919	1.904510*

Colombia

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-183.262	NA	0.002005	10.81497	11.0816	10.90701
1	13.87324	315.4164	2.08E-07	1.607244	3.473661*	2.251531
2**	72.93268	74.24616*	6.73e-08*	0.289561*	3.755765	1.486094*

* indicates lag order selected by the criterion
** Optimal lag length: The number of lag picked by most of the criteria
LR: sequential modified LR test statistic (each test at 5% level),
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

(Continued on next page)

Egypt

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-224.6961	NA	0.021396	13.18264	13.44927	13.27468
1**	-39.60813	296.1408*	4.41e-06*	4.663322*	6.529739*	5.307609*
2	-6.763255	41.2907	6.40E-06	4.843615	8.309819	6.040148

Greece

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-87.82593	NA	8.58E-06	5.361482	5.628113	5.453523
1**	80.51274	269.3419*	4.61e-09*	-2.200728*	-0.334310*	-1.556441*
2	104.6634	30.36088	1.10E-08	-1.523625	1.942579	-0.327092

Indonesia

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-152.3164	NA	0.005518	8.989509	9.211701	9.06621
1	-30.81207	201.35	2.26E-05	3.474975	4.808131*	3.93518
2**	4.523996	48.46089*	1.37e-05*	2.884343*	5.328461	3.728052*

India

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-129.2388	NA	0.001476	7.670788	7.892981	7.747489
1	92.57631	367.5793	1.96E-08	-3.575789	-2.242634*	-3.115584
2**	129.4816	50.61302*	1.09e-08*	-4.256093*	-1.811975	-3.412384*

South Korea

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-173.1169	NA	0.001123	10.23525	10.50188	10.32729
1	42.07664	344.3096	4.14E-08	-0.00438	1.862038*	0.639907
2**	103.268	76.92625*	1.19e-08*	-1.443885*	2.022319	-0.247352*

Malaysia

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-42.41816	NA	6.41E-07	2.766752	3.033383	2.858793
1**	145.3153	300.3735*	1.14e-10*	-5.903730*	-4.037313*	-5.259443*
2	180.2171	43.87655	1.46E-10	-5.840976	-2.374772	-4.644443

* indicates lag order selected by the criterion
** Optimal lag lenth: The number of lag picked by most of the criteria
LR: sequential modified LR test statistic (each test at 5% level),
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

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Mexico

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-284.3085	NA	10.40832	16.53191	16.75411	16.60861
1	-142.8465	234.4227*	0.013632*	9.876943	11.21010*	10.33715*
2	-117.0412	35.39014	0.014287	9.830926*	12.27504	10.67463

Pakistan

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-139.3751	NA	0.000163	8.307148	8.573779	8.399189
1	19.65511	254.4483	1.49E-07	1.276851	3.143269*	1.921138
2**	70.64273	64.09873*	7.67e-08*	0.420415*	3.88662	1.616949*

Peru

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-92.71489	NA	0.000183	5.583708	5.805901	5.660409
1	29.76529	202.9672	7.09E-07	0.013412	1.346567*	0.473617
2**	70.61198	56.01831*	3.15e-07*	-0.892113*	1.552005	-0.048404*

Philippine

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-111.1743	NA	0.000526	6.638533	6.860726	6.715234
1	15.49899	209.9158	1.60E-06	0.828629	2.161784	1.288834
2**	61.79422	63.49060*	5.21e-07*	-0.388241*	2.055877*	0.455468*

Poland

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-248.1161	NA	1.315834	14.46378	14.68597	14.54048
1	-125.4861	203.2155	0.005055	8.884919	10.21807*	9.345124
2**	-90.74195	47.64910*	0.003179*	8.328111*	10.77223	9.171821*

South Africa

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-90.18001	NA	0.000158	5.438857	5.66105	5.515558
1**	103.6149	321.1459*	1.04e-08*	-4.206567	-2.873412*	-3.746362*
2	130.2389	36.51285	1.04E-08	-4.299365*	-1.855246	-3.455655

* indicates lag order selected by the criterion
** Optimal lag lenth: The number of lag picked by most of the criteria
LR: sequential modified LR test statistic (each test at 5% level),
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

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Thailand

Lag	LogL	LR	FPE	AIC	SC	HQ
0	21.13445	NA	2.74E-07	-0.921968	-0.699776	-0.845267
1	203.9814	303.0035	3.37E-11	-9.941793	-8.608637*	-9.481588
2**	239.0622	48.11087*	2.08e-11*	-10.51784*	-8.073722	-9.674132*

Turkey

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-199.2451	NA	0.004997	11.72829	11.99492	11.82033
1**	-22.01156	283.5736*	1.61e-06*	3.657803	5.524221*	4.302090*
2	16.61335	48.55702	1.68E-06	3.507809*	6.974013	4.704342

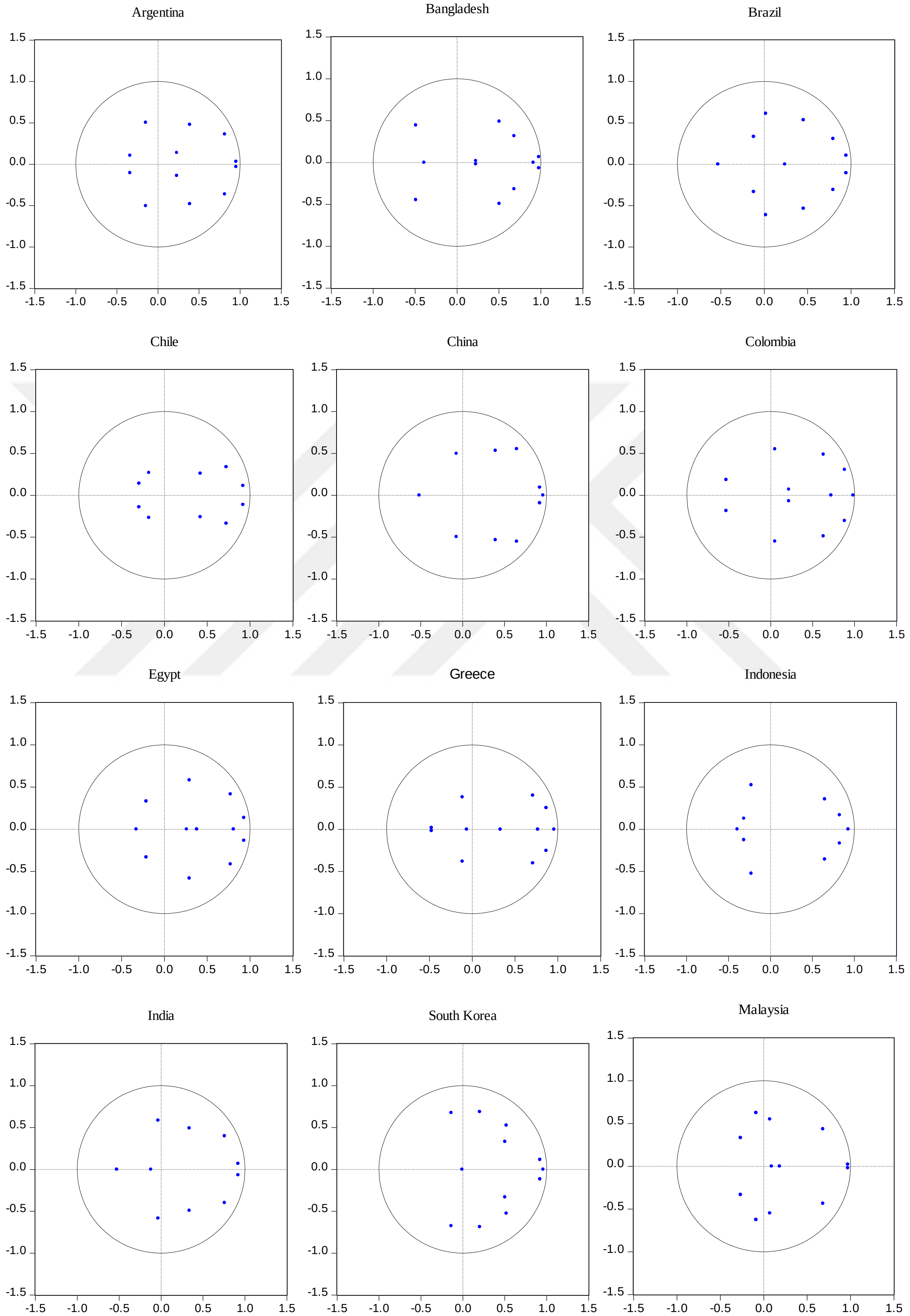
ARE

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-148.8299	NA	0.004521	8.790281	9.012473	8.866981
1	13.22412	268.5467	1.83E-06	0.958622	2.291777*	1.418827
2**	47.08161	46.43314*	1.21e-06*	0.452479*	2.896598	1.296189*

* indicates lag order selected by the criterion
** Optimal lag lenth: The number of lag picked by most of the criteria
LR: sequential modified LR test statistic (each test at 5% level),
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

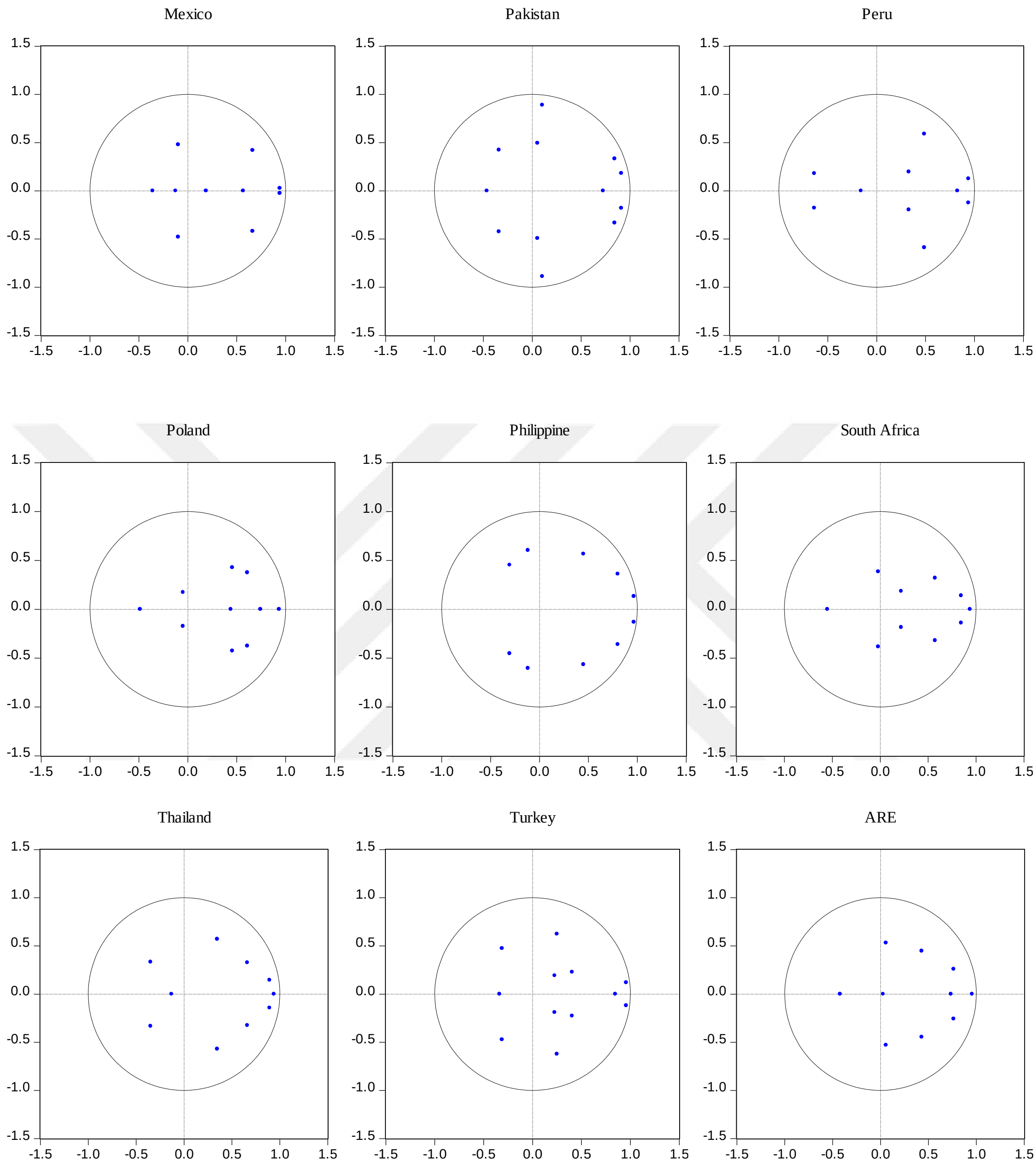
Appendix D: Stationarity of VARs

Inverse Roots of AR Characteristic Polynomial



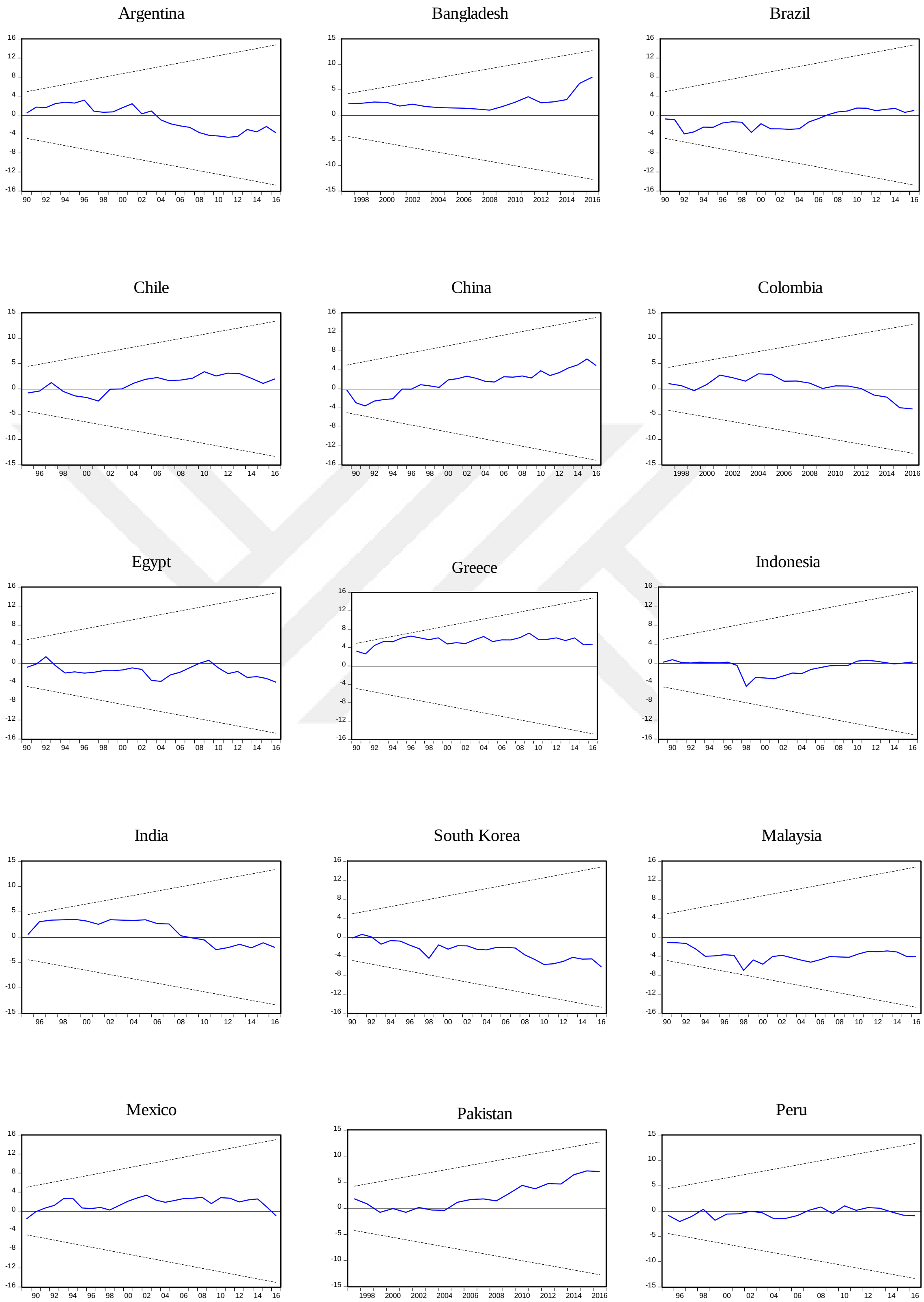
Note: Estimated VARs are stationary as all the inverse roots lie inside the unit circle

(Continued on next page)



Note: Estimated VARs are stationary as all the inverse roots lie inside the unit circle

Appendix E: Stability Diagnosis



The plots of cumulative sum of recursive residuals (CUSUM)

5% Significance

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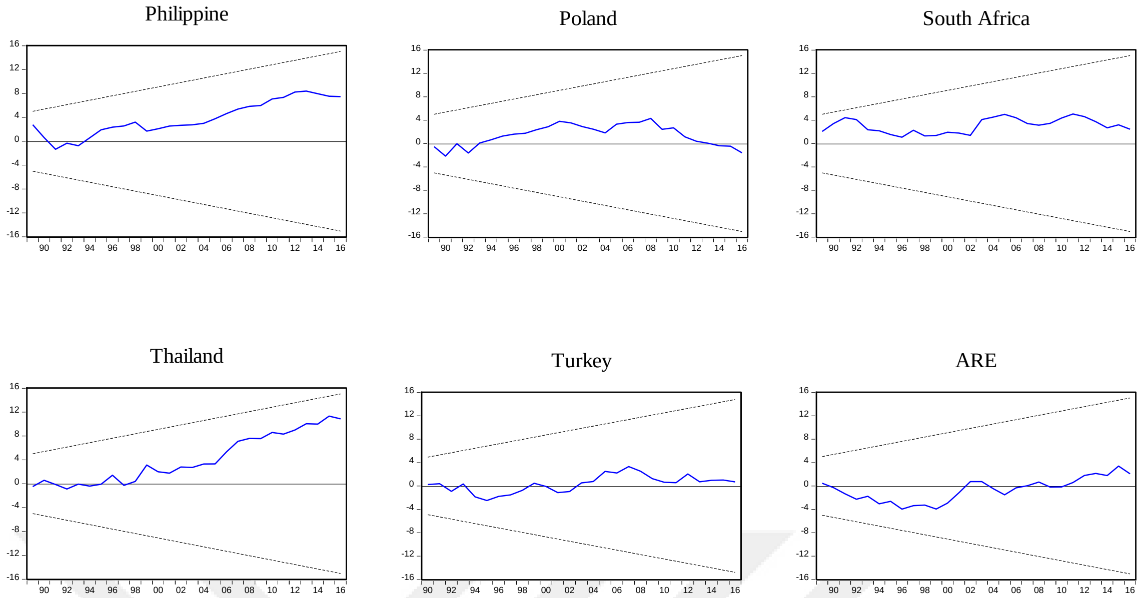

The plots of cumulative sum of recursive residuals (CUSUM)
5% Significance

Appendix F: REER Misalignment of Selected EMEs

Year	ARE	Argentina	Bangladesh	Brazil	Chile	China	Colombia
1980	-14.423	99.648	47.043	-6.971	116.644	-9.741	-7.421
1981	-5.330	64.353	52.387	11.485	165.364	-2.821	6.766
1982	5.089	-26.016	51.176	22.592	146.189	11.329	21.313
1983	8.696	-18.304	58.526	-4.980	104.089	31.307	28.664
1984	16.204	-7.873	81.073	-15.241	100.379	39.069	27.719
1985	23.685	-21.126	88.210	-19.682	64.407	36.992	18.585
1986	12.357	-35.866	71.012	-25.578	31.592	11.588	-6.801
1987	6.293	-42.148	68.977	-24.628	12.563	4.102	-12.022
1988	4.420	-40.328	67.990	-26.719	-3.291	18.417	-10.162
1989	7.488	-61.062	73.662	-3.298	-9.982	39.241	-9.344
1990	-2.689	-25.133	57.768	15.402	-22.231	1.726	-16.822
1991	-4.404	1.767	50.204	-3.210	-27.981	-11.822	-14.055
1992	-5.858	16.469	34.102	-16.541	-30.497	-17.245	-10.760
1993	19.906	39.292	36.183	-12.414	-34.181	-14.905	-1.074
1994	18.279	37.182	33.928	-7.889	-35.141	-36.440	21.969
1995	7.967	28.597	34.820	4.746	-32.596	-32.610	27.221
1996	6.451	24.233	30.807	14.761	-30.119	-28.473	34.173
1997	10.159	27.877	35.464	24.361	-21.745	-23.376	40.867
1998	13.531	33.159	44.520	28.976	-17.986	-16.791	29.557
1999	9.060	32.918	40.896	-9.468	-15.676	-16.293	14.204
2000	10.742	41.628	37.227	2.387	-9.897	-9.126	-0.271
2001	13.259	50.804	31.034	-10.605	-12.905	3.450	-7.353
2002	19.144	-34.724	24.621	-13.764	-9.294	9.744	-11.073
2003	8.022	-23.058	15.170	-16.786	-12.338	9.748	-25.525
2004	2.281	-19.841	7.624	-13.963	-6.510	11.513	-21.577
2005	2.840	-8.023	-0.669	4.750	-1.219	12.212	-14.454
2006	6.763	1.117	-7.856	14.445	1.558	11.881	-18.422
2007	7.981	8.711	-9.614	19.689	-2.943	11.347	-11.208
2008	12.567	15.503	-10.130	21.474	-3.747	14.524	-9.050
2009	17.567	14.206	-6.278	16.903	-8.018	10.624	-13.565
2010	13.159	22.454	-5.585	27.998	-4.429	3.041	-3.823
2011	4.394	24.426	-11.020	28.646	-4.645	-1.015	0.447
2012	4.033	29.289	-16.704	11.289	-1.068	-2.291	8.750
2013	3.645	19.699	-10.390	0.425	0.028	-3.002	10.155
2014	4.202	0.991	-7.849	-6.591	-6.235	-6.600	7.851
2015	15.477	13.281	1.455	-26.626	-1.765	-3.527	-10.251
2016	14.788	-5.103	1.994	-27.129	3.667	-14.942	-13.581

Source: Author’s estimates

(Continued on next page)

REER Misalignment of Selected EMEs

Year	Egypt	Greece	Indonesia	India	S. Korea	Malaysia	Mexico
1980	-9.104	-4.508	-22.674	-19.376	58.910	-12.020	
1981	-9.237	1.208	-3.803	-9.546	51.703	-9.773	
1982	-5.330	8.009	18.868	-0.912	50.393	-2.024	
1983	0.393	2.256	10.181	13.278	43.597	4.971	
1984	11.791	1.431	20.862	20.712	37.088	12.070	
1985	19.965	-0.025	31.480	25.581	24.897	10.066	81.756
1986	21.547	-5.458	13.298	18.446	0.274	-4.104	19.361
1987	35.762	-3.245	-8.856	17.475	-2.667	-5.480	-4.270
1988	53.190	-0.853	-4.781	19.750	7.772	-10.764	7.437
1989	56.234	-0.450	2.251	17.934	26.014	-8.965	7.009
1990	-0.875	3.761	4.514	12.134	22.805	-9.862	8.304
1991	-42.257	3.855	6.307	0.623	22.086	-9.987	21.382
1992	-33.631	5.230	6.299	-5.347	11.321	-1.609	35.596
1993	-20.454	4.405	12.703	-13.329	6.372	1.160	50.016
1994	-14.249	3.650	13.983	-8.768	6.810	0.060	48.665
1995	-12.119	5.387	11.755	-11.153	10.492	2.428	3.980
1996	-4.884	6.887	21.444	-11.785	14.817	8.705	19.928
1997	9.488	5.340	16.124	-3.847	0.839	7.568	43.664
1998	21.840	3.217	-43.875	0.873	-28.003	-12.025	50.407
1999	28.810	3.583	-16.899	-1.271	-21.602	-9.168	69.277
2000	41.616	-4.860	-19.012	-1.014	-17.401	-6.062	87.907
2001	33.990	-5.668	-22.587	-2.168	-23.559	0.283	103.312
2002	19.947	-4.102	-6.314	-4.407	-19.993	1.787	105.193
2003	-14.669	0.466	-0.132	-7.891	-16.759	-2.842	82.953
2004	-19.378	1.618	-5.599	-10.594	-14.553	-6.331	74.680
2005	-9.502	0.886	-8.128	-10.094	-2.801	-5.958	78.917
2006	-9.787	1.051	5.278	-12.503	3.522	-2.519	74.443
2007	-9.409	2.334	3.404	-7.790	2.781	-0.443	65.109
2008	-6.566	4.375	-2.151	-13.660	-16.968	0.000	52.108
2009	5.680	6.486	-4.315	-13.551	-26.249	-3.106	23.434
2010	9.139	5.933	5.654	-5.400	-19.777	2.032	21.467
2011	3.229	7.783	4.471	-7.534	-19.325	2.258	10.368
2012	9.462	4.841	-0.003	-13.404	-18.450	1.983	-2.852
2013	0.158	5.069	-4.440	-15.963	-13.110	2.622	-7.128
2014	6.779	5.882	-10.742	-15.593	-6.777	2.152	-16.593
2015	23.467	2.010	-9.493	-10.461	-3.778	-5.666	-32.075
2016	4.827	3.166	-5.706	-11.479	-3.862	-9.397	-46.287

Source: Author’s estimates

(Continued on next page)

REER Misalignment of Selected EMEs

Year	Pakistan	Peru	Philippine	Poland	Thailand	Turkey	S. Africa
1980	-6.925	15.851	-10.204	-25.052	-13.030	6.867	-0.884
1981	8.312	17.217	-5.014	-16.906	-8.419	17.830	4.245
1982	2.198	5.632	0.982	2.306	-3.402	14.177	-0.842
1983	2.422	-15.693	-12.840	16.441	2.802	17.458	10.230
1984	9.182	-26.864	-11.407	73.463	4.247	19.802	-1.168
1985	7.272	-47.010	-0.537	53.305	-4.462	28.499	-23.498
1986	-6.254	-41.861	-20.521	18.719	-10.745	12.001	-27.984
1987	-11.991	-27.783	-25.615	-15.874	-13.182	7.486	-17.298
1988	-9.517	-39.946	-23.450	-21.005	-12.557	5.316	-20.795
1989	-10.393	10.536	-17.027	-15.710	-7.424	15.550	-19.415
1990	-11.094	0.427	-20.190	-25.945	-5.607	28.325	-16.259
1991	-9.623	11.106	-18.701	7.876	-2.742	28.650	-12.311
1992	-8.366	7.518	-7.856	7.189	-2.301	21.417	-8.412
1993	-7.007	-3.362	-6.133	11.264	1.510	27.258	-8.433
1994	-5.369	2.161	6.309	8.560	3.746	-9.068	-9.595
1995	-3.701	3.558	13.688	12.145	4.833	-4.297	-8.164
1996	-3.714	7.388	28.311	16.530	12.901	-5.945	-10.659
1997	0.968	12.833	33.999	15.455	3.061	-3.350	0.945
1998	6.557	17.446	17.690	18.985	-7.619	3.485	-0.137
1999	2.847	7.566	28.541	9.163	-1.346	6.090	1.837
2000	5.668	13.568	19.723	16.099	-2.780	13.476	5.907
2001	0.068	19.316	13.224	28.059	-5.190	-11.139	-0.764
2002	6.840	21.067	12.153	20.237	-0.845	-6.279	-11.248
2003	5.075	16.529	0.161	4.926	-2.687	-4.083	18.947
2004	3.466	15.216	-7.106	1.617	-2.741	-4.482	31.004
2005	4.112	15.797	-5.658	11.740	-6.722	1.448	33.424
2006	3.574	13.744	0.318	11.957	1.062	-3.766	27.753
2007	-1.335	10.903	4.720	14.931	6.537	-0.172	19.244
2008	-7.863	13.351	4.297	25.572	6.148	-2.893	4.733
2009	-8.635	12.277	-0.389	5.274	1.702	-11.248	12.217
2010	-2.971	12.731	2.076	12.745	6.352	-4.360	27.858
2011	3.525	9.176	1.584	11.786	4.031	-15.749	23.590
2012	12.236	13.582	6.306	10.471	2.989	-11.935	15.570
2013	20.859	9.468	11.280	11.985	7.221	-11.641	2.507
2014	46.279	2.981	12.387	12.299	1.888	-13.515	-4.416
2015	83.674	-2.447	21.767	8.673	2.742	-11.044	-5.147
2016	117.147	-10.403	20.039	4.332	-4.020	-9.814	-12.153

Source: Author’s estimates

Appendix G: Summary Statistics

Table 93

Summary Statistics of Variable for Growth Regression

Variable	Variation	Mean	Std. Dev.	Minimum	Maximum
Growth Rate	Overall	2.711	2.774	-9.055	10.884
	Between		2.104	-1.754	8.444
	Within		1.859	-4.590	7.372
Real Income	Overall	8.439	1.179	5.901	11.500
	Between		1.142	6.307	10.946
	Within		0.375	6.967	9.791
Inflation	Overall	9.665	10.860	-1.281	56.105
	Between		5.926	2.818	27.566
	Within		9.340	-10.177	49.482
Government Consumption	Overall	13.611	4.852	3.075	23.660
	Between		4.476	4.927	21.828
	Within		2.085	7.035	20.331
Investment Spending	Overall	23.609	7.837	11.227	48.135
	Between		6.187	16.093	36.915
	Within		4.975	8.105	40.657
Terms of Trade	Overall	4.564	0.280	3.749	5.443
	Between		0.202	4.201	5.056
	Within		0.198	3.930	5.021
Openness	Overall	40.759	34.734	4.757	189.592
	Between		30.438	12.613	111.723
	Within		17.517	-8.986	118.628
Net Foreign Asset	Overall	6.106	19.060	-67.597	49.871
	Between		15.582	-49.923	27.873
	Within		11.431	-35.895	31.873
Human Capital	Overall	1.972	0.357	0.871	2.590
	Between		0.286	1.373	2.434
	Within		0.222	1.386	2.407
Polity2	Overall	3.655	6.133	-8	10
	Between		4.876	-8	9.7
	Within		3.852	-9.120	11.830
ngd	Overall	0.354	0.692	-2.480	2.530
	Between		0.606	-1.417	1.579
	Within		0.358	-1.111	1.739
Undervaluation	Overall	-4.776	6.361	-34.867	0
	Between		2.724	-9.318	-0.644
	Within		5.779	-30.892	4.542
Overvaluation	Overall	11.475	30.189	0	346.620
	Between		15.695	0.981	74.494
	Within		25.966	-63.019	283.601
Misalignment	Overall	13.008	15.485	0.498	93.460
	Between		9.813	3.066	44.658
	Within		12.136	-30.599	83.539

Source: Author’s calculation

Table 94

Summary Statistics of Variables for Trade Regression

Variable	Variation	Mean	Std. Dev.	Minimum	Maximum
Trade Balance	Overall	-0.013	0.364	-1.240	0.868
	Between		0.320	-0.687	0.506
	Within		0.185	-0.566	0.430
Home Real Income	Overall	4.136	0.551	1.895	5.020
	Between		0.181	3.554	4.379
	Within		0.521	2.477	5.602
Real Income of Rest of the World	Overall	4.300	0.323	3.779	4.757
	Between		0.008	4.296	4.336
	Within		0.323	3.783	4.759
REER	Overall	4.556	0.253	3.394	5.411
	Between		0.150	4.298	4.841
	Within		0.204	3.629	5.126
Undervaluation	Overall	-4.776	6.361	-34.867	0
	Between		2.724	-9.318	-0.644
	Within		5.779	-30.892	4.542
Overvaluation	Overall	11.475	30.189	0	346.620
	Between		15.695	0.981	74.494
	Within		25.966	-63.019	283.601
Misalignment	Overall	11.974	13.244	0.498	90.809
	Between		8.817	3.066	40.335
	Within		10.210	-27.309	62.448

Source: Author’s calculation

Table 95
Summary Statistics of Variables for Consumption Regression

Variable	Variation	Mean	Std. Dev.	Min	Max
Aggregate Consumption Expenditure	Overall	5.395	1.002	3.480	8.444
	Between		0.890	4.119	7.114
	Within		0.497	3.873	6.786
Real Income	Overall	5.672	1.064	3.407	9.125
	Between		0.948	4.203	7.651
	Within		0.523	4.012	7.146
Real Interest Rate	Overall	13.388	15.730	0.938	111.500
	Between		10.291	4.804	43.568
	Within		12.099	-21.060	81.320
Inflation Rate	Overall	9.965	11.053	-1.281	56.105
	Between		5.911	2.818	27.566
	Within		9.575	-9.878	49.782
REER	Overall	4.564	0.253	3.394	5.411
	Between		0.150	4.298	4.841
	Within		0.205	3.637	5.133
Undervaluation	Overall	-4.975	6.447	-34.867	0
	Between		2.637	-9.318	-0.644
	Within		5.915	-31.091	4.343
Overvaluation	Overall	11.580	30.934	0	346.620
	Between		16.096	0.981	74.494
	Within		26.608	-62.914	283.706
Misalignment	Overall	12.130	13.542	0.498	90.809
	Between		9.015	3.066	40.335
	Within		10.444	-27.153	62.604

Source: Author’s calculation

Table 96
Summary Statistics of Variables for Investment Regression

Variable	Variation	Mean	Std. Dev.	Minimum	Maximum
Aggregate Investment	Overall	24.231	6.726	10.214	47.386
	Between		5.613	17.630	40.271
	Within		3.888	12.077	36.432
Rental Cost of Capital	Overall	13.418	15.730	0.968	111.530
	Between		10.291	4.834	43.598
	Within		12.099	-21.030	81.350
Real Income	Overall	5.672	1.064	3.407	9.125
	Between		0.948	4.203	7.651
	Within		0.523	4.012	7.146
FDI	Overall	7.726	1.909	1.420	11.811
	Between		1.115	4.851	10.044
	Within		1.591	3.077	10.591
REER	Overall	4.564	0.253	3.394	5.411
	Between		0.150	4.298	4.841
	Within		0.205	3.637	5.133
Undervaluation	Overall	-4.975	6.447	-34.867	0
	Between		2.637	-9.318	-0.644
	Within		5.915	-31.091	4.343
Overvaluation	Overall	11.580	30.934	0	346.620
	Between		16.096	0.981	74.494
	Within		26.608	-62.914	283.706
Misalignment	Overall	6.416	33.476	-40.106	346.620
	Between		16.057	-3.374	68.826
	Within		29.543	-101.591	284.210

Source: Author’s calculation

Appendix H: Underlying Fundamentals of Equilibrium REER

Table 97
Directions to which fundamentlas affect REER across economies

Fundamentals	Terms of	Productivity	Investment	Government	Openness	Net Foreign	Official Dev.
Argentina	-	-		+		+	+
Bangladesh	+	-	-	+		-	
Brazil	-	-	-	+		+	
Chile	+		+		+		+
China	+			-	+		-
Colombia	+	-		+	+		+
Egypt	-	-		+	+		+
Greece	-	-		+	+	+	
Indonesia	+		+	-			+
India	-	-	-			+	
South Korea	+	-	-	+	+		
Mexico	+		-		+	+	
Malaysia	+	-	+	+			+
Pakistan	-	-		-	+	-	
Peru	-	-	-	-			
Philippine	-	-		-	+		
Poland	+		+	+	+		
Thailand	+	-		+			+
Turkey	-	-	-		+	+	
South Africa	-	-		+		-	
ARE	+	-	+	-			

Source: Based on author's estimate of long-run cointegrating relationship between REER and its fundamentals (Chapter IV)

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Selected Research Activities

1. Mamun, A., Bal, H., & Akca, E. E. (2019). The Export-Output Growth Nexus in Bangladesh : A Leveraged Bootstrap Approach. *Journal of Asia Business Studies,* 13(2).
2. Mamun, A., Basher, S., Hoque, N., & Ali, M. H. (2018). Does Stock Market Development Affect Economic Growth? Econometric Evidence from Bangladesh. *Management & Accounting Review*, 17(1), 123–144.
3. Mamun, A., Hoque, N., & Mohammad Ahshanul Mamun, A. (2014). Dynamics and traits of entrepreneurship: An Islamic approach. *World Journal of Entrepreneurship, Management and Sustainable Development,* 10(2), 128–142.