UNIVERSITI PUTRA MALAYSIA

EQUILIBRIUM EXCHANGE RATE MODELS AND EXCHANGE RATE MISALIGNMENT IN ASEAN COUNTRIES, CHINA, JAPAN AND KOREA

MOHAMAD SHUKRI BIN JOHARI

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By

MOHAMAD SHUKRI BIN JOHARI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

May 2018

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DEDICATION

This work is dedicated to…

My mother,
Hajjah Zainon Omar

My beloved wife,
Nur Azura Sanusi

My lovely children,
Nur Zahierah Afiqah Mohamad Shukri
Muhammad Danis Mohamad Shukri
Muhammad Haziq Mohamad Shukri

My eldest and youngest sister,
Suzliana and Suraini

My late nephew,
Amir Hafizzuddin
"You are always in my heart"

Others nephews,
Anis Nur Liyana
Anis Nur Faezah
Anis Nur Alia Najwa
Faiz Iskandar

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment
of the requirement for the degree of Doctor of Philosophy

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May 2018

Chairman **: Professor Muzafar Shah Habibullah, PhD**
Faculty **: Economics and Management**

The misalignment of exchange rates among ASEAN, China, Japan and Korea (henceforth Plus Three Countries) has been seriously debated over the past few decades. In order to better understand the behaviour of exchange rates for ASEAN Plus Three, this study focuses on three objectives. First, to examine the roles of macroeconomics fundamentals on the real exchange rates; second, to evaluate the misalignment of exchange rates; and third, to evaluate and determine the best model to represent the exchange rates behaviour for these countries, using FEER, NATREX and BEER models. This study uses exchange rates as the dependent variable. The independent variables consist of productivity differences, net foreign assets, government spending, terms of trade, openness, real interest differences, current account, output gaps, total factor productivity, dependency ratio of the young, real interest rate, and tax revenue and foreign direct investment. To achieve the goal, Autoregressive Distributed Lag (ARDL) was used, along with the Hausman test based on Dynamic Panel Data, and model evaluation based on forecasting techniques. The results suggest that the macroeconomics fundamental variables have different impact on the exchange rates. This study demonstrates the misalignment of exchange rates using the residuals of estimation. It could imply that the currency would experience undervaluation if the disequilibrium error has positive value, and overvaluation if the disequilibrium error is negative. Next, the results from forecasting techniques based on "out-of-sample predictions" and "forecast encompassing" suggest that FEER, NATREX and BEER models are able to represent what is the best model for each different country in this region. Finally, this study suggests that the policy makers should take into account the macroeconomic indicators in order to explain exchange rate movement and subsequently achieve economic goals. Besides, ASEAN Plus Three countries should take into consideration the possibility of the formation of such a currency union as the European Union (EU) countries. On thought of that, the

Chinese yuan (or renminbi) or the Japanese yen could be the anchor currency due to its have large currency coverage areas and more stable.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MODEL KESEIMBANGAN KADAR PERTUKARAN MATA WANG DAN KETIDAKJAJARAN KADAR PERTUKARAN MATA WANG DI NEGARA ASEAN, CHINA, JEPUN DAN KOREA

Oleh

MOHAMAD SHUKRI BIN JOHARI

Mei 2018

Pengerusi : **Profesor Muzafar Shah Habibullah, PhD**
Fakulti : **Ekonomi dan Pengurusan**

Ketidakseimbangan kadar pertukaran matawang di kalangan negara ASEAN, China, Jepun dan Korea (seterusnya disebut Campur Tiga) sering dibahaskan sejak beberapa dekad yang lalu. Dalam usaha untuk memahami dengan lebih mendalam corak kadar pertukaran mata wang untuk negara ASEAN Campur Tiga, kajian ini menyenaraikan tiga objektif. Pertama, mengenal pasti faktor penentu asas makroekonomi kepada kadar pertukaran mata wang benar; kedua, menilai ketidakjajaran kadar pertukaran mata wang; dan ketiga, menilai serta mengenalpasti model yang terbaik bagi menerangkan corak kadar pertukaran mata wang di negara-negara ini, dengan menggunakan model FEER, NATREX dan BEER. Kajian ini menggunakan kadar pertukaran mata wang sebagai pembolehubah bersandar. Pembolehubah bebas pula merangkumi pembolehubah perbezaan produktiviti, aset asing bersih, perbelanjaan kerajaan, terma perdagangan, keterbukaan ekonomi, perbezaan kadar faedah benar, akaun semasa, jurang output, produktiviti faktor keseluruhan, nisbah kebergantungan golongan muda, kadar faedah benar, hasil cukai dan pelaburan langsung asing. Untuk mencapai objektif kajian ini, kaedah Autoregresive Distributed Lag (ARDL) telah digunakan, berserta ujian Hausman berdasarkan ARDL untuk Dynamic Panel Data, dan penilaian model berdasarkan teknik peramalan. Dapatan kajian menunjukkan bahawa pembolehubah asas mempunyai kesan yang berbeza pada kadar pertukaran mata wang. Kajian ini juga berjaya menunjukkan ketidakjajaran kadar pertukaran mata wang menggunakan residual anggaran. Ini menunjukkan bahawa mata wang mengalami penyusutan nilai jika residual ketidakjajaran adalah bernilai positif, manakala mata wang mengalami terlebih nilai jika residual ketidakjajaran adalah bernilai negatif. Seterusnya, dapatan kajian bagi teknik peramalan "out-of-sampel" dan "forecast encompassing" menunjukkan bahawa model FEER, NATREX dan BEER mampu mewakili model terbaik untuk negara yang berbeza di rantau ini. Akhir sekali, dapatan kajian juga mencadangkan agar pembuat dasar mengambil kira

petunjuk makroekonomi untuk menerangkan pergerakan kadar pertukaran mata wang dan seterusnya mencapai matlamat ekonomi. Selain itu, negara-negara ASEAN Campur Tiga harus mengambil kira kemungkinan memperkenalkan kesatuan mata wang seperti yang dilakukan oleh negara-negara Kesatuan Eropah (EU). Berdasarkan pandangan ini, mata wang yuan China (atau renminbi) atau mata wang yen Jepun boleh menjadi mata wang peneraju kerana mempunyai kawasan liputan mata wang yang luas serta lebih stabil.

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This thesis has been submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

Muzafar Shah bin Habibullah, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Chairman)

Zulkornain bin Yusop, PhD
Professor
Faculty of Economics and Management
Universiti Putra Malaysia
(Member)

Lee Chin, PhD
Associate Professor
Faculty of Economics and Management
Universiti Putra Malaysia
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Supervisory
Committee: Professor Dr. Zulkornain bin Yusop

Signature: _____
Name of
Member of
Supervisory
Committee: Associate Professor Dr. Lee Chin

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ARDL	Autoregressive Distributed Lags
ASEAN	Association of Southeast Asian Nations
BEER	Behavioral Equilibrium Exchange Rate
CA	Current Account
DEPY	Dependency Ratio of the Young
DFE	Dynamic Fixed Effect
DPROD	Productivity Differential
FDI	Foreign Direct Investment
FEER	Fundamental Equilibrium Exchange Rate
GOVS	Government Spending
IFS	International Financial Statistic
LOP	Law of One Price
MG	Mean Group
NATREX	Natural Real Exchange Rate
NFA	Net Foreign Assets
OPEN	Trade Liberalization
Plus Three Countries	China, Japan and Korea
PMG	Pool Mean Group
PPP	Purchasing Power Parity
PWT	Penn World Table
R'	Real Interest Rate
REER	Real Effective Exchange Rate
RER	Real Exchange Rate
RID	Real Interest Rates Differential
TFP	Total Factor Productivity
TOT	Terms of Trade
UIP	Uncovered Interest Parity
UNCTAD	United Nations Conference on Trade and Development
UNSD	United Nation Statistic Department
WDI	World Development Indicators
YGAP	Output Gaps

CHAPTER 1

INTRODUCTION

The establishment of Association of Southeast Asian Nations (henceforth ASEAN) since 1967 has enhanced international trade among ASEAN members as well as trade with the rest of the world. The trade involves high transaction of foreign currencies. International trade in ASEAN continue to grow rapidly after this region agreed to strengthen partnership with three developed countries, namely People's Republic of China (henceforth China), Republic of Korea (henceforth Korea) and Japan in 1997 until 1999. Figure 1.1 indicates that the trend of values and shares of merchandise exports and imports in ASEAN, China, Japan and Korea (henceforth Plus Three Countries) has increased during 1970 until 2012.

The enhancement in cooperation especially in economics and finance between ASEAN and the Plus Three Countries since 1997 showed sustainable growth in total trade among the participating nations despite the challenges due to uncertainties in the global economy. ASEAN's information website[1] reported total trade among them has reached US$727.1 billion in 2014. The Plus Three Countries contributed 28.8 percent of ASEAN's total trade.

The enhancement of international trade) however does not indicate a good economic performance as a whole for ASEAN Plus Three Countries. Corsetti, Pesenti and Roubini (1998) stressed that high volatility of exchange rates by small and opens economy countries in ASEAN especially those who rely on international trade may result in individual currencies of each country being undervalued or overvalued. The internal financial systems in ASEAN member countries are still weak and less resilient. Thus, with a small open economies and newly emerging countries, the ASEAN currencies are readily confronted with volatility and misalignment against foreign currencies such as the US dollar. Generally, the appreciations of domestic currency imply the increase in competitiveness of national currency in currency market. However, it does not imply increase in competitiveness if a high currency's appreciation causes the domestic currency to be overvalued.

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[1] http://www.asean.org
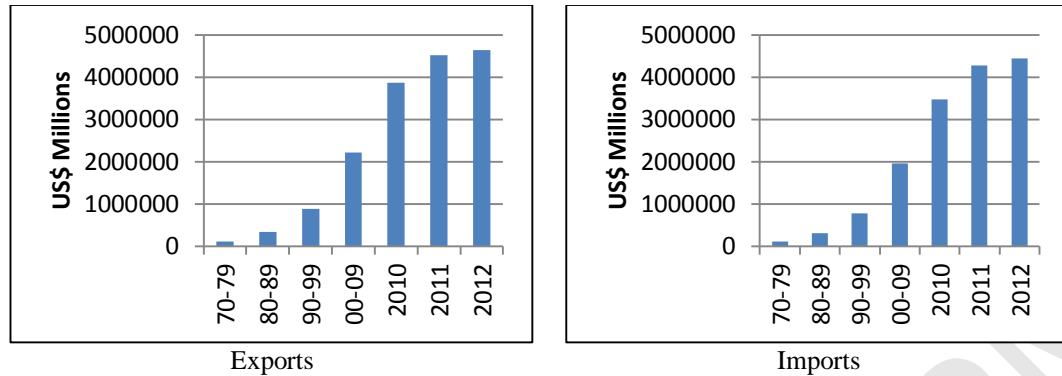
(Sources: United Nations Conference on Trade and Development (UNCTAD))

Figure 1.1 : Values and Shares of Merchandise Exports and Imports in ASEAN Plus Three Countries, 1970-2012 (Average)

The traditional and simplest theory of exchange rates to determine misalignment of the currency is the Purchasing Power Parity (PPP) model. The theory of this model hypothesizes that the comprehensive and unrestricted trade in goods and services is based on the Law of One Price (henceforth LOP). The LOP describes that the price of a good would be the same throughout the world are weak assumptions. In other words, the LOP theory does not consider the difference in general price level or inflation rates between two trading countries.

Figure 1.2 describes the theory of PPP/LOP and the misalignment of exchange rate. Generally, the theory of PPP/LOP suggests that if one country's price level increases relative to another's, its currency should depreciate. As a reciprocal to this change, the other's currency should appreciate. This prediction is happen in the long run. As shown in Figure 1.2, PPP/LOP often has little predictive power in the short run. The relative price levels between two countries trading fail to track the actual exchange rate well, thus creating a huge misalignment of exchange rate. Although PPP/LOP theory provides some guidance to the long run movement of exchange rates, it is not perfect and in the short run it is indeed a poor predictor.
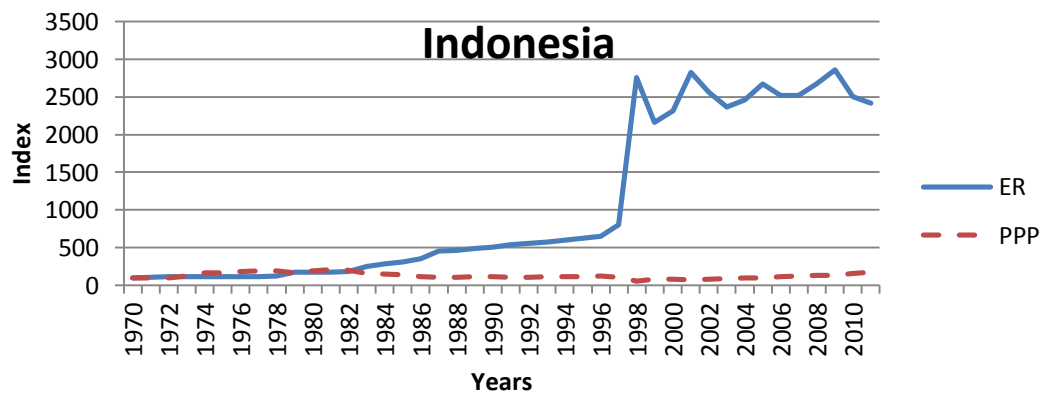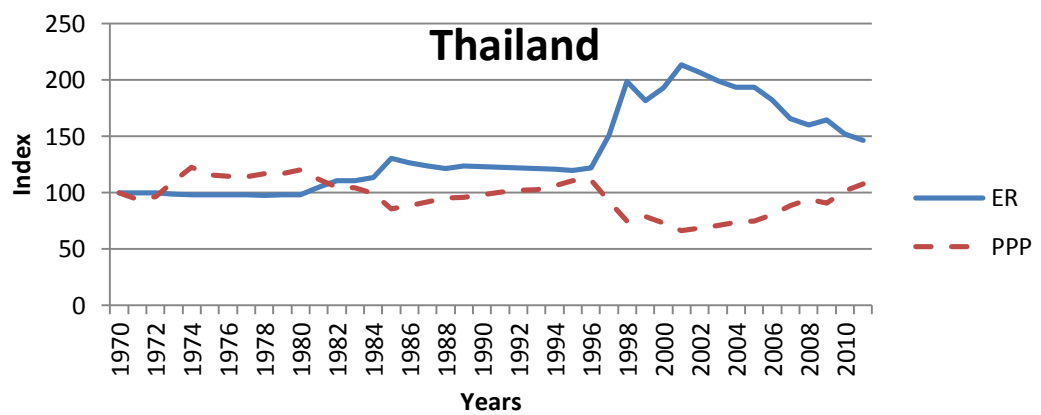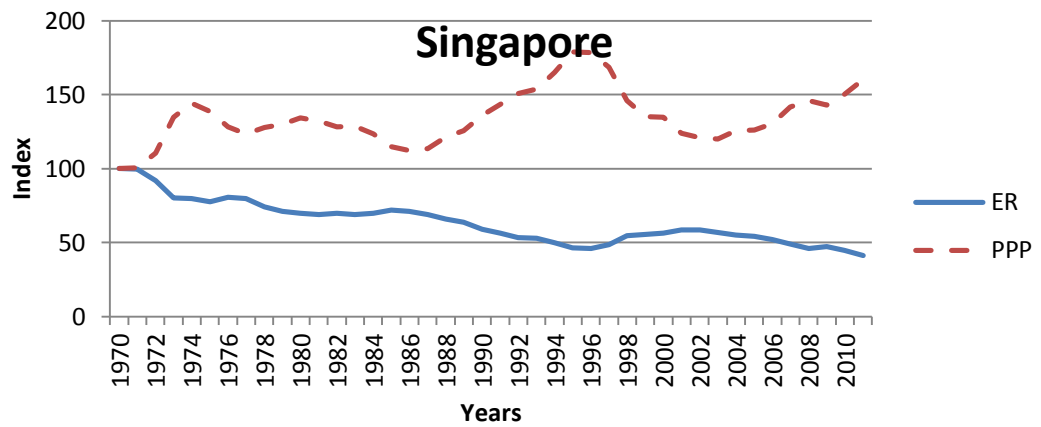
Singapore

Thailand

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The Philippines

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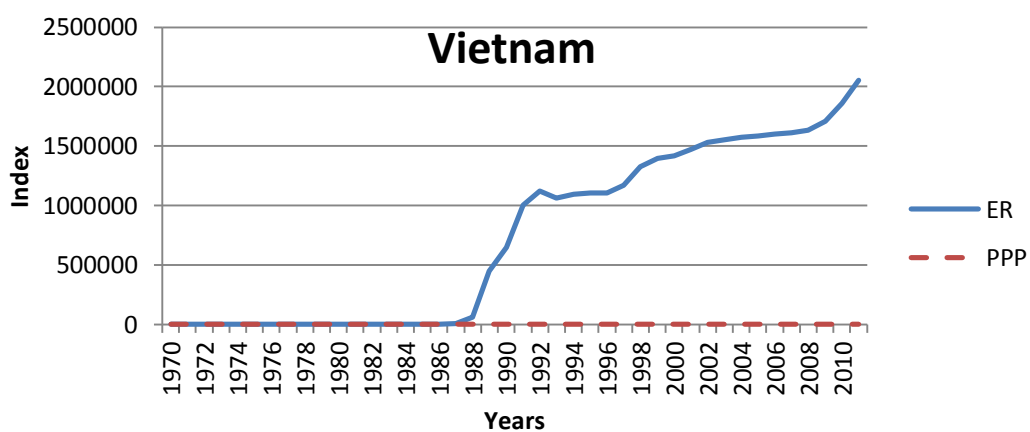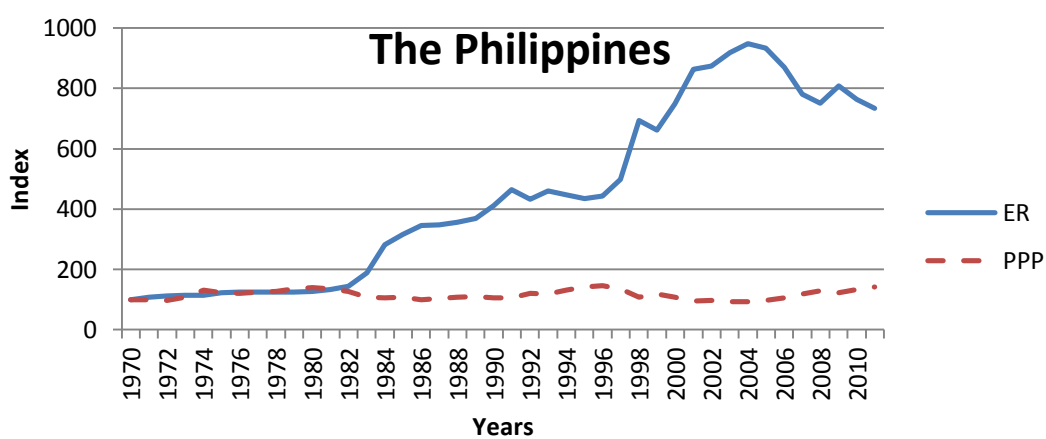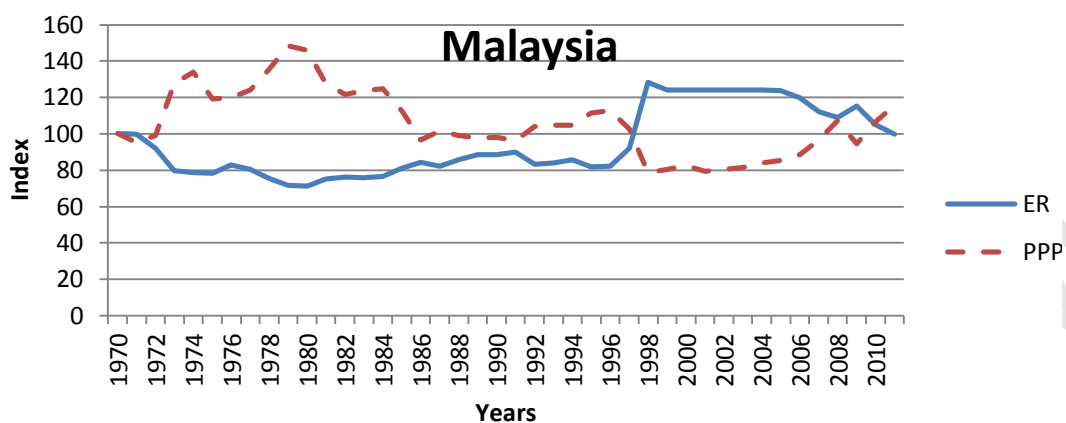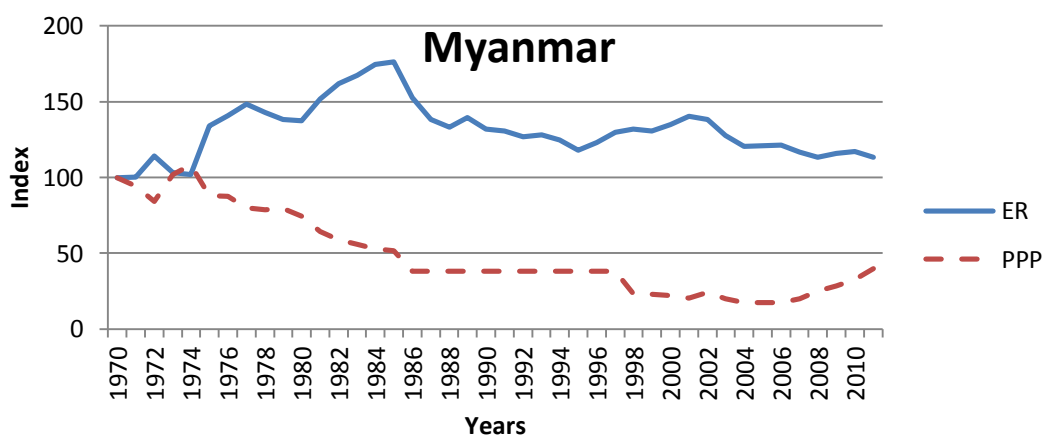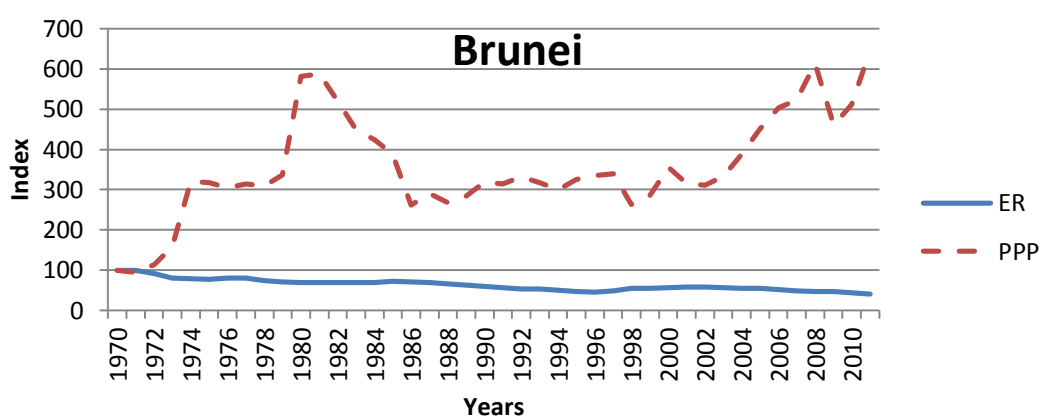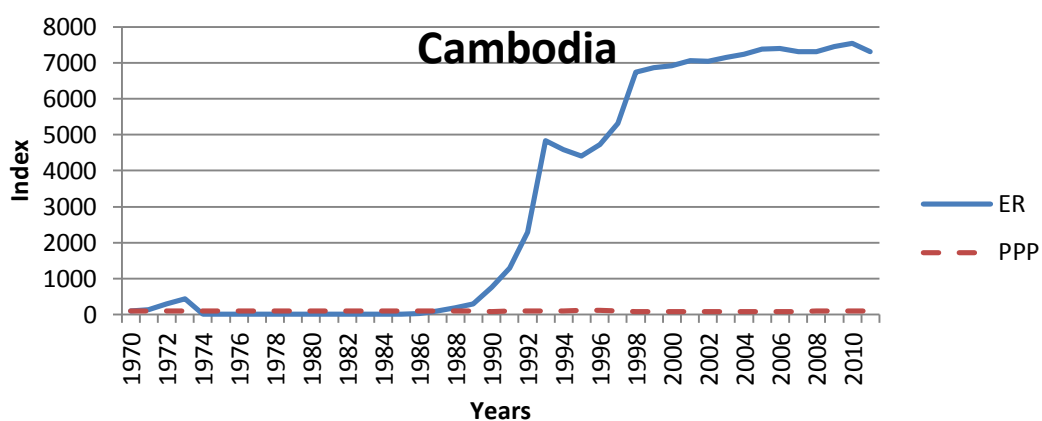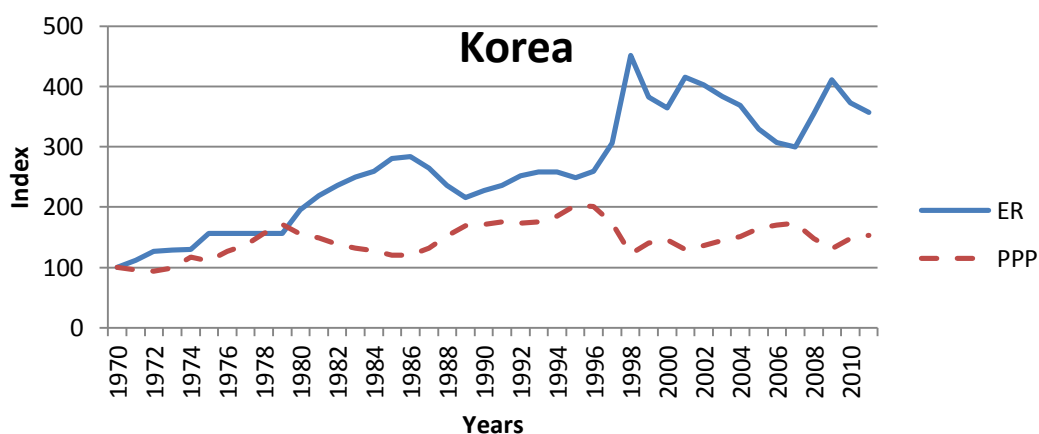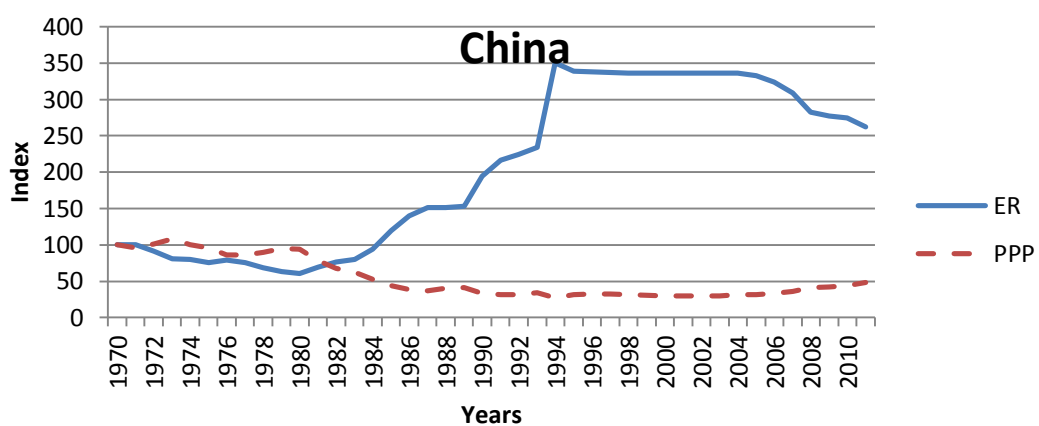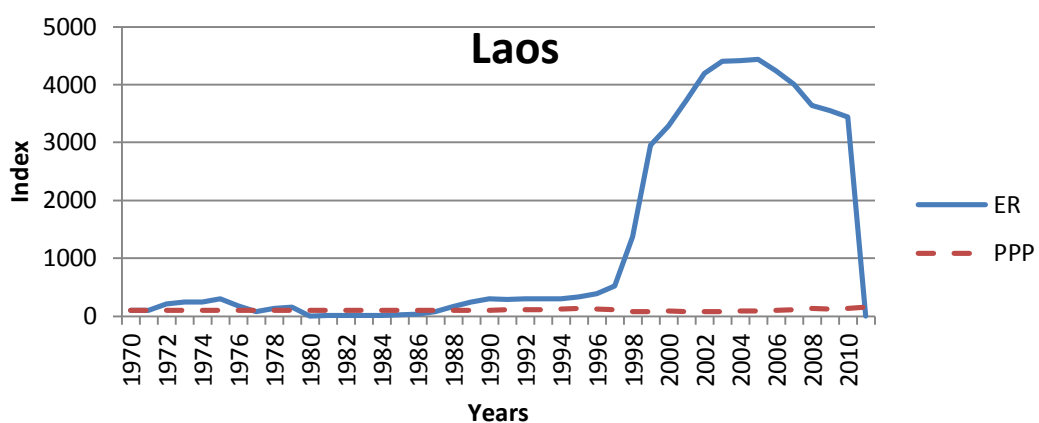
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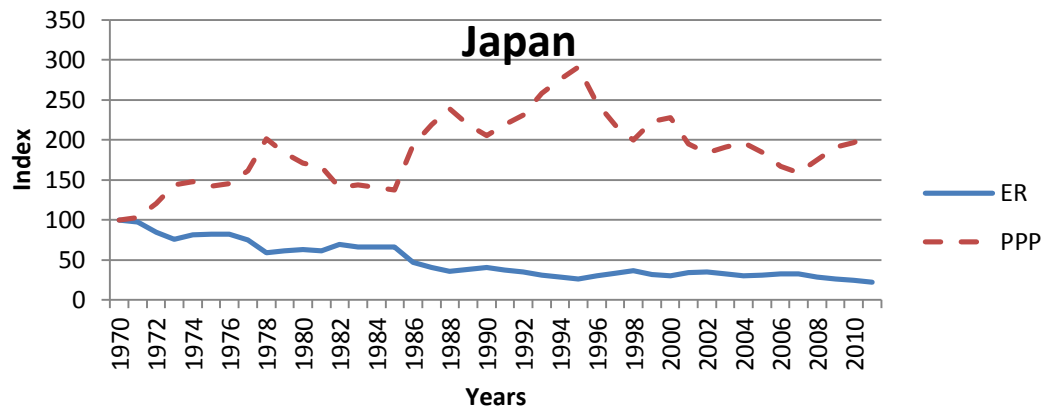
(Source: World Development Indicator (WDI), United Nation Statistical Division (2012) and authors' computations. Note: Index: 1970=100)

Figure 1.2 : Purchasing Power Parity of ASEAN Plus Three Countries, (1970-2011)

The issues associated with exchange rate misalignment among the ASEAN countries have been seriously debated over the past few decades. Chin (2005) and Chin and Azali (2005) found that there is little evidence of exchange rate misalignment in Indonesia, Malaysia, the Philippines, Singapore and Thailand during the 1997 Asian financial crisis. Naseem, Tan and Hamizah (2009) suggested that exchange rate misalignment and volatility are important determinants in encouraging Malaysian import flows, especially during the crisis. Generally, exchange rate misalignment will occur when there are deviations from its equilibrium path thus creating opportunities for arbitrage activities.

Why do some countries need to determine the exchange rate misalignment? How to assess the equilibrium exchange rate and thereby its misalignment? In order to answer these two questions, several theories need to be considered. First, the effects of misalignment of currency to a country's economy are quite huge. For instance, the overvaluation of a currency is believed to have caused national currency to experience depreciation and thereby reducing economic growth. On the other hand, the undervaluation of a currency implies that the national currency tend to appreciate, thus making the currency expensive against foreign currency. Imports would increase and exports demand would decline, thus creating deficit in trade balance (Daniel and VanHoose, 2005). However, Rodrik (2008) provided evidence that undervaluation of a currency (a high real exchange rate) would stimulate economic growth. Villavicencio (2006) said the persistent exchange rate misalignments would generate severe macroeconomic disequilibrium often leading to costly external imbalances and sometimes can be considered as an indicator of potential crisis.

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Several models can be used in order to estimate the equilibrium exchange rate thereby its misalignment. Driver and Westaway (2004) stated that the equilibrium exchange rate can be assessed using Uncovered Interest Parity, Purchasing Power Parity (Barrett, 1981; Halpern and Wyplosz, 1997; Sahminan, 2005; Mishra and Sharma, 2010), Balasssa-Samuelson, Monetary Models (Chin, 2005; Chin and Azali, 2005), Capital Enhanced Equilibrium Exchange Rate (Keblowski and Welfe, 2010), and Intermediate Term Model Based Equilibrium Exchange Rate.

The others models also can be used to estimate equilibrium exchange rate are Fundamental Equilibrium Exchange Rate (Egert and Lahreche-Revil, 2003; Koske, 2008; Benassy-Quere, Bereau and Mignon, 2008), Behavioural Equilibrium Exchange Rate (Quere Revil and Mignon, 2011; Fernandez, Osbat and Schnatz, 2006; Villavicencio, 2006; Berger and Kempa, 2012; Rubaszek, 2004; Egert and Lahreche-Revil, 2003; Sidek Yusoff, 2009), Natural Real Exchange Rate (Naseem et al., 2009; You and Sarantis, 2008; You and Sarantis, 2012b), Desired Equilibrium Exchange Rate, and others.

In assessing the equilibrium and misalignment exchange rate it is important to identify the macroeconomic fundamental factors that might influence the equilibrium exchange rate. Many studies have provided evidence that the macroeconomic fundamental factors might influence the equilibrium exchange rate. These factors include term of trade (Keblowski and Welfe, 2010; Egert and Lahreche-Revil, 2003; Naseem et al., 2009), trade liberalization (Fernandez et al., 2006; Egert and Lahreche-Revil, 2003; Sidek and Yusoff, 2009), current account (Villavicencio, 2006; Rubaszek, 2004; Egert and Lahreche-Revil, 2003), total factor productivity (You and Sarantis, 2008; You and Sarantis, 2012b), real interest rate (Sahminan, 2005; Berger and Kempa, 2012; Chin, 2005; Chin and Azali, 2005; Naseem et al., 2009), productivity differential (Quere, Revil and Mignon, 2011; Egert and Lahreche-Revil, 2003; Sidek and Yusoff, 2009; Naseem et al., 2009), net foreign assets (Quere, Revil and Mignon, 2011; Villavicencio, 2006; Sidek and Yusoff, 2009; Sahminan, 2005) and government spending (Fernandez et al., 2006; Sidek and Yusoff, 2009; Naseem et al., 2009). Only a few studies provide evidence that the output gaps, dependency ratio of the young, tax revenue and foreign direct investment would influence the equilibrium exchange rate. You and Sarantis (2012b) used dependency ratio of the young, tax revenue and foreign direct investment, whilst Berger and Kempa (2012) used the output gaps as a macroeconomic fundamental factor that might influence equilibrium exchange rate. Nevertheless Berger and Kempa (2012) failed to prove that the output gap significantly influences the equilibrium exchange rate.

In order to support an argument where exchange rates can be influenced by macroeconomic variables rather than price level, all important variables were incorporated into three models namely Fundamental Equilibrium Exchange Rates (FEER), Natural Real Exchange Rates (NATREX) and Behaviour Equilibrium Exchange Rates (BEER) models. Figure 1.3 shows the scatter plot to describe the relationship between two variables; exchange rate and other macroeconomic variables. This study selected Singapore as an example to demonstrate these

relationships (see Appendix A to Appendix L for other countries). The figure clearly indicates upward trends (correlation) between exchange rate and current account, trade openness, terms of trade, output gaps, dependency ratio of the young, foreign direct investment, total factor productivity and government spending. The downward trends (correlation) occurred between exchange rate and real interest rate, tax revenue, productivity differential, net foreign assets and real interest rate differential. Using these three models an early conclusion is that the exchange rate can also be influenced by macroeconomic base rather than price base.

ASEAN Plus Three has experienced two major recessions since its establishments. It was considered that the Asian financial crisis of 1997-1998 was caused by the weak and less resilient financial systems. The crisis started in Thailand after the government floated the *baht* from its fixed exchange rate regime. The crisis is believed to have resulted in a financial contagion (Kogid, 2002) with most of the currencies in Asian experiencing volatility and depreciation against the US dollar. In order to stabilize the currency, each country in this region implemented various exchange rate regimes. Whilst Thailand was forced to float the Thai baht, Malaysia implemented a fixed exchange rate regime by pegging the currency at RM3.80 per US dollar.

Another crisis which occurred in this region as well as in the rest of the world was the sub-prime/financial crisis in the United State and Europe in 2007-2009. This crisis significantly impacted the ASEAN Plus Three's economy. Moreover, most of ASEAN Plus Three's nations rely on the foreign sector to expand their markets.

The above scenario is believed to have created a phenomenon of disequilibrium in exchange rates causing purchasing power parity (henceforth PPP) volatility and misalignment. These scenarios have motivated the conduct of this study. Issues arising out of the Asian financial crisis of 1997/1998 and the latest sub-prime/financial crisis in the United State and Europe also serve to illustrate the relevance of this study given that these financial crises lead to internal and external shocks that affect equilibrium in exchange rate. This study determines the factors that influence the exchange rate movement. In addition this empirical study investigates the equilibrium and misalignment in exchange rate for ASEAN Plus Three countries.
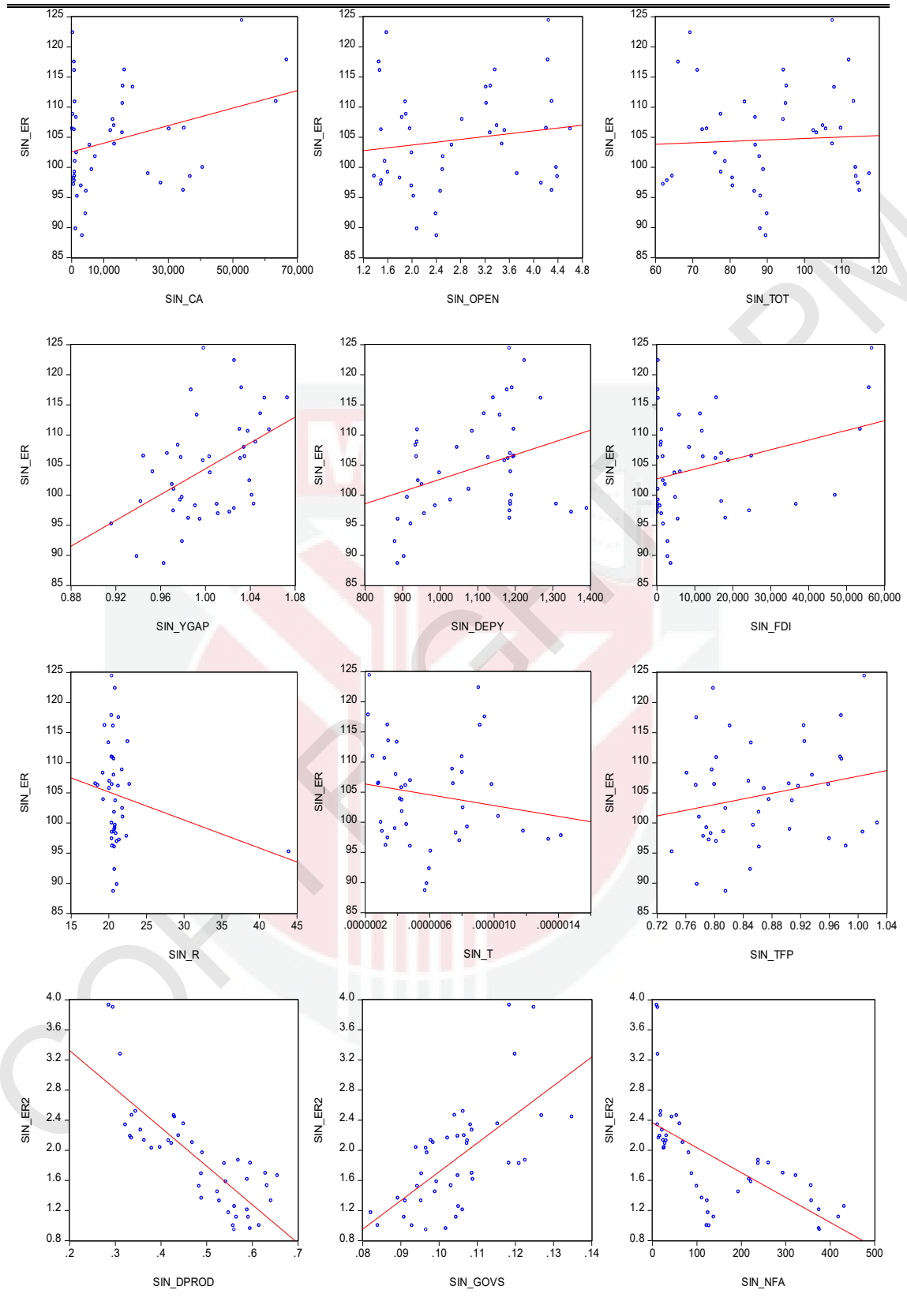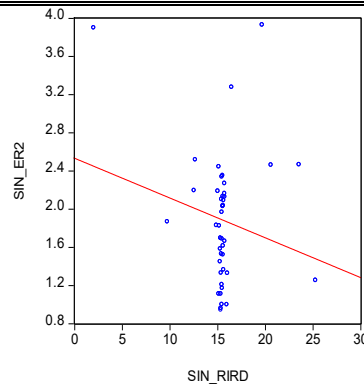
(Sources: World Development Indicators (WDI), United Nations Conference on Trade and Development (UNCTAD), United Nation Statistic Department (UNSD), Penn World Table, Asian Development Bank (ADB), International Financial Statistic (IFS). ***Notes:*** SIN – Singapore; ER – exchange rate; CA – current account; $OPEN$ – trade openness; TOT – terms of trade; $YGAP$ – output gaps; $DEPY$ – dependency ratio of the young; FDI – foreign direct investment; R – real interest rate; T – tax revenue; TFP – total factor productivity; $DPROD$ – productivity differential; $GOVS$ – government spending; NFA – net foreign assets and RID – real interest differential.)

Figure 1.3 : Scatter Plot between Exchange Rate and Macroeconomic Variables in Singapore, 1970-2012

1.1 Problem Statement

The misalignment of exchange rates among ASEAN Plus Three countries have been debated over the past few decades (Chin, 2005; Chin and Azali, 2005; Sahminan, 2005; Nuryadin, 2006; Chin, Azali, Yusop and Yusoff, 2007; Coudert and Couharde, 2007; You and Sarantis, 2008; Koske, 2008; Chin, Habibullah and Azali, 2009; Sidek and Yusoff, 2009; Naseem et al., 2009; Wong, 2013).

The impact of misalignment of currency to an economy is quite huge. Therefore economist, policymakers and others currency players (such as exporters-importers, money changer and etc.) should be concerned with this issue. For instance, the undervalued of the domestic currency for most ASEAN Plus Three countries including Korea during Asian's financial crisis 1997/1998 implies that the currency for those countries experience depreciation and thereby reduced economic growth. Depreciation of the currency also increases foreign debt during that crisis since most of the ASEAN Plus Three countries depend on foreign trade to meet the need for intermediate goods. On the other hand, the overvalued of the domestic currency implies that the currency is expensive and this will increase imports and decrease exports demand, thus creating deficit in the trade balance. Therefore, it is important to study the behaviour of exchange rates.

The traditional theory of exchange rate behaviour was discovered by Gustaz Cassel in 1918 through the Purchasing Power Parity (PPP) and the Law of One Price (LOP) theories. The PPP/LOP models use the price based estimates and are relatively easy to implement. However, previous studies argued that these theories are not perfect since it only provides the behaviour of exchange rate in the long-run and fail to predict well in the short-run. Furthermore, the PPP/LOP theories does not take into account that many goods and services are not traded across borders but its prices are included in measuring a country's price level. These models also do not address the economically interesting question of whether a particular exchange rate is driven by economics fundamental or not. Another concern is that the PPP/LOP theory explained that the equilibrium of exchange rate will be achieved only if it equivalents the purchasing power of national currencies in terms of particular goods. However, this assumption is weak especially for low-income and emerging economies in comparison to developed nations. Furthermore, the PPP approach does not take into account the real factors such as net asset level and balance of payments position.

Other researchers extended the theory in order to identify the short run, medium run and long run behaviour of misalignment of exchange rates. The extension of the basic theory is represented by the BEER model (Egert and Lahreche-Revil, 2003; Rubaszek, 2004; Fernandez, Osbat and Schnatz, 2006; Villavicencio, 2006; Sidek Yusoff, 2009; Revil and Mignon, 2011; Berger and Kempa, 2012), FEER model (Egert and Lahreche-Revil, 2003; Koske, 2008; Benassy-Quere, Bereau and Mignon, 2008) and NATREX model (You and Sarantis, 2008; Naseem et al., 2009; You and Sarantis, 2012b). Egert and Lahreche-Revil (2003) found that the BEER model allows the "expected future movements" in real exchange rates determined by a set of macroeconomic fundamentals through econometric estimation with an extended version of the uncovered interest parity as the theoretical background, whilst FEER and NATREX describe the equilibrium exchange rate based on internal and external balance. These three models differ from PPP model, where the BEER and NATREX will vary over time in respond to changes in the fundamentals (Stein and Lim, 2002; Driver and Westaway, 2004); whilst FEER is the study of medium-run exchange rate behaviour (Driver and Westaway, 2004). Another advantage of BEER, FEER and NATREX models is that the models does not require the fundamental factors and the real equilibrium exchange rate to be stationary (Edwards and Savastano, 1999; Driver and Westaway, 2004).

In the case of ASEAN countries, exchange misalignments have not been extensively studied. Chin (2005) and Chin and Azali (2005) used the monetary model to explain the exchange rates behaviour. Both studies estimated exchange rates using the relative foreign and domestic monetary aggregate, income differential, interest rate differential and expected inflation differential. However, the model in this study excludes other macroeconomic fundamental factors which are also important determinants of the exchange rate (see Figure 1.3). Some of the previous studies agree that nominal exchange rates play an important role in the exchange rates behaviour. However, it does not give a complete picture of the price competitiveness of the domestic goods relative to foreign goods. This is based on the argument that the nominal exchange

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rates do not take into account inflation in the country (BNM, 1999). A study conducted by Naseem et al. (2009) using NATREX model highlighted that the real economic fundamentals are government consumption, real interest rate, terms of trade and productivity index. However You and Sarantis (2012b) stressed that social time preference such as the dependency ratio of the young (DEPY) should also be included in the estimation model. Other fundamental factors that should be considered are the tax revenue and foreign direct investment.

A question arises whether these exchange rate movements should be a concern for policymakers? This question has motivated a study to investigate the exchange rate movements in ASEAN Plus Three countries by using different approaches. This study suggests employing three common approaches such as fundamental equilibrium exchange rate (FEER), natural real exchange rate (NATREX) and behaviour equilibrium exchange rate (BEER). Basically, these three models use the economic fundamentals as factors driven to exchange rate movements instead of price based by PPP/LOP theory. Hence, the best model is the one that can determine the movement of exchange rate which reflect the smallest misalignment for this region.

1.2   Research Questions

Three research questions are addressed in this study. Firstly have the previous studies on exchange rate model successfully described the real situation of bilateral exchange rate in ASEAN Plus Three countries? Secondly, how huge is the deviation of the estimated equilibrium exchange rate from the actual exchange rate? Finally, does the model represent the real world situation?

1.3   Research Objectives

As mentioned earlier, the exchange rate in each of the ASEAN Plus Three countries was misaligned due to their small open economies. Being emerging countries, they are rather weak and less resilient to shocks affecting their financial system. Hence, estimation of equilibrium exchange rates is needed. One of the purposes of this study is to examine in depth why estimation of equilibrium exchange rate might be informative.

Therefore; the general objective in this study is:

1. To investigate the behaviour of exchange rate movement in ASEAN Plus Three countries.

The specific objectives are:

1. To examine the roles of macroeconomics fundamentals on the real exchange rate for ASEAN Plus Three countries using the Fundamental Equilibrium Exchange Rate (FEER), Natural Equilibrium Exchange Rate (NATREX), and Behavioural Equilibrium Exchange Rate (BEER) approaches.
2. To evaluate the misalignment based on all models (BEER, FEER and NATREX).
3. To evaluate and determine the best model to represent the exchange rates behaviour in these countries.

1.4 Significance of Study

The study of exchange rate behaviour is complex, unique and interesting. The on-going research on this subject would continue to increase our understanding on exchange rate. Based on Driver and Westaway (2004), the information from the empirical study of estimation equilibrium exchange rates is frequently used in discussing policy-related issues by academician as well as policy makers. This information provides the current situation of exchange rates and long-term exchange rates, thereby the future movements in exchange rates. Other than that, a country which implements fixed exchange rate could use the information of equilibrium exchange rate to know whether a particular entry rate will be sustainable in terms of cost. If not an adjustment of relative inflation rates is needed in order to justify any nominal exchange rate peg.

Estimation of equilibrium exchange rates is needed in order to know whether an observed change in the value of exchange rate is caused by shocks element in the macroeconomic environment. This is especially so for the open economies, where terms of trade can have significant implications on inflation. High domestic inflation can reduce demand of exports for the country and increase the imports (ceteris paribus), *vice versa*. Therefore estimating equilibrium exchange rates is important in order to generate the best policy response (Driver and Westaway, 2004).

Countries that implement a free market economy utilize the analysis of exchange rate behaviour to show their relative level of economic performance by comparing their PPP. Moreover, arbitrageurs such as banks and firms can adopt exchange rate analysis to generate profit by taking advantage of price differentials that occur simultaneously in different markets.

Policymakers play an important role in investigating and measuring the level of equilibrium exchange rates since prices faced by traders (importers and exporters) rely on exchange rates. Any misalignment and volatility in exchange rates will increase trading costs. This was observed in the Asian financial crisis 1997/1998. Corsetti, Pesenti and Roubini (1998) reported that when the volume of exports and imports for

ASEAN countries decreased significantly as exchange rates became misaligned and subsequently change immediately. Therefore, it is important for policymakers to have an effective policy to ensure stability in equilibrium exchange rates in order to sustain growth in international trade.

Traders and investors would experience difficulties in making short and long run decisions given a lack of confidence in the financial system. Significant volatility and extreme misalignment in real exchange rates would prove costly to them. Therefore, an investigation to determine the equilibrium exchange rate in order to discover whether a currency is undervalued or overvalued is important.

1.5 Organization of the Study

This study is organized as follows. The overview of the estimation equilibrium exchange rate in ASEAN countries is summarized in Chapter 1. Chapter 2 will discuss the theoretical framework of equilibrium exchange rates, and present the published empirical and theoretical literature on equilibrium exchange rates in emerging as well as in developing countries. Research Methodology is explained in Chapter 3. Chapter 4 presents the results and discussion. Finally, Chapter 5 will summarize the main findings and conclude with some policy implications, as well as suggestion for further studies.

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BIBLIOGRAPHY

Alper, A. M., & Civcir, İ. (2012). Can Overvaluation Prelude to Crisis and Harm Growth in Turkey. *Journal of Policy Modeling*, *34*(1), 112–131.

Amano, R. A., & Norden, S. V. (1995). Terms of trade and real exchange rates : the Canadian evidence. *Journal of International Money and Finance*, *14*(1), 83–104.

Arize, A. c. (2011). Purchasing Power Parity in LDCs: An Empirical Investigation. *Global Finance Journal*, *22*, 56–71.

Baak, S. (2012). Measuring misalignments in the Korean exchange rate. *Japan and the World Economy*, *24*(4), 227–234.

Baharumshah, A. Z., Aggarwal, R., & Haw, C. T. (2007). East Asian Real Exchange Rates and PPP : New Evidence from Panel-data Tests. *Global Economic Review*, *36*(2), 103–119.

Baharumshah, A. Z., & Soon, S.-V. (2012). Mean reversion in bilateral real exchange rates : evidence from the Malaysian ringgit. *Applied Economics*, *44*, 2921–2933.

Baharumshah, A. Z., Tze-haw, C., & Fountas, S. (2008). Re-examining purchasing power parity for East-Asian currencies : 1976-2002. *Applied Financial Economics*, *18*, 75–85.

Barrett, R. N. (1981). Purchasing Power Parity And The Equilibrium Exchange Rate. *Journal of Money, Credit and Banking*, *13*(2), 227–240.

Beckmann, J., Belke, A., & Dobnik, F. (2012). Cross-section Dependence and The Monetary Exchange Rate Model – A Panel Analysis. *The North American Journal of Economics and Finance*, *23*, 38–53.

Belloc, M., & Federici, D. (2010). A two-country NATREX model for the euro/dollar. *Journal of International Money and Finance*, *29*(2), 315–335.

Benassy-Quere, A., Bereau, S., & Mignon, V. (2008). *Equilibrium Exchange Rates : A Guidebook for the Euro-Dollar Rate* (No. 2008–2).

Bénassy-Quéré, A., Béreau, S., & Mignon, V. (2009). The dollar in the turmoil. *Journal of the Japanese and International Economies*, *23*(4), 427–436.

Benassy-Quere, A., Lahreche-Revil, A., & Mignon, V. (2011). World-consistent equilibrium exchange rates. *Journal of the Japanese and International Economies*, *25*, 12–32.

Béreau, S., Villavicencio, A. L., & Mignon, V. (2010). Nonlinear Adjustment of The Real Exchange Rate Towards its Equilibrium Value: A Panel Smooth Transition Error Correction Modelling. *Economic Modelling*, *27*(1), 404–416.

Berger, T. and Kempa, B. (2012). Taylor Rules and The Canadian-US Equilibrium Exchange Rate. *Journal of International Money and Finance*, 1–16.

Berger, T., & Kempa, B. (2012). Taylor rules and the Canadian–US equilibrium exchange rate. *Journal of International Money and Finance*, 1–16.

Bildirici, M. E., & Kayikci, F. (2013). Effects of oil production on economic growth in Eurasian countries: Panel ARDL approach. *Energy*, *49*, 156–161.

BNM. (1999). *Rencana IV: Rejim Kadar Pertukaran Tetap - Implikasi ke atas Ekonomi Malaysia.* Malaysia.

Bouveret, A. (2010). BEER Hunter : the Use and Misuse of Behavioural Equilibrium Exchange Rates First version : 29 October 2009 This version : 18 April 2010 Abstract : Behavioural Equilibrium Exchange Rates have been widely used by International Institutions such as the IMF ,.

Carton, B., & Hervé, K. (2012). Estimation of consistent multi-country FEERs. *Economic Modelling*, *29*(4), 1205–1214.

Cerra, V., & Saxena, S. C. (2010). The Monetary Model Strikes Back: Evidence From the World. *Journal of International Economics*, *81*(2), 184–196.

Cerrato, M., Kim, H., & MacDonald, R. (2013). Equilibrium Exchange Rate Determination and Multiple Structural Changes. *Journal of Empirical Finance*, *22*(22), 52–66.

Cheung, Y.-W., & Lai, K. S. (1993). A Fractional Cointegration Analysis of Purchasing Power Parity. *Journal of Business & Economic Statistics*, *11*(1), 103–112.

Chin, L. (2005). *The Monetary Approach to Exchange Rate Determination in Five ASEAN Countries*. University Putra Malaysia.

Chin, L., & Azali, M. (2005). EXCHANGE RATE MISALIGNMENTS IN ASEAN-5 COUNTRIES. *Labuan Bulletin OF INTERNATIONAL BUSINESS & FINANCE*, *3*, 11–31.

Chin, L., Azali, M., Yusop, Z., & Yusoff, M. (2007). The monetary model of exchange rate : evidence from The Philippines. *Applied Economics Letters*, (14), 993–997.

Chin, L., Habibullah, M. S., & Azali, M. (2009). Tests of different monetary aggregates for the monetary models of the exchange rate in five ASEAN countries. *Applied Economics*, (41), 1771–1783.

Chinn, M. (2000). Three Measures of East Asian Currency Evaluation. *Contemporary Economic Policy*, *18*(2), 205–214.

Chong, Y., & Hendry, D. F. (1986). Econometric Evaluation of Linear Macro-Economic Models. *Review Of Economics Studies*, *LIII*, 671–690.

115

Civcir, I. (2003). The Monetary Model of the Exchange Rate under High Inflation: The Case of the Turkish Lira/US Dollar. *Finance a Uver - Czech Journal of Economics and Finance*, *53*(3–4), 113–129.

Clark, P. B., and MacDonald, R. (1999). Exchange Rates and Economic Fundamentals: A Methodological Comparison of BEERs and FEERs. In J. MacDonald, R. and Stein (Ed.), *Equilibrium Exchange Rates* (pp. 285–322). Washington, DC: Springer.

Corsetti, G., Pesenti, P., & Roubini, N. (1998). *What Caused The Asian Currency And Financial Crises? A Macroeconomic Overview.* (No. 6833). *NBER Working Paper No. 6833*.

Coudert, V., & Couharde, C. (2007). Real Equilibrium Exchange Rate in China Is The Renminbi Undervalued? *Journal of Asian Economics*, *18*(4), 568–594.

Coulibaly, I., & Gnimassoun, B. (2013). Optimality of a monetary union: New evidence from exchange rate misalignments in West Africa. *Economic Modelling*, *32*, 463–482.

Daniel, J. P., & VanHoose, D. D. (2005). *International Monetary and Financial Economics.* (3rd ed.). Thomson.

Devarajan, S., Lewis, J. D., & Robinson, S. (1993). External Shocks , Purchasing Power Parity, and the Equilibrium Real Exchange Rate. *Oxford Journals*, *7*(1), 45–63.

Devereux, M. B. (1999). Real Exchange Rate Trends and Growth: A Model of East Asia. *Review of International Economics*, *7*(3), 509–521.

Driver, R. L., & Westaway, P. F. (2004). *Concepts of Equilibrium Exchange Rates* (No. 248). United Kingdom.

Eden, H. V., Bin, L., Romyn, G., & Xiaoguang, Y. (2001). NATREX And Determination of Real Exchange Rate of RMB. *Journal of Systems Science and Complexity*, *14*(4).

Edwards, S., & Savastano, M. (1999). *Exchange Rates in Emerging Economics: What Do We Know? What Do We Need to Know?* (No. 7228).

Égert, B., Halpern, L., & Macdonald, R. (2005). *Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues* (No. 106).

Egert, B., & Lahreche-Revil, A. (2003). Estimating the Equilibrium Exchange Rate of the Central and Eastern European Acceding Countries: The Challenge of Euro Adoption. *Review Of World Economics*, *139*(4), 683–708.

Égert, B., Lahreche-Revil, A., & Lommatzsch, K. (2004). *The Stock-Flow Approach to the Real Exchange Rate of CEE Transition Economies* (No. 2004–15).

Fernandez, F. M., Osbat, C., & Schnatz, B. (2006). Towards The Estimation of Equilibrium Exchange Rates for Transition Economies: Methodological Issues and a Panel Cointegration Perspective. *Journal of Comparative Economics*, *34*, 499–517.

Frait, J., Komarek, L., & Melecký, M. (2004). The Real Exchange Rate Misalignment in the Five Central European Countries. *Warwick Economic Research Papers*, (739).

Frankel, J. A., & Rose, A. K. (1996). A panel project on purchasing power parity: Mean reversion within and between countries. *Journal of International Economics*, *40*(1–2), 209–224.

Groen, J. J. J. (2000). The monetary exchange rate model as a long-run phenomenon. *Journal of International Economics*, *52*(2), 299–319.

Habibullah, M. S. (1999). *Divisia Monetary Aggregates and Economic Activities in Asian Developing Economies*. Ashgate, Brookfield.

Habibullah, M. S., Din, B. H., & Abdullah, H. (2012). Border Effects: The Cases For States Of Northen Malaysia and Provinces of Southern Thailand. *Journal of International Economic Review*, *5*(1), 15–27.

Hallman, J. J., Porter, R. D., & Small, D. H. (1991). Is the Price Level Tied to the M2 Monetary Aggreagate in the Long Run? *The American Economic Review*, *81*(4), 841–858.

Halpern, L., & Wyplosz, C. (1997). Equilibrium Exchange Rates In Transition Economies. *Staff Papers - International Monetary Fund*, *44*(4), 430–461.

He, X., & Qin, D. (2004). Aggregate Investment in People ' s Republic of China : Some Empirical Evidence. *Asian Development Review*, *21*(1), 99–117.

Hendry, D. F., & Clements, M. P. (2001). *Economic Forecasting: Some Lessons from Recent Research*. UK.

Ho, C. S. F., & Ariff, M. (2012). Time to Equilibrium in Exchange Rates: G-10 and Eastern European economies. *Global Finance Journal*, *23*(2), 94–107.

Holtemöller, O., & Mallick, S. (2012). Exchange Rate Regime , Real Misalignment and Currency Crises. *Economic Modelling*.

Hoque, A., & Banerjee, R. (2012). Does Purchasing Power Parity Hold for Garment Export-Oriented Developing Countries? *Procedia - Social and Behavioral Sciences*, *65*, 8–13.

Husted, S., & MacDonald, R. (1999). The Asian Currency Crash: Were Badly Driven Fundamentals to Blame. *Journal of Asian Economics*, *10*(4), 537–550.

Irhan, H. B., Alacahan, N. D., & Korap, L. (2011). An Empirical Model for the Turkish Trade Balance: New Evidence from ARDL Bounds Testing Analyses. *Instanbul University Econometrics and Statistics E-Journal*, *14*(1), 38–61.

Isard, P. (2007). *Equilibrium Exchange Rates: Assessment Methodologies* (No. WP/07/296).

Ito, T., Isard, P., & Symansky, S. (1997). *Economic Growth And Real Exchange Rate: An Overview of The Balassa-Samuelson Hypothesis in Asia* (No. 5979). Massachusetts Avenue.

Keblowski, P., & Welfe, A. (2010). Estimation of The Equilibrium Exchange Rate: The CHEER Approach. *Journal of International Money and Finance*, *29*, 1385–1397.

Kogid, M. B. (2002). *Krisis Kewangan, Jangkitan dan Kemeruapan: Analisis Integrasi Pasaran Kewangan Malaysia*. Malaysia: Universiti Kebangsaan Malaysia.

Koske, I. (2008). Assessing the Equilibrium Exchange Rate of the Malaysian Ringgit: A Comparison of Alternative Approaches. *Asian Economic Journal*, *22*(2), 179–208.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. C. (1992). Testing the Null Hypothesis of Stationarity Against the Alternative of A Unit Root: How Sure Are We That Economic Time Series Have a Unit Root? *Journal of Econometrics*, *54*, 159–178.

Lim, G.-C. (2000). *Misalignment and Managed Exchange Rates: An Application to the Thai Baht* (WP/00/63).

Lòpez-Villavicencio, A., Mazier, J., & Saadaoui, J. (2012). Temporal Dimension and Equilibrium Exchange Rate : A FEER / BEER Comparison. *Emerging Markets Review*, *13*, 58–77.

Macdonald, R. (2000). *The Role Of The Exchange Rate In Economic Growth: A Euro-Zone Perspective* (No. 9).

MacDonald, R. (1998). What determines real exchange rates ? The long and the short of it. *Journal of International Financial Markets, Institutions and Money*, *8*, 117–153.

Mark, N. C. (1995). Exchange rates and fundamentals: Evidence on long-horizon predicability. *The American Economic Review*, *85*(1), 201–218.

Meese, R. A., & Rogoff, K. (1983). Empirical Exchange Rate Models of the Seventies: Do they fit out of sample ? *Journal of International Economics*, *14*(1–2), 3–24.

118

Melecky, M., & Komarek, L. (2007). The Behavioral Equilibrium Exchange Rate of the Czech Koruna. *Transition Studies Review*, *14*(1), 105–121.

Mishra, R. K., & Sharma, C. (2010). Real exchange rate behavior and optimum currency area in East Asia: Evidence from Generalized Purchasing Power Parity. *International Review of Financial Analysis*, *19*(3), 205–213.

Mundell, R. (2003). Prospects For An Asian Currency Area. *Journal of Asian Economics*, *14*, 1–10.

Narayan, P. K. (2004). *Reformulating Critical Value for the Bound F-statistics Approach to Cointegration: An Application to the Tourism Demand Model for Fiji.*

Naseem, N. A. M., Hui-boon, T., & Hamizah, M. S. (2009). Exchange Rate Misalignment, Volatility and Import Flows in Malaysia. *International Journal of Economics and Management*, *3*(1), 130–150.

Ng, T. H. (2002). Should The Southeast Asian Countries Form a Currency Union? *The Developing Economies*, *2*(June), 113–134.

Nuryadin, D. (2006). Real Effective Exchange Rate Determination in Indonesia: A Behavioral Equilibrium Exchange Rate Approach. *Jurnal Ekonomi Pembangunan*, *11*(2), 147–158.

Park, C., & Park, S. (2013). Exchange Rate Predictability and a Monetary Model with Time-varying Cointegration Coefficients. *Journal of International Money and Finance*.

Pattichis, C., Maratheftis, M., & Zenios, S. A. (2007). Is the Cyprus Pound Real Effective Exchange Rate Misaligned ? A BEER Approach. *International Economic Journal*, *21*(1), 133–154.

Pesaran, B., & Pesaran, M. H. (2009). *Time Series Econometrics using Microfit 5.0*. Oxford University Press.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds Testing Approaches To The Analysis Of Level Relationships. *Journal of Applied Econometrics*, *16*, 289–326.

Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled Mean Group Estimation of Dynamic Heterogeneous Panels. *Journal of the American Statistical Association*, *94*(446), 621–634.

Pesaran, M. H., & Smith, R. (1995). Estimating long-run relationships from dynamic heterogenous panels. *Journal of Econometrics*, *68*, 79–113.

Quere, A. B., Revil, A. L., and Mignon, V. (2011). World-consistent Equilibrium Exchange Rates. *Journal of The Japanese and International Economie*, *25*, 12–32.

Rahn, J. (2003). *Bilateral Equilibrium Exchange Rates of EU Accession Countries Against The Euro* (No. 11). Finland.

Rapach, D. E., Strauss, J. K., & Zhou, G. (2010). Out-of-Sample Equity Premium Prediction : Combination Forecasts and Links to the Real Economy. *The Review of Financial Studies*, *23*(2), 821–862.

Rapach, D. E., & Wohar, M. E. (2002). Testing the monetary model of exchange rate determination: new evidence from a century of data. *Journal of International Economics*, *58*(2), 359–385.

Rasekhi, S., & Rostamzadeh, M. (2011). Fundamental Modeling Exchange Rate using Genetic Algorithm: A Case Study of European Countries. *Journal of Economics and Behavioral Studies*, *3*(6), 352–359.

Rodrik, D. (2008). The Real Exchange Rate and Economic Growth. In L. H. Elmendorf, D. W., Mankiw, N. G., and Summers (Ed.), *Brookings Papers On Economic Activity*.

Rubaszek, M. (2004). A Model Of Balance Of Payments Equilibrium Exchange Rate. *Eastern European Economics*, *42*(3), 5–22.

Rubaszek, M. (2008). *Economic Convergence And The Fundamental Equilibrium Exchange Rate in Poland* (No. 12910).

Sahminan. (2005). *Estimating Equilibrium Real Exchange Rates of the Rupiah* (No. WP/08/2005).

Sekkat, K., & Varoudakis, A. (2000). Exchange rate management and manufactured exports in Sub-Saharan Africa. *Journal of Development Economics*, *61*(1), 237–253.

Sidek, N. Z. M., & Yusoff, M. (2009). An Empirical Analysis of Malaysian Ringgit Equilibrium Exchange Rate and Misalignment. *Global Economy & Finance Journal*, 2(2), 104–126.

Stein, J. L. (1994). The Natural Real Exchange Rate of the United States Dollar and Determinants of Capital Flows. In J. Williamson (Ed.), *Estimating Equilibrium Exchage Rates* (pp. 38–85). Washington, DC: Institute for International Economics.

Stein, J. L. (1995). *The Fundamental Determinants of the Real Exchange Rate of the U.S. Dollar Relative to Other G-7 Currencies* (No. WP/95/81).

Stein, J. L. (2005). *The Transition Economies: A Natrex Evaluation Of Research* (No. 1449).

Stein, J., & Lim, G. (2002). Introduction to Exchange Rates in Europe and Australia: Fundamnetal Determinants, Adjustment and Policy Implications. *Australia Economic Papers*, *41*, 329–591.

Syllignakis, M. N., & Kouretas, G. P. (2011). Markov-switching Regimes and The Monetary Model of Exchange Rate Determination: Evidence from the Central and Eastern European markets. *Journal of International Financial Markets, Institutions and Money*, *21*(5), 707–723.

Taylor, M. P. (1988). An empirical examination of long-run purchasing power parity using cointegration techniques. *Applied Economics*, *20*(10), 1369–1381.

Villavicencio, A. L. (2006). Real Equilibrium Exchange Rate: A Panel Data Approach For Advanced and Emerging Economies. *Economie Internationale*, *108*, 59–81.

Williamson, J. (1983). *The Exchange Rate System.* Washington DC: Institute for International Economics.

Wong, H. T. (2013). Real exchange rate misalignment and economic growth in Malaysia. *Journal of Economic Studies*, *40*(3), 298–313.

You, K. F., & Sarantis, N. (2008). *The Equilibrium Real Effective Exchange Rate of China : A NATREX Approach*.

You, K., & Sarantis, N. (2012a). A twelve-area model for the equilibrium Chinese Yuan/US dollar nominal exchange rate. *Journal of International Financial Markets, Institutions and Money*, *22*(1), 151–170.

You, K., & Sarantis, N. (2012b). Structural breaks and the equilibrium real effective exchange rate of China: A NATREX approach. *China Economic Review*, *23*(4), 1146–1163.