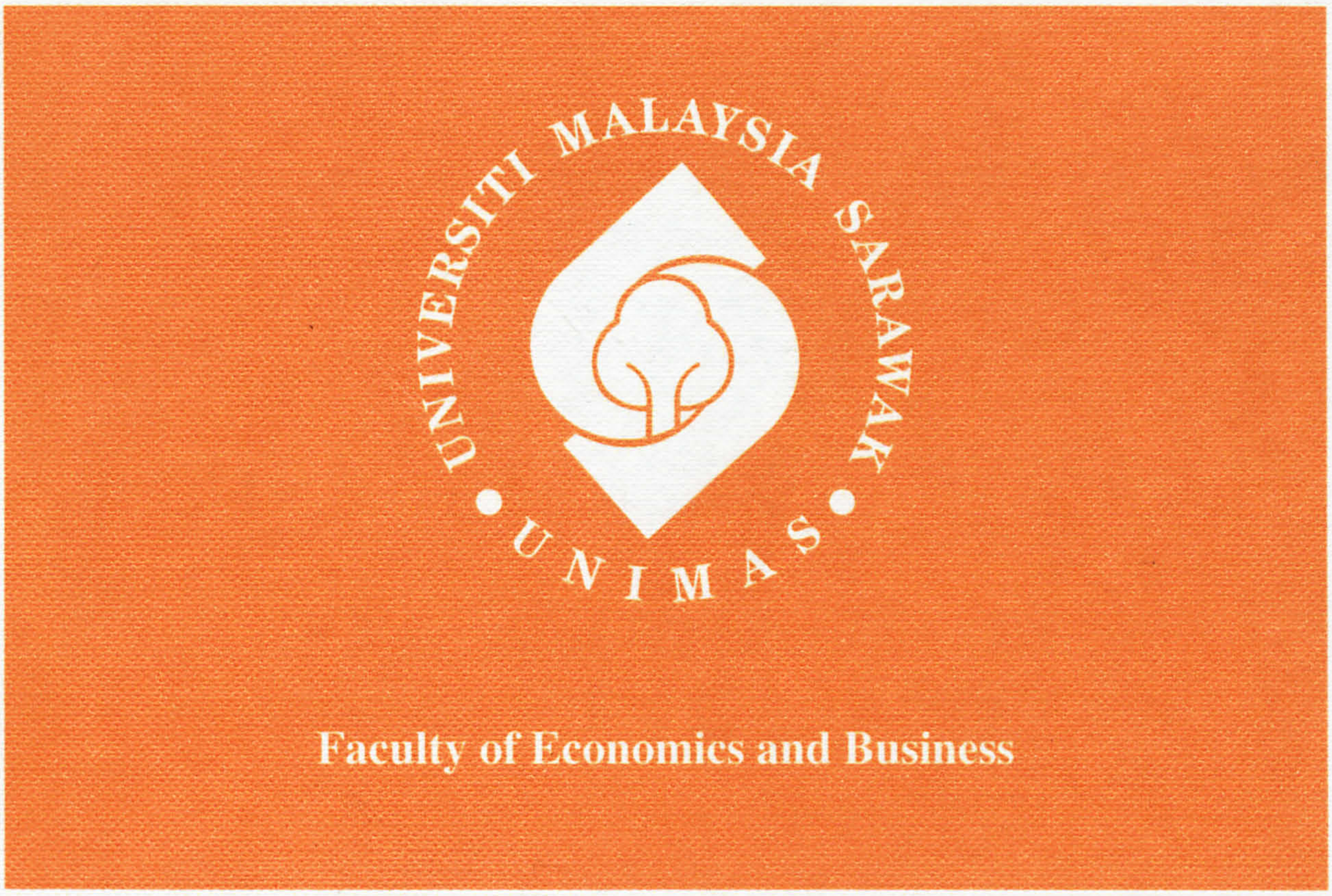

THE RELATIONSHIP BETWEEN ASEAN CURRENCIES WITH RENMINBI

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Master of Science
(Economics)
2013

THE RELATIONSHIP BETWEEN ASEAN CURRENCIES WITH RENMINBI

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A thesis submitted
In fulfillment of the requirements for the degree of Master of Science in Economics

Faculty of Economics and Business
UNIVERSITI MALAYSIA SARAWAK
2013

Statement of Originality

The work described in this Thesis, entitled
"The Relationship between ASEAN Currencies with Renminbi",
is to that best of the author's knowledge that of the author except
where due reference is made.

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ABSTRACT

THE RELATIONSHIP BETWEEN ASEAN CURRENCIES WITH RENMINBI

By

Chong Mui Foon

This study aimed to examine the possibility of the Chinese Renminbi to be the common currency for the ASEAN region. For this purpose, this study inspected whether the Chinese Renminbi has a cointegrating relationship with each of the ASEAN currencies. In addition, this study also explored the causal impacts between the Chinese Renminbi and the ASEAN currencies. This study assumed that it is appropriate to suggest the formation of Renminbi bloc in this region if there are cointegrating relationships existing between the Chinese Renminbi and the ASEAN currencies. The results of this study proved that there are five ASEAN currencies that cointegrated with the Chinese Renminbi across all periods. Moreover, the Granger causality tests confirmed the existence of causal impacts between the Chinese Renminbi and the ASEAN currencies. The findings of this study implied that the Renminbi bloc is feasible in this area, if China could grow to be a highly influential country with its speedy growth in the long run.

ABSTRAK

HUBUNGAN ANTARA MATA WANG DI NEGARA-NEGARA ASEAN DENGAN RENMINBI

Oleh

Chong Mui Foon

Kajian ini mengkaji kemungkinan Renminbi menjadi mata wang bersama bagi negara-negara ASEAN. Kajian ini menyelidik tentang hubungan antara Renminbi dengan mata wang di negara-negara ASEAN. Selain itu, kajian ini juga menyelidik tentang kesan Renminbi terhadap mata wang di negara-negara ASEAN. Kajian ini mengangap bahawa Renminbi sesuai dijadikan mata wang bersama bagi negara-negara ASEAN jika Renminbi menunjukkan hubungan dengan mata wang di negara-negara ASEAN. Keputusan dari ujian menunjukkan terdapat lima mata wang bagi negara-negara ASEAN yang mempunyai hubungan dengan Renminbi dalam semua tempoh masa. Di samping itu, Renminbi juga mempunyai kesan terhadap mata wang di negara-negara ASEAN. Oleh itu, keputusan dari kajian ini menunjukkan Renminbi sesuai dijadikan mata wang bersama di negara-negara ASEAN jika China menjadi negara yang lebih berpengaruh dan berkuasa dengan kemajuan yang cepat dalam masa jangka panjang.

ACKNOWLEDGEMENT

First of all, I would like to dedicate my deepest appreciation to my supervisor, Associate Professor Dr. Venus Liew Khim Sen for his valuable guidance, encouragement and concern to me in completing this study. His willingness to share his knowledge with me is most appreciated. Besides, I would like to thanks to my co-supervisor, Associate Professor Dr. Puah Chin Hong for the guidance and advice that he extended to me in my completion of this thesis.

In addition, I would like to thanks to the staffs of the Faculty of Economics and Business (FEB), staffs of the Centre for Graduate Studies as well as librarians at CAIS for their help in getting useful information for this study. My special thanks also go to my family members who have supported me all the while. Lastly, I would like to thanks to all my friends, I appreciate all the supports that lead me to the completion of this thesis.

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CHAPTER ONE

INTRODUCTION

1.0 Introduction

The economic crisis in 1997 and recent global downturn among Asian economies disclose that integration endeavor is crucial. There are different types of integration such as trade integration, investment integration and financial integration. Optimum Currency Area (OCA) is among the famous financial integrations, which was introduced by Mundell (1961). OCA is defined as a group of countries that share a single currency in all transaction process. There are many importance and potential benefits[1] that can be gained by a country through the OCA establishment. The main benefit is the reduction of transaction cost. By using the same currency, there is no apparent need for a country to exchange their currency when making payment to other countries within the same OCA. This benefit will directly enhance the trade and investment activities within the area and the country's economy is said to be developed rapidly.

Several studies[2] have found that Asian countries have the potential to form an optimum currency and therefore establishing OCA. Mundell (2003) stated that Asia has the potential to be a currency area. Due to the importance of economy integration, a

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[1] See more in Kwan (1998), Mkenda (2001), Huang & Guo (2006), Sahin (2006), Bacha (2008), Ricci (2008) and Swofford (2008).

[2] See Zhang, Sato & McAleer (2004), Kwack (2005), Aminian (2005), Huang & Guo (2006), Ahn, Kim & Chang (2006), Rana (2007), and Swofford (2008).

number of efforts have been initiated. These include ASEAN[3] Free Trade Area (AFTA) in 1992 when ASEAN had six members[4], ASEAN Investment Area (AIA) in 1998, the creation of ASEAN plus Three[5] in 1999and the Chiang Mai initiative (CMI)[6] in 2000. In the fifth ASEAN summit in October 1998, AIA was signed with the aim to ensure ASEAN is a competitive, conducive and liberal investment area. Greater transparency, more liberal and competitive regimes and the lower transaction cost among nations will directly increase the investment activities among the region economies. In short, the economic crisis in 1997 had encouraged greater regionalism which leads to the formation of ASEAN plus Three and henceforth the Chiang Mai Initiative (CMI).

Moreover, the conquest of Euro zone[7] in 1999 has increased the arguments on currency union and it has also encouraged the emergence of currency blocs in other regions all over the world. In addition, ithas created interest of Asia in monetary integration. Euro adoption eliminates the volatility of exchange rates and supported price transparency. Thus, it increases the trade and makes the countries a more attractive choice for investment. This is because elimination of unstable exchange rates will lower the cost and risk of cross-border business. Furthermore, it results in the production of cheaper goods and services as trade enhancement among the region will lay pressure on the price. Finally, the economy can achieve growth due to the improvement of the

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[3]Association of Southeast Asian Nations.
[4]Brunei, Indonesia, Malaysia, The Philippines, Singapore and Thailand.
[5]ASEAN plus three Northeast Asian countries which are Japan, Korea and China.
[6] CMI highlights on the bilateral currency swap arrangement (BSAs) among members to overcome the short-term liquidity difficulties and protect the region from the future crisis.
[7] Eurozone are first constructed by 11 members of the European Union (EU) that share a single currency which is Euro. The 11 members included Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain. Eurozone now has 17 members with the addition of Cyprus, Estonia, Greece, Malta, Slovakia, and Slovenia.

determinants of the growth, which are trade and investment. Therefore, exchange rate plays a very significant role for a country since it is a key to link between a domestic country and a foreign country. For instance, both import and export goods will adjust through the exchange rate. Due to various effects brought by financial crisis, the success of Euro zone and the importance of exchange rate for a country, studies on the use of common currency are popular among researchers. Areas which are widely studied are related to the possibility of having a common currency for a country and determining which currency would be the most suitable for an optimum currency region.

However, the recent Euro sovereign debt which started in Greece in the late 2009 raised doubts on whether a single currency can really survive or whether ASEAN countries still need to initiate a single currency like Euro zone since the fall of Euro and the debt crisis drove the region to the border of collapse. According to Minescu (2011), the causes for the Euro debt are due to the speedy growth in the level of debts and the real estate price enlargement. Greece faced a public debt of more than 100% of Gross Domestic Product (GDP) before the country joined Euro; Ireland burst the real estate bubble[8] in debt around 900% to GDP ratio in 2008 and caused a huge cost to recapitalise the banking system; Portugal itself experienced large public debt and budget deficit after joining the Euro in 1999 because it was affected by a steady loss of competiveness in wages and their worst ever downshift of economy in the 1990s which resulted in problems of managing the country's public finance; and Spain experienced the highest unemployment rate among the major developed countries of Euro zone from 1995 to 2011. Therefore, countries of Euro zone themselves push the region to the crisis.

[8]The value of the property decreases.

Nevertheless, the European Union (EU) and International Monetary Fund (IMF) provided financial assistance to Euro zone members that faced difficulty in the crisis which started in May 2010 by providing them bailout fund. Besides that, there are two temporary measures that would bailout Euro zone members called the European Financial Stability Facility (EFSF) created in June 2010 and the European Financial Stability Mechanism (EFSM) created on 5 January 2011. Yet, these two financial measures will be expired in 2013. Therefore, the Euro zone finance ministers set up a permanent bailout fund known as European Stability Mechanism which will begin operation in 2013 (Minescu, 2011).

Although there is a tough phase for Euro zone at the moment, the achievement from the Euro adoption are not to be forgotten. The European Commission (EC) reported that there are achievements of optimum currency formation to the members from 1999 to 2009. According to them, inflation was reported at only around 2% on average within that period, which saw a drop of more than 1% compared to the 1990s; job opportunities were increased and achieved nearly 16 million; long-term interest rate fell half the level of the 1990s; increased trade and foreign direct investment (FDI) among Euro zone countries by around 5%-15% and 15%-35%, respectively; and the Euro emerged its role in international level where the use of the Euro in foreign reserves rose 7% in 2007. Looking through the achievements and benefits from single currency adoption in Euro zone, the zone is still a good role model for ASEAN countries despite there is a Euro debt crisis because it provides the region a precious lesson. In fact, the objectives for the integration in ASEAN are also similar with Europe whereby the region sees for growth,

job creation and better crisis management. Therefore, the adoption of a single currency is believed to be able to drive ASEAN to a higher stage.

The adoption of common currency in Euro zone, although recently few problems emerged, stimulated a lot of interest in regional monetary integration in some regions including ASEAN because deeper monetary integration is able to reduce the risk of financial and exchange rate crises.In this respect, although the task force had been set up among the ASEAN countries for deeper integration, not all the countries are ready to reach the deadlines of the task force. In this view point, more empirical investigations are needed to validate the suitability of the member countries towards deeper economic integration agendas. It is noted that one European Union did not actually fulfilled the all the requirements at the time euro was adopted (Ricci, 2008). The inclusion of those unprepared or unsuitable countries in the currency zone may have in part led to the recent episode of the Euro zone sovereign debt crisis. The lesson from the Euro zone crisis, among others, is to ensure the suitability of countries before forming a currency zone. The study on the currencies relationships would be one of the foundations or supporting evidence upon the countries' suitability. At least it could serves as a preliminary qualifying round to identify the potential ASEAN member countries that can reach the task force deadlines.

According to Dorrucci, Firpo, Fratzscher and Mongelli (2004), a low level of exchange rate variability is an important criterion for the formation of single currency as it will lower the cost of abandoning the exchange rate flexibility and the cost for common

currency adoption. Lim (2005) stipulated that the convergence of exchange rate is one of the important requirements for monetary integration. The convergence can reduce the pre-integration levels of divergence among participating countries. Hence, it alleviates the costs of losing the exchange rate instrument in macroeconomic stabilization after integration. This is important because members of the currency union are said to generate fewer costs and greater benefits according to the theory of OCA[9].

On the other hand, there are some studies which suggested OCA for ASEAN despite claims from a few studies that only several countries out of the ten ASEAN countries can be a starter and are good candidates for the OCA (Bunyaratavej & Hahn, 2003; Lew & Ku, 2006). Some other pertinent studies also pointed out that the ASEAN region is suitable for the common currency and suggested that the region should have a common currency (Madhur, 2002; Agarwal, Penm, Wong & Martin, 2004; Aminian, 2005; Kenan & Meade, 2008). For that reason, this study aims to determine the possibility for the Chinese Renminbi to serve as the common currency for ASEAN members.

A majority of previous studies have proposed the Japanese Yen as the common currency for Asia or East Asia and some even suggested the United States dollar (USD) (Aggarwal & Mougoue, 1993: 1996; Tse & Ng, 1997; Kwan, 1996; Esaka, 2003; Bowman, 2003; Lim, 2005; Jeon & Zhang, 2007; Shirono, 2009). However, this study focus is given to the Chinese Renminbi. There are two reasons why the Renminbi is

[9]This could be achieved by sharing of a single currency by a group of countries. See Mundell (1961) for details on OCA.

considered as a better choice. Firstly, even though USD is still the dominant currency, the currency has been increasingly challenged after the Asian financial crisis in 1997. USD is claimed to be one of the causes for the Asian financial crisis in which the Asian currencies are effectively pegged to the US dollar. Besides that, ASEAN countries should decrease their dependence on the USD in order to develop the region and not to enlarge United States' authority. Secondly, previous studies have investigated the possibility of the Japanese Yen as the common currency because ofJapan being the most developed country in Asia and Japan itself too was claimed as a country that has an apparent increase in trade and investment activities with Asia (Kwan, 1998; Bowman, 2003; and Shirono, 2009). However, China has now emerged as the world's fastest growing economic with the 10% average growth rate over the past 30 years and it also surpasses Japan in 2010 as the world's second largest economy after United States. On July 21, 2005, the People's Bank of China announced the reforming of China's exchange rate regime. The exchange rate regime was to manage float. This reformation brings China to the higher stage as Renminbi strengthened after pegging was ended (Bloomberg, 2010). The total trade and economic cooperation between China and ASEAN had also increased. The largest trading partner for ASEAN is China since 2009 and ASEAN overtook Japan as China's third largest trading partner in 2011. In addition, Fratzscher and Mehl (2011) pointed out that Chinese Renminbi is prepared to be the dominant currency in Asia. Therefore, this study intends to focus on the possibility for the Chinese Renminbi to serve as the common currency for ASEAN members.

Trade cooperation between China and ASEAN can be clearly seen after ASEAN-China Free Trade Area (ACFTA) agreement was fully implemented in January 2010 for six ASEAN members namely Brunei, Indonesia, Malaysia, the Philippines, Thailand and Singapore. This action eliminates the tariffs for 90% of products to zero tariffs. For the remaining four ASEAN countries[10], the move to eliminate tariffs is scheduled to commence in 2015. In addition, China started trading Malaysia currency (RM) against the Chinese Renminbi on the domestic foreign exchange market on August 19, 2010. According to the China Foreign Exchange Trading Centre (CFETC), the purpose of this step is to promote bilateral trade between China and Malaysia and to facilitate the use of Chinese Renminbi to settle cross-border trade (Channel News Asia, 2010). Lately, some economic professors forecast the decline of United States and highlighted the increasing strength of China. They believe that economic growth of the United States is not as positive as many have expected; most estimates will place China and United States on the same level by the early 2020s; and the Chinese Renminbi will be the world's reserve currency within two decades. In addition, in order to increase the role of the Chinese Renminbi in global trade and finance, some steps are taken by the Chinese government to enhance the international use of the Chinese Renminbi. The ways to promote international use of the Chinese Renminbi include China permitting the settlement of trade transaction with the Chinese Renminbi, easing the restrictions on cross-border remittances of the Chinese Renminbi for settlement, permitting the issuance of the Chinese Renminbi-denominated bonds in Hong Kong and by foreigners in the mainland, permitting selected banks to offer offshore Chinese Renminbi deposit accounts and

[10]Cambodia, Laos, Myanmar and Vietnam are referred as CLMV.

setting up local currency bilateral swap lines with other central banks (Prasad & Ye, 2012).

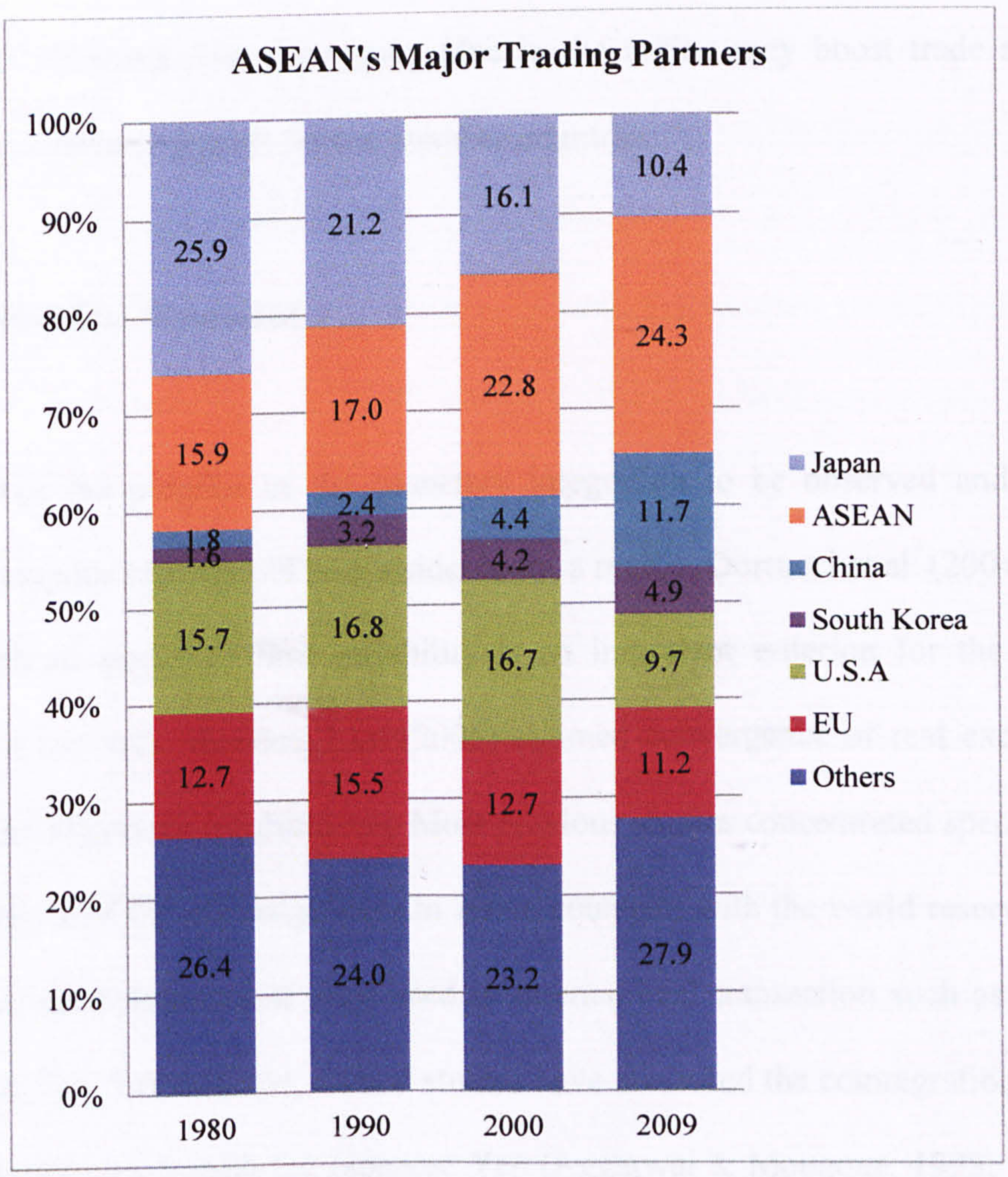
1.1 Background of the Study

ASEAN and China have accomplished progressive economic growths in the last decade and both have been claimed as the most dynamic economies in the world (Zhang and Ow, 1996). Simultaneous trades between ASEAN and China realistically show a hike. Figure 1.0 shows the ASEAN major trade partners from 1980 to 2009 which include European Union, United States, Japan, China, South Korea, ASEAN countries and other countries around the world. Excluding the other countries, Japan is the main trading partner for ASEAN countries with 25.9% of trade value in 1980. However, the total trade of ASEAN with South Korea is the least which is only 1.6%. The total trade with China was quite low at merely 1.8%. Japan retains as a major trading partner for ASEAN in 1990, conversely the trade value decreased to 21.2% of ASEAN total trade. ASEAN trade with China has shown an increasing trend but the percentage of trade was the least among other trading partners.

Nonetheless, the trade with China was enlarged between 2000 and 2009 whereby the enlargement of trade value increased from 4.4% to nearly triple the rate, at 12.0%. That amount to an annual average growth of 10% over the period of 30 years. Thus, the trade integration between China and ASEAN is growing at an immersed pace. On the other hand, the ASEAN trade with Japan has decreased continuously to 10.9% in 2009. In other words, the key trading partner of ASEAN is replaced by China lately. As shown

in Figure 1.0, the trade among ASEAN members has increased from around 16.0% in 1980 to 24.3% in 2009, equivalent to an average growth rate of 1.5% per annum over the past 30 years. This further implies that ASEAN countries are moving towards integration, but at a substantially slow rate.

Figure 1.0: The Trade between ASEAN and Its Major Trading Partners, 1980-2009 (%)



Source: International Monetary Fund (year)

In addition, the Joint Media Statements of the 10th ASEAN Economic Ministers (AEM) and the Minister of Commerce (MOFCOM) stated that the exports from ASEAN

to China have increased 31.9 billion USD from 2009 to 2010. However, the imports from China to ASEAN have raised 21.1 billion USD within the same period. The bilateral trade volume between China and ASEAN in 2010 was 292.78 billion USD and this amount was increased to around 24% in 2011 with the total trade volume between China and ASEAN reached 362.9 billion USD. In short, ASEAN and China are highly integrated through trade. As exchange rate is an important determinant for trade, therefore, implementing a currency bloc in the region may boost trade and indirectly improve economic growth for the member countries.

1.2 Problem Statement

For the purpose of the monetary integration to be observed and in particular which currency bloc should be considered for a region, Dorrucci et al. (2004) stated that a low level of exchange rate variability is an important criterion for the formation of optimum currency. Besides, Lim (2005) claimed convergence of real exchange rate as one of the important requirements. Most previous studies concentrated specifically on the convergence of the exchange rates in Asian countries with the world reserve currency or in detail, the currency that most used in international transaction such as USD and the Japanese Yen. For instance, several studies have measured the cointegration of currencies in Asian economies with the Japanese Yen (Aggarwal & Mougoue, 1993, 1996; and Tse & Ng, 1997). Azali, Royfaizal, and Lee (2009) showed that the Japanese Yen is highly suggested as a potential alternative vehicle currency for the Asian region since the financial integration was strengthened after the crisis. The question of whether it should

be dollar bloc or Yen bloc has been examined in Asian economies by Kwan (1998), Bowman (2003), Esaka (2003), Lim (2005), and Shirono (2009). Australian dollar (Koala) has also been re-examined by Bowman (2003) as compared with the Japanese Yen on the currency relationship after the East Asian crisis.

Despite the interest on examining the potential implementation of single currency in Asia, all previous studies related to the Chinese Renminbi are limited. Shirono (2009) remains as the only study that has considered Yuan (Chinese Renminbi) bloc as part of the currency arrangement in East Asia and hence provide supportive empirical evidence. The author focused on trade and welfare gains to examine the suitability of the Chinese Renminbi as a common currency for East Asia countries. But, exchange rate is examined in this study because it is an important determinant for trade. The elimination of variability of exchange rates will promote higher trade. However, does Chinese Renminbi have a cointegrating relationship with the ASEAN currencies? If the answer is positive, Chinese Renminbi can be the common currency for the ASEAN region. Therefore, this study extends the aforementioned works by attempting to test if the Chinese Renminbi can be a common currency for ASEAN countries in view of currency cointegration. Three sample periods which are before, during and after global financial crisis were used to analyse the competitiveness. This study include the period especially after the Global Financial Crisis (GFC) is to see if there is a change in the cointegtating relationship between the Chinese Renminbi and each of the ASEAN exchange rates. If Chinese Renminbi has cointegrated relationship with more ASEAN currencies even after the global financial crisis, it will be suitable to be a common currency in the region.

As stated by Mckinnon (1963), the more open a country is the more feasible for them to form an optimum currency because the less effective is the nominal exchange rate as a policy instrument. Small open countries can also form a single currency with other equally open countries to gain the benefits from OCA. Therefore, the countries can enjoy the reduction of transaction cost and exchange rate risk. This situation will further enhance economic growth of the OCA member countries because the elimination of exchange rate risk is a significant benefit which will promote trade activities by enhancing the competitiveness and efficiency within a country (Kwan, 1998).

To form a common currency with the choice of anchor currency and investigating its suitability largely depends on the macroeconomic fundamentals. In this aspect, China has emerged as a major economic power and its rapid growth makes China as the world's fastest-growing major economy. China's average growth rate over the past 30 years has reached 10%. As reported in the Central Intelligence Agency (CIA) World Factbook 2009, purchasing power parity (PPP)[11] is high for China compared to other countries which is commonly investigated by other researchers in the currency relationship such as Japan, Australia, Germany and New Zealand. Accordingly, China is ranked at third place for the PPP among all the countries in the world after European Union and United States in 2009. In terms of trade, China and ASEAN bilateral trade boost rapidly especially after China joined the World Trade Organization (WTO) in 2001. Moreover, the implementation of ASEAN-China free trade area in January 2010 and the trading using Malaysian currency against the Chinese Renminbi in August 2010 has also facilitated the growth in trade. The trade between ASEAN and China increased from 2009 to 2010

[11]Rates of currency conversion that eliminate the differences in price levels between countries.

where both of the exports and imports from China have increased by 39.1% and 21.8%, respectively (Joint Media Statements of the 10th ASEAN Economic Ministers (AEM) and the Minister of Commerce (MOFCOM), 2011).

It is an undeniable fact that ASEAN countries are more integrated in trade with China. China has been the world's fastest-growing major economy with an average growth rate of 10% for the past 30 years, according to the World Development Indicators (World Bank, 2010). Since 2008, China has overtaken Japan in terms of the shares to ASEAN trade. Japan's shares to ASEAN trade recorded about 20% in 2001 and it has reduced gradually to 11% in the year 2011. Since the launch of ASEAN-China CECA in 2003 onwards, China's shares towards the ASEAN trade have been regularly growing with an average growth rate of 24.5% over the periods from 2003 till 2011 (WTO, 2011). Based on these observed returns, perhaps the Chinese Renminbi could be a better option for a currency bloc with ASEAN countries.

Following the past work done by Zhou (1998), it is prevalent to assess whether the Chinese Renminbi and ASEAN currencies may have been influenced by one another in this region. Secondly, the evidence of a currency bloc can be further showed through enhanced degree of cointegration over certain time periods (Bowman, 2003 and Bowman, 2005, p.83). Thus, the research questions of this study are, do Chinese Renminbi has a cointegrating relationship with each of the ASEAN exchange rates? Do Chinese Renminbi Granger cause each of the ASEAN exchange rates? Based on these research questions, the purpose of this study is to investigate whether the Chinese Renminbi has a

cointegrating relationship with each of the ASEAN exchange rates and also to investigate if the Chinese Renminbi Granger cause each of the ASEAN exchange rates.

1.3 Objectives of the Study

1.3.1 General Objective

This study aims to investigate the cointegrating and causal relationship between the Chinese Renminbi with each of the ASEAN exchange rates.

1.3.2 Specific Objectives

There are two specific objectives for this study:

i. to investigate whether Chinese Renminbi has a cointegrating relationship with each of the ASEAN exchange rates; and

ii. To investigate if Chinese Renminbi granger cause each of the ASEAN exchange rates.

This study includes the Chinese Renminbi (RMB) as the base currencies for the exchange rates of ASEAN, namely the Brunei Dollar (BND), Cambodian Riel (KHR), Lao Kip (LAK), Indonesian Rupiah (IDR), Malaysian Ringgit (MYR), Myanmar Kyat (MMK), Philippines Peso (PHP), Singapore Dollar (SGD), Thai Baht (THB), and the Vietnamese Dong (VND).

1.4 Significance of the Study

The most direct and immediate benefits from having a common currency is reduced transaction costs and the elimination of exchange rate uncertainty. Furthermore, it enhances the efficiency and competitiveness of the ASEAN economy. There was a popular saying in Europe that if one travelled through all 15 EU countries, changing money in each country but not actually spending it, he or she would return home with only half the original amount. With countries using the same currency, transaction costs can be reduced. The elimination of exchange rate uncertainty will result in saved hedging costs for companies that previously hedged exchange rate risk.

In addition to that, consumers will benefit, as increased price transparencies will promote Asia-wide competition, resulting in less inflation. Reduced transaction costs and elimination of currency risk will promote cross-border investment and trade. From the result of this study, policy makers of each ASEAN country can observe the possibility of forming a common currency with China if there is an important relationship between the ASEAN exchange rate and the Chinese Renminbi. Hence, the economy and the development of the ASEAN countries can be further developed. It is also the intention of this research into seeing whether the establishment of common currency will affect the perception towards the policy makers and the politicians, as well as the choice of proper country policy.

1.5 Organisation of the Study

The following is the structure of this study. A concise explanation of empirical literatures about the relevance theory, model and testing procedures will be presented in Chapter Two. In Chapter Three, there is a brief description on the data, sample period as well as analysis tools that were employed in this study. Results and discussion are reported in Chapter Four. In the last chapter which is Chapter Five, conclusions and policy implications will be presented.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The success of the single currency area establishment in Europe provided interest and indeed the attention of various researchers on the topic of OCA[12] which said as the theoretical genesis discussion on monetary integration (Patrick, 2000). Monetary union is needed in East Asia with the belief in intraregional exchange rate stability is desirable in the region. In order to achieve intraregional exchange rate stability, Kawai (2008) stated that there must be some convergence of exchange rate in East Asia. Hence, this chapter reviews some of the earlier studies on OCA and convergence of exchange rate which will be a principle for the investigation to attain objective of the study. Therefore, the scope of the review is divided into four sub-parts which comprise of theoretical framework, empirical testing procedure, empirical evidences and the concluding remark. The summary of literature reviews will be presented from Table 2.1 until Table2.3 to give a general reviews about this study. All the literatures included in the tables were reviewed although some of the studies were not discussed in detail in this chapter.

[12] See for example, Bayoumi & Eichengreen (1997), Kempa (2002), Kim & Chow (2003), Angresano (2004), Dutta (2005), Furceri& Karras (2006).

2.1 Reviews on Theoretical Framework

2.1.1 Theory of OCA

The theory of OCA was first introduced by Mundell (1961) and further discussed in two influential papers by McKinnon (1963) and Kenen (1969). OCA is defined as a group of countries that share for a single currency. According to Mundell (1961), a single currency represents a single central bank that has note-issuing powers. At the early time, the basic discussion on monetary integration is in term of OCA criteria and the cost-benefits of having monetary integration. Therefore, the general explication on the theory, specifically on the cost-benefits and criteria of OCA is deemed to be crucial and will be discussed in the subsequent section.

2.1.1.1 The Costs and Benefits from the formation of OCA

The theoretical discussion on monetary integration is OCA (Patrick, 2000). The benefits that can be gained by the participating countries of forming an OCA together should be larger than the cost of forming OCA. According to Kwan (1998), the net benefits (benefits minus costs) of forming OCA should be positive in order to support a country to join a currency union. Benefits and cost may occur in both microeconomic and macroeconomic levels but mostly in micro level (Mkenda, 2001).

The main benefit of monetary integration is the transaction cost reduction which can be claimed as an important benefit from the formation of OCA among OCA

economies[13]. The transaction cost are the cost associated with exchanging currencies, such as lost international trade due to exchange rate uncertainty and hedging to avoid exchange rate risk (Meissner & Oomes, 2008). The elimination of exchange rate risk is another significant benefit which will lead to the growth of OCA members. This is because the eliminated exchange rate will promote trade and investment activities by enhancing the competitiveness and efficiency within a country. Increased resources allocation and businesses by companies due to the price transparencies in the countries are also claimed to be the benefits of monetary integration (Kwan, 1998; Swofford, 2008 and Bacha, 2008). Furthermore, Kwan (1998) claims that enhancement of the usefulness of money is a main benefit from the formation of OCA.

The costs of OCA countries are further discussed by numerous authors and they mainly discussed the loss of autonomous monetary and exchange rate policy by members (Kwan, 1998; Mkenda, 2001; Sahin, 2006; and Bacha, 2008). Monetary policies in economies of the currency union are required to be unified where the individual country is unable to decide the monetary policy for its own nation. Hence, Bacha (2008) stated that the policy coordination and commitment within the OCA economies are needed. Nevertheless, the cost of OCA can be a smaller or larger amount according to Mkenda (2001). The formation will be burdened by more cost if the shocks affecting the member countries are asymmetric and, vice versa. Sahin (2006) added two costs which are, the

[13] See more in Kwan (1998), Mkenda (2001), Huang & Guo (2006), Sahin (2006), Bacha (2008), Ricci (2008), and Swofford (2008).

restriction on country fiscal policy due to it is fully effective under fixed exchange rates and the likely increase in unemployment rate[14].

Alternatively, several researchers carried out their work by focusing on investigating the macroeconomic costs and benefits if the selected countries concur to have a single currency together. For example, Karras (2005) examined the costs and benefits if the Japanese Yen were obtained as a common currency in 18 Asian and Pacific countries. Alternatively, Furceri and Karras (2006) observed various costs and benefits if the new EU member countries[15] implement the euro as a common currency and compared it to the EMU[16] countries as well as new potential candidate countries[17].

2.1.1.2 Criteria for OCA

The OCA criteria are another point stressed in the theory of OCA in order to analyze the quality of the country to be a suitable candidate to form an OCA. Factor mobility is one of the OCA criteria as claimed by Mundell which included labor and capital mobility. Factor mobility is significant to examine the suitability of a country to form a currency union. The higher factor mobility among countries indicates that the countries are more likely to obtain currency integration. This is due to the mobility that

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[14] See Sahin (2006) for details.
[15]Malta, Cyprus, Czech Republic, Slovak Republic, Estonia, Slovenia, Hungary, Latvia, Lithuania, and Poland.
[16]Denmark, Sweden, UK, Austria, Germany, Netherlands, Belgium, Luxembourg, France, Finland, Ireland, Spain, Italy, Portugal, and Greece.
[17]Croatia, Bulgaria, Romania, Turkey, and FYROM.

will replace the exchange rate flexibility in undertaking adjustment when a shock happens.

Mckinnon (1963) focused on the importance of economic openness. He claims that the more open the country, the more feasible it is for them to form an OCA. Moreover, small open countries can also form an OCA with other equally open countries to gain the benefits from OCA. Therefore, the countries can enjoy the transaction cost reduction and minor exchange rate risk.

Kenen (1969) pointed out the importance of product diversification as the OCA criteria. The more diversified a country is, the more suitable it is to form an OCA. If the country produces diversified products, the nominal exchange rate may decline during a shock. This is because the more diversified countries will only experience small effects due to their variety in export products as compared to the less diversified country. In addition, similar production structures among countries also provide less nominal exchange rate adjustments and hence lead to the feasibility of forming OCA.

On the other hand, numerous studies have further examined various OCA criteria in their papers. These include similarity in industrial structural, similar inflation rates and political factors (Jonung & Sjoholm, 1999), symmetry of shocks affecting member countries, similar policy objectives among member countries, and high degree of intra-regional economic interdependence (Kwan, 1998), business cycle synchronization (Alesina, Barro & Tenreyro, 2002; Rana 2007), similar GDP size, direction of trade and

foreign direct investment (FDI) and similarities in economic structures and responses to common shocks (Kwack, 2004), symmetry of shocks[18] (Zhang, Sato & McAleer, 2004,2008; Zhao& Kim, 2009), intra-regional trade, financial integration and similarity in rates of inflation (Sahin, 2006), common trend in economic fundamental among countries (Ahn et al. 2006), symmetry of economic activity and country characteristics[19] (Banik, Biswas & Criddle, 2009) (refer Table 2.1 for more details).

2.1.2 Model

2.1.2.1 Exchange Rates Cointegration and Influence

In order to examine the exchange rates convergence among economies, Hall, Robertson and Wickens (1992) developed a simple three variables model. They stated two types of convergence which included strong system convergence where all pairs of variables in the system have converged and weak system convergence where only some pairs of variables have converged. As reported in Hall et al. (1992), the three variables consisted of the Deutsche Mark, the pound sterling and the United States dollar. This model is also followed by Patrick (2000).

Hall et al. (1992) have put effort into investigating whether convergence emerges between the Deutsche Mark and the Pound Sterling with the sample period from 1976 to 1989 following the three variables model below:

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[18]Included correlation, size and speed of adjustment to shocks.
[19] Included similar in size, development, and are geographical proximate.

$$(\mathrm{LDM} - \mathrm{LUK})_t = a_t + b_t(\mathrm{LDM} - \mathrm{LUS})_t + \varepsilon_t \qquad (2.1)$$

where LDM, LUK and LUS are the logs form of exchange rates for the Deutsche Mark, the Pound Sterling and the US dollar, respectively. Time-varying parameters are presented where b_t is the critical parameter. According to the anticipation, if convergence emerges between the Deutsche Mark and the Pound Sterling, $b_t$would tend to a value of zero. However, this parameter would lean towards a value of one if convergence emerges between the Pound Sterling and the US dollar.

Hall et al. (1992) however, pointed out that it is not adequate to consider the Deutsche Mark and the Pound Sterling as converged even though theb_t is zero. They claimed that$a_t$must be constant and$b_t$must be zero. In addition, cointegration among the variables must be tested prior to the model estimation but this test also explained as necessary but not adequate for convergence between the variables.

Patrick (2000) followed the above model to examine the convergence exchange rate in CARICOM[20] by replacing the three variables in Hall et al. (1992) to the Trinidad dollar, the US dollar and individual CARICOM currencies. The nominal exchange rates per SDR (special drawing rights) were used and the variables were in logged form. The model is illustrated below:

$$(\mathrm{LTT} - \mathrm{LCARICOM})_t = a_t + b_t(\mathrm{LTT} - \mathrm{LUS})_t + \varepsilon_t \qquad (2.2)$$

[20]Consisted of countries namely Barbados, Guyana, Jamaica, Eastern Caribbean, the Bahamas, Belize, and Suriname.

where the LTT, LUS and LCARICOM symbolise the logs of nominal exchange rates of Trinidad dollar, the US dollar and each of the CARICOM currencies respectively. In order to estimate the time-varying parameters of$a_t$andb_t in the model, the Kalman Filter[21] was employed and the specific model is shown below:

$$Y_t = a_t + b_t X_t + \varepsilon_t \tag{2.3}$$

where,

$$a_t = a_{t-1} + \varepsilon_t \tag{2.3a}$$

$$b_t = b_{t-1} + \varepsilon_t \tag{2.3b}$$

$$Y_t = \text{LTT} - \text{LCARICOM};\ X_t = \text{LTT} - \text{LUS} \tag{2.3c}$$

The equation (2.3a) and (2.3b) are the transition equations with the coefficients of the latter referred to as state variable. However, the ε_t in the equation (2.3), (2.3a) and (2.3b) is an error term.

On the other hand, Hall and Haldane (1991) developed a linear regression model based on cross-currency exchange rates. The model is afterward popularized by Frankel and Wei (1994) and it is now called as Frankel-Wei model.

Hall and Haldane (1991) investigated the relationship between the Pound Sterling with both of the US dollar and the Deutsche Mark. Specifically, they aimed to examine

[21] See more in Hall & Haldane (1991) for the time-varying parameter estimation using Kalman filter.

how much the movements of Pound Sterling bilateral exchange rates are associated with both of the movements in the US dollar and Deutsche Mark. The authors developed the model as below:

$$LNUS/LNST_t = \alpha_{1t} + \beta_{1t}LNM/LNUS_t + \varepsilon_{1t} \quad (2.4)$$

$$LNM/LNST_t = \alpha_{2t} + \beta_{2t}LNM/LNUS_t + \varepsilon_{2t} \quad (2.5)$$

where all data are in natural logarithm (LN) form. US, ST, M represent the US dollar, Pound Sterling and Deutsche Mark, respectively. Both α_{it}(i = 1, 2) are stochastic constants while β_{it} (i =1, 2) are time varying parameters and the ε_{it} (i = 1, 2) are error terms.

Frankel and Wei (1994) followed the model developed by Hall and Haldane (1991). The model shown below allows the weight of each foreign country to be estimated:

$$\Delta LEAC_t = \alpha + \beta_1 \Delta LUS_t + \beta_2 \Delta LY_t + \beta_3 \Delta LM_t + \beta_4 \Delta LA_t + \beta_5 \Delta LN_t + \varepsilon_t \quad (2.6)$$

All the variables are in logged form and the Δ is first series difference. The logged difference of East Asian currencies, the US dollar, the Japanese Yen, the German Mark, the Australian dollar, the New Zealand dollar are represented by LEAC, LUS, LY, LM, LA, and LN, respectively. This model was further followed by Bowman (2003).

In addition, Lim (2005) examined the converging trend in the time series framework with a simple statistical test following Verspagen (1994). The model is as below:

$$W_{i,t} = LEX_{i,t} - LEX_t^* \tag{2.7}$$

where the logarithm of the real exchange rate for country *i* at time t and the logarithm of average real exchange rate for n countries are represented by $LEX_{i,t}$ and LEX_t^*, respectively. Under the assumption, W_i changes according to the following process for each time period:

$$W_{i,t+1} = \beta W_{i,t} + \varepsilon_{i,t} \tag{2.8}$$

Accordingly, the convergence of the currency in country i from the sample group occurs if $\beta < 1$ and vice versa.

2.2 Reviews on Empirical Testing Procedures

Different authors have used different kinds of testing procedures in their studies. This sub-section will review various testing procedures that had been employed in previous studies and thus guide for the methodological part in this study.

2.2.1 Unit Root Test

The Unit Root testis an initial step to determine whether the variables are stationary.[22] This step is important because it can influence the behavior and properties of a series. If the series is non-stationary, it may cause false return. According to the previous studies, Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) were the most commonly employed unit root tests. Based on the conventional type of cointegration tests such as Engle-Granger (1987), Johansen (1988) as well as Johansen and Juselius (1990), potential long run relationship will exist only if the variables have the same order of integration. For example, all variables must be integrated in the order of zero, denotes as $I(0)$ or integrated of order one, denotes as $I(1)$. However, this study did not demand the variable to be in the same order of integration because the newly developed approach called Auto-Regressive Distributed Lag (ARDL) approach will be applied. This approach can proceed as long as the variables are not integrated of order two, denotes as $I(2)$.

2.2.1.1 Augmented Dickey Fuller (ADF) Test

ADF test is the most common unit root test and it tests the null hypothesis of unit root. Tse and Ng (1997), Liang (1999), Mkenda (2001), Kempa (2002), Yelten (2003),

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[22] See Aggarwal & Mougoue (1996), Tse & Ng (1997), Liang (1999), Mkenda (2001), Kempa (2002), Yelten (2003), Bowman (2003), Zhang et al. (2004), Lim (2005), Ahn et al. (2006), Huang & Guo (2006), Masron & Yusop (2006), Azali et al. (2010), Neves, Stocco& Silva (2008), Zhang et al. (2008), Azali et al.(2009), Zhao & Kim (2009)for details.

Lim (2005), and Ahn et al. (2006), Zhang et al. (2008), Neves et al.(2008), Zhao and Kim (2009) used ADF test in their studies (refer to Table 2.2 for more details).

Tse and Ng (1997) applied DF/ADF test to examine unit roots contained in the variable by following the regression model shown below:

$$\Delta \ln y_t = \beta_0 + \beta_1 t + \beta_2 \ln y_{t-1} \tag{2.9}$$

where, y_t = exchange rate

$$\Delta \ln y_t = \ln y_t - \ln y_{t-1}$$

The null hypothesis of the ADF test is the series contains a unit root and is non-stationary yet the alternative hypothesis is the series does not contain unit root and is stationary. If the ADF's value is larger than the critical value, the null hypothesis is rejected and this implies that the series is stationary and does not contain unit root. If the t-statistic is smaller than the critical value, the null hypothesis cannot be rejected. This means that the series contains a unit root and is non-stationary. Therefore, the first difference on the series needs to be undertaken in order to achieve stationary. However, it is important to note that the t-statistic and the critical value are viewed disregarding sign for the ADF and PP test.

2.2.1.2 Phillips-Perron (PP) Test

PP test was also commonly used among researchers to investigate the stationarity of variables. The test also ignores every series correlation in the test regression and this makes it differ from the ADF test. The test regression is shown below:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \mu_t \tag{2.10}$$

where μ_t is $I(0)$ and may be heteroskedastic. By directly modifying the test statistics $t_{\pi=0}$ and $T_{\hat{\pi}}$, the PP test can be correct for any series correlation and heteroskedasticity in the errors μ_t of the test regression. The null and alternative hypothesis of PP test are the same with the ADF test where the null hypothesis is the series contains a unit root and is non-stationary yet the alternative hypothesis is the series do not contain unit root and is stationary. The null hypothesis is rejected if the adjusted t-statistic is larger than the critical value. However, the null hypothesis cannot be rejected if the adjusted t-statistic is smaller than the critical value.

Liang (1999), Kempa (2002), Zhang et al. (2004), Masron and Yusop (2006), Huang and Guo (2006), Zhang et al. (2008) are some of the authors that have conducted PP test to investigate the stationarity of variables.

2.2.1.3 Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test

KPSS test is a stationarity test with the null hypothesis of stationary against the alternative of a unit root. The null hypothesis of KPSS can only be rejected if the observed LM statistic value is greater than the critical value. Ahn et al. (2006) added KPSS test in their study to examine the stationarity of data. Since the null hypothesis of stationarity is not rejected at the 5% level in the first-differenced data series, they concluded that the data series in the sample is stationary and that each of the level data series in the sample is integrated of order one, denotes as, $I(1)$. Zhang et al. (2004) showed the same result by employing this test on their variables which included real gross domestic product (RGDP), consumer price index (CPI) and real exchange rate. On the other hand, Azali et al. (2010) used this to examine the stationarity of the GDP per capita for the country in their paper.

The KPSS test differs from the other two unit root tests above (ADF and PP test) where the series is assumed to be stationary under the null hypothesis. Normally, the KPSS test is used for confirmatory analysis where this test will be applied after the ADF and PP tests in order to confirm the series stationarity.

2.2.2 Cointegration Test

This is the statistical approach that tests the long-run relationship among non-stationary variables that in the same order of integration (Masron & Yusop, 2006). The

concept of cointegration was firstly introduced by Granger (1981). Then, Engle and Granger (1987) developed it to form the Engle-Granger cointegration test. However, this test has a limitation that it only allows one cointegration relationship. Therefore, the Johansen's cointegration (1988) approach is said to be more efficient than Engle-Granger's (1987) test in which Johansen method extends the multivariate cointegration test. Therefore, the commonly used cointegration tests are Johansen (1988) and Johansen and Juselius (1990) tests.

2.2.2.1 Johansen and Juselius Method

Numerous authors have used this test to ensure the cointegrating relationship among the selected variables. The Johansen's approach is based on Vector Auto-Regression (VAR) model and therefore the VAR model participated in this cointegration test through equation (2.11). The Y_t is a vector of p-dimension time series variables with the k-lag vector autoregressive:

$$Y_t = \Pi_1 Y_{t-1} + \cdots + \Pi_k Y_{t-k} + \alpha + \varepsilon_t, \qquad t = 1,2,\ldots T \qquad (2.11)$$

where$\Pi_1, \Pi_2 \ldots\ldots \Pi_k$ are parameter matrixes, α represents a vector of constant, and Y_t is a vector of the non-stationary variables.

There are two tests of Johansen (1988) and Johansen and Juselius (1990) which are used to identify the number of cointegrating vectors in the model. The two tests are the Trace test (equation 2.12) and Maximum Eigenvalue test (equation 2.13).

i. Trace test

$$\tau_{trace} = -T \sum_{i=r+1}^{N} \ln[1 - (r_i)^2] \qquad (2.12)$$

where, T marked as the total number of observations, N represents the total number of variables, r_i is the i^{-th} pair of variables. This test evaluates the null hypothesis in which the number of cointegrating vector is less than or equal to against the general alternative that the number of cointegrating vector is more than r.

ii. Maximum Eigenvalue test

$$\tau_{max} = -T \ln(1 - \lambda_{r+1}) \qquad (2.13)$$

In the Maximum Eigenvalue test, it evaluates that null hypothesis is the number of contegrating vectors as r against the specific alternative hypothesis of r+1 cointegrating vector. The critical value provided by Johansen (1988) does not include an intercept term but Johansen and Juselius (1990) included it in the critical value. If the trace statistic and maximum-eigenvalue statistic exceeds the critical value, then the null hypothesis can be rejected. According to Johansen and Juselius (1990), the Maximum Eigenvalue test is

more powerful than the Trace test. Thus, the Maximum Eigenvalue test is usually more favorable than the trace test.

Aggarwal and Mougoue (1996) and Liang (1999) used both Johansen (1988) and Johansen and Juselius (1990) tests in their studies. Aggarwal and Mougoue (1996) observed the relationship among two sets of Asian currencies by using the multivariate likelihood ratio test. Tse and Ng (1997), Lim (2005) and Ahn et al. (2006) followed the Johansen's maximum likelihood approach to verify the relationship among currencies system and cointegrating vector among countries real exchange rate. In addition, Masron and Yusop (2006) employed the trace and maximum eigenvalue tests introduced by Johansen and Juselius (1990) to investigate the long run relationship between exchange rate and OCA variables.

2.2.3 Ordinary Least Squares (OLS) Regression Analysis

Esaka (2003) employed this method in order to estimate the constant weight of foreign currencies in determining the nominal value of their currencies. Below is the regression model:

$$\Delta LNEAC_t = \beta_0 + \beta_1 \Delta LNY_t + \beta_2 \Delta LNUS_t + \beta_3 \Delta LNM_t + \varepsilon_t \qquad (2.14)$$

where, Δ is the first difference operator, ε_t is an error term, LNEAC, LNY, LNUS and LNM are the natural logs for the exchange rate of East Asian currency, the Japanese Yen, the US dollar and the Deutsche Mark, respectively.

Bowman (2003) also used OLS regression analysis as one of the techniques in their study. The author followed a few of the previous studies in order to indicate the impact of Australian dollar on some of the Asian currencies by using OLS regression. He also followed the Frankel and Wei (1994) regression to determine the impact of various OECD currencies in nine East Asian currencies. The regression is shown below:

$$\Delta LEAC_t = \alpha + \beta_1 \Delta LUS_t + \beta_2 \Delta LY_t + \beta_3 \Delta LM_t + \beta_4 \Delta LA_t + \beta_5 \Delta LN_t + \varepsilon_t \qquad (2.15)$$

where EAC is East Asian currency, and it regressed against the logged difference of the US dollar (US), the Japanese Yen (Y), the German Mark (M), the Australian dollar (A) and the New Zealand dollar (N). The weightings of all currencies will be determined through the regression, as all currencies are expressed in term of the Swiss Franc.

Bowman (2003) also followed Kwan's (1996) technique by adding the Australian dollar in the regression. The regression is as below:

$$\Delta LNAC_t = \alpha + \beta_1 \Delta LNY_t + \beta_2 \Delta LNM_t + \beta_3 \Delta LNA_t + \varepsilon_t \qquad (2.16)$$

where the Δ is first difference operator; the LNAC, LNY, LNM, and NLA are the natural logs of the Asian currency, the Japanese Yen, the Mark and the Australian dollar. All currencies are expressed in term of the US dollar.

In addition, Bowman (2003) adopted Gan (2000) as well where the regression is modeled as:

$$\Delta LNEAC_t = \alpha + \beta \Delta LNY_t + \varepsilon_t \qquad (2.17)$$

where the Δ is first series difference; the LNEAC and LNY are the natural logs of the East Asian currencies and the Japanese Yen. The regression (2.17) was rerun by replacing the Japanese Yen with the Australian dollar in order to obtain the impact of the Japanese Yen and the Australian dollar on East Asian currencies. All currencies are expressed in term of the US dollar.

Bowman (2003) finally estimates the relationship between East Asian currencies with the US dollar, the Japanese Yen and the Australian dollar following Aggarwal and Mougoue (1996) study. The regression is shown follow:

$$LNEAC_t - LNUS_t = \alpha + \beta(LNA_t - LNUS_t) + \varepsilon_t \qquad (2.18)$$

Where LNEAC, LNUS and LNA represent natural logs of East Asian currencies, US dollar and Australian dollar.

In addition, Chen, Peng and Shu (2009) estimate the potential of Chinese Renminbi as an International Currency by employing the OLS regression. The authors test the impact of a few major currencies including the Chinese Renminbi on the Asian currencies. The regression is shown below:

$$\Delta LAC_t = \alpha + \beta_1 \Delta LUS_t + \beta_2 \Delta LEU_t + \beta_3 \Delta LY_t + \beta_4 \Delta LRMB_t + \varepsilon_t \qquad (2.19)$$

where the series is in logs difference against the Swiss Franc. AC, US, EU, Y and RMB represent the Asian currencies, the US dollar, the Euro, the Japanese Yen and the Chinese Renminbi, respectively.

2.2.4 Correlation Analysis

In order to estimate the relationship between members of OCA, numerous researchers[23]have employed correlation analysis to find out the correlation of structural shocks among selected countries. It is assumed that the positive (negative) correlation among countries implies that the countries have symmetric (asymmetric) shocks. Moreover, countries that have symmetric (asymmetric) shocks are likely to employ similar (dissimilar) policies and thus, they are considered (not considered) as good candidates for OCA. Among all structure disturbances, the correlation of supply and demand shocks was mostly estimated.

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[23] See Bayoumi & Eichengreen (1994), Kempa (2002), Kwack (2005), Zhang et al. (2004), Bystrom, Olofsdotter & Soderstrom (2005), Saxena (2005), Ahn et al. (2006), Huang & Guo (2006), Zhang et al. (2008), Dauti & Herzog (2008),and Lee & Azali (2009).

Supply shocks have been given more focus because the change in demand-management policies will not bring any effects on it and it is possible to be invariant with respect to alternative international monetary arrangements. On the other hand, demand shocks are less informative than supply shocks about regional members because it contains impact of monetary and fiscal policies (Bayoumi & Eichengreen, 1994). Some researchers not only placed their attention on supply and demand shocks but also money market shocks (Kempa, 2002), global and monetary shocks (Huang & Guo, 2006), and exchange rate shocks (Zhang et al., 2008).

Furthermore, some researchers estimated the correlation of macroeconomic characteristics among countries. Examples of the characteristics are the correlation of growth (GDP), inflation (measured as the change in the logarithm of the GDP deflator), regional budget surplus, deficits, openness (export plus import as a share of regional GDP), exports, fiscal budget, changes in the exchange rate, the price of the producers of industrial products and retail price.[24]

Ahn et al. (2006) pointed out two assessments for correlation coefficients. Firstly, statistical significance must be examined because signs of correlations alone are insufficient to be investigated. The formula for significant correlations is as follow where the null hypothesis$H_0: \rho = 0$.

$$Z = 0.5\sqrt{N-3}(\ln[(1+r)(1-\rho)/(1-r)(1+\rho)]) \qquad (2.20)$$

[24] See Bayoumi & Eichengreen (1994), Bystrom et al. (2005), Rana (2007), and Dauti & Herzog (2008).

where, r refers to estimated correlation coefficient and ρ refers to null value of the correlation coefficient. Secondly, structural shocks are group as symmetric if the correlation is positive and vice versa.

Kwan (1998) however employed the correlation technique in another way which is to examine whether the Japanese Yen can be adopted as a common currency in the region. In order to investigate the appropriateness of Japanese Yen as a common currency in Asia, Kwan compared the trade structure of Japan with Asian countries.

2.2.5 Impulse Response Function Analysis (Vector Autoregressive (VAR)Model)

Kempa (2002), Kwack (2004), Zhang et al. (2004), Saxena (2005), Huang and Guo (2006), Zhang et al. (2008), and Lee and Azali (2009) are some studies that employed impulse response function analysis. They used the immune response function analysis to examine the size of shocks, speed of adjustment from shocks, and effects or responses of shocks. Generally, smaller size of shocks, faster speed of adjustment and symmetric effects or responses of shocks within a country will lead them to be a good candidate to form an OCA.

If the size of shocks is small in a country, only small costs from abandoning policy autonomy are acquired and thus the country is suitable to form an OCA. However, faster speed of adjustment from shocks will impose small costs on a country that desires

to form an OCA. Lastly, countries would also said to be potential candidates to form an OCA together if they share similar effects and responses of shocks.

2.2.6 Variance Decomposition Analysis (VAR model)

This analysis was conducted by Kempa (2002), Kim and Chow (2003),Zhang et al. (2004), Saxena (2005), and Zhao and Kim (2009) in order to measure the contribution of shocks to the chosen variables. In other words, variance decomposition determines the amount of the forecast error variance of each variable which can be explained by the level of shocks to the other variables.

2.2.7 Causality Test

2.2.7.1 Granger Causality Test

This test is applied in order to determine the short run causality direction between dependent and independent variables after found that the variables are cointegrated through cointegration test. After a thorough review of literature, only a very small number of studies were conducted using this test. These include Masron and Yusop (2006), and Dauti and Herzog (2008).

According to the research by Masron and Yusop (2006), the Granger causality was applied based on vector error correction model (VECM) to examine whether exchange rate volatility had an impact on OCA criteria. In addition, Wald test was used

by calculating the F-statistic based on the null hypothesis to examine the causality between independent and dependent variables. Independent variable is said to not causing the dependent variable if the null hypothesis is accepted. Nevertheless, Dauti and Herzog (2008) used granger causality analysis to explore the influence of the exchange rate on the prices. This is important because the general inflation level (stable inflation is the fundamental criterion according to the Maastricht criteria) will be influenced as the changes of exchange rate will directly influence the import prices.

2.3 Reviews on Empirical Evidence

2.3.1 Empirical Evidence on Feasibility of Optimum Currency Area

Kwack (2004), Zhang et al. (2004), Huang and Guo (2006), and Ahn et al. (2006) stated that there are similarities in economic structure among various Asian countries. Kwack (2004) concluded in his findings that 10 East Asian countries are positively and highly correlated in demand and supply shocks. Furthermore, the author analyzed the feedback of those countries on shocks and found that their feedbacks turned more symmetrical. Zhang et al. (2004) also conducted a study on 10 East Asian economies and found that the structural shocks are bigger but the adjustments to shocks are to be smaller in comparison with Europe countries.

Huang and Guo (2006) carried out a research on nine East Asian countries and concluded that the size of supply shocks was small. However, the size of demand and monetary shocks are larger as compared to EMU. They also presented some similar

findings as Kwack (2004) where the underlying disturbances are positively correlated but only among Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand. Ahn et al. (2006), however only performed their study on supply shocks as Bayoumi and Mauro (2001) claimed that the supply shocks are to be more relevant than demand shocks and the supply shocks are ''more related to underlying private sector behavior''. Their outcome on size of the supply shocks is the same as Huang and Guo (2006) findings where shocks tend to occur in smaller size but it reveals a faster speed of adjustment via shocks.

In view of Asian economies' characteristics, Kwack (2004) declared that market size, openness of those economies, export and import share in the total of East Asian trade and FDI inflows are large, higher, growing and increasing respectively. Aminian (2005) divided characteristics into general and collective characteristics where general characteristics encompasses populations, per capital income, industrial structures, financial depth, exchange rate regime, economic and trade policies, and lastly trade as percentage of GDP. Collective characteristics include factor mobility, interdependence and symmetry of shocks. Based on these characteristics, Aminian (2005) concluded both characteristics support monetary cooperation in East Asia.

Using the intra-regional trade intensity index where the ratio of intra-regional trade shares to the share of the world's trade with the region, Rana (2007) found that the trade integration was considered high in East Asia. Besides, the author claimed that the financial integration showed improvement. Swofford (2008) drew the conclusion that

variables which consist in all countries and some several groups of countries are consistent with the microeconomic foundations of a common currency area.

2.3.2 Empirical Evidence on Which Currency to Choose

The section summary the empirical evidence obtained from the literature reviews and is summarized in Table 2.3. From 1998 until 2009, there were several studies that emphasized on the alternative currency for Asian countries. Kwan (1998) studied the single currency for East Asia by focusing on trade and FDI, trade structure, economic structure and similarity of inflation rates. In term of trade and FDI, Kwan (1998) argued that the dependence on Japan by Asian economies is not sturdy while China has become a main trading partner and newly industrializing economies (NIEs) emerged as important investing countries. On the other hand, Japan indicated a similar trade structure with NIEs countries but China's trade structure is significantly different with ASEAN. In contrast, Japan is improbable to form an OCA with East Asian due to the dissimilar economic structure. Lastly, Kwan (1998) pointed out that the inflation rates in Japan is relatively lower than East Asian economies while some of the countries with higher development also faced low inflation rate such as Singapore, Taiwan, Malaysia, Thailand and South Korea. Thus, these economies suggested forming an OCA with Japan. Kwan (1998) drew attention on China by declaring that China's economic is being enhanced and its linkages with neighboring nations will provide a chance for them to replace Japan as the leading economic power in East Asian. Therefore, Renminbi will develop as a key

currency for the region. Nevertheless, Kwan (1998) stated that such situation will not occur in the near future.

Bowman (2003) studied the relationship in terms of currency for Asian countries as well as the United States, Japan and Australia. The author pointed out that Australian currency is engaged in a similar role as the Japanese Yen. The study found that the linkage of currency between both Australia and Japan with Asian were increased. At the same time, Bowman (2003) concluded that the influences of US dollar decreased while the impacts from Australian dollar and the Japanese Yen on Asian currencies were increased in the post-1997 crisis.

By comparing the co-movement prices, Lim (2005) found that both United States and Japan supported OCA for ASEAN-5 except Indonesia. Lim (2005) also tested the convergence in currencies and hence his findings have indicated that only Hong Kong has a long-run cointegration relationship with the Japanese Yen. At the same time, Karras (2005) investigated the possibility of the Japanese Yen as a common currency in eighteen Asian countries[25] highlight on costs and benefits adopting Yen. A positive result was obtained even though the costs and benefits differed significantly across countries. Azali et al. (2009) also recommended Yen, due to the improvement in financial integration after the crisis.

[25] Consisted ofAustralia, Bangladesh, China, Hong Kong, Indonesia, India, Japan, Korea, Sri Lanka, Malaysia, Nepal, New Zealand, Pakistan, the Philippines, Papua New Guinea, Singapore, Thailand and Taiwan.

Moreover, Shirono (2009) analyzed the currency arrangements in East Asia focus on Yen (Japanese Yen) and Yuan (Chinese Renminbi). However, the research started by comparing United States and Japan with East Asia in term of trade effect and welfare gain. The results showed that trade effects with East Asian are similar in both United States and Japan but the welfare gains are larger in Japan as compared to United States. Between Japan and China, the outcomes of trade effects are alike with the finding between United States and Japan but the welfare gains for East Asia is bigger in currency union with China. This condition suggested that currency union with China will attract more attention if the trade share in East Asia continues to increase.

At the same time, Chen et al. (2009) investigated the potential of the Chinese Renminbi as an international currency. The authors examined the influence of the Chinese Renminbi on some of the Asian currencies in two sample periods which are before and after the exchange rate reform in China. The study found that Chinese Renminbi is significant in impacting the Asian currencies after the exchange rate reforms in China. However, the Japanese Yen shows a decreasing trend in its impact on the Asian currencies.

2.4 Concluding Remarks

Through a comprehensive review, the gaps of previous studies have been successfully identified. To be more specific, there is a lack of research on investigating the exchange rate relationship in identifying the possibility of Renminbi bloc formation.

Besides, in the past, related study for Asia has been focused on the possibility of Yen bloc. Through the slight discussion on the possibility of Renminbi bloc, Kwan (1998) is quite positive on it. The author believed that Chinese Renminbi could be a better choice if the China economy improves and its economic relationship with the others countries in the region enlarges. Shirona (2009) also sees the feasibility of the formation of Renminbi bloc if the trade share between ASEAN and China continues to increase. In addition, the study by Chen et al. (2009) is the only research that included Chinese Renminbi in examining the role of Chinese Renminbi on some of the Asian currencies. Furthermore, previous related researches provide an idea for this study in examining cointegrating relationship of the ASEAN exchange rates with the Chinese Renminbi.

Table 2.1: Summary of Literature Reviews on Theoretical Framework

Authors (year)	Methodology	Data	Findings/ Conclusions
Mundell (1961)	• Descriptive Study (theory)	• -	• Currency area should be a region. • Highlighted the factor mobility (labor and capital) especially the labour mobility as important criteria to form an optimum currency area (OCA).
McKinnon (1963)	• Descriptive Study (theory)	• -	• Did not agree with factor mobility as important OCA criteria because the author claimed that there is factor mobility among regions and among industries where it is difficult to distinguish it. • Pointed out that the degree of openness is significant criteria to form an OCA.
Kenen (1969)	• Descriptive Study (theory)	• -	• Suggested product diversification as an important criterion to form an OCA.
Hall and Haldane (1991)	• Time varying parameter model - Kalman filter • Ordinary least squares (OLS) estimation • The maximum likelihood	• Countries: United States, United Kingdom, Germany • Sample period: daily data between January 1976 and August 1989. • Variables: United States dollar, Sterling and Deutschmark	• The relationship between Sterling and the dollar has weakened since the 1970s. • The relationship between the sterling and Deutschmark significantly strengthened during the sample period.
Hall, Robertson and Wickens (1992)	• Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) unit root tests • Cointegration analysis	• Countries: Euro Economies • Sample period: Annually data over 1970 to 1991 (split in to two sample period - 1970 to 1980 and 1981 to 1991) • Variables: exchange rates	• No cointegration exists over the whole period. • In the first period, there is no cointegration. • In the second period, there is no sufficient to reject non-cointegration but it suggests that a structural change exist during the 1980s.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Frankel and Wei (1994)	• OLS regression	• Countries: Korea, Singapore, Hong Kong, Taiwan, Malaysia, Indonesia, the Philippines, Thailand, China, Japan, German, Australia, New Zealand and United States • Sample period: 1972 to 1992 • Variable: exchange rates	• There is little evidence of Yen bloc and East Asia countries maintain strong relationship with the United States.
Bayoumi and Eichengreen (1997)	• Standard deviation (measure output disturbance, forecasts dependent variables)	• Countries: France, Italy, U.K., Austria, Belgium, Denmark, Ireland, Netherlands, Norway, Switzerland, Spain, Portugal, Sweden, Finland, Greece • Sample period: annually data over 1973-1982, 1975 -1984, 1977-1986, 1981-1990, 1983-1992 (for standard deviation estimation); annually data over 1987, 1991 and 1995 (forecasts of dependent variable) • Variables: bilateral trade, exports, GDP	• Countries are gradually more able to stabilize their exchange rates. • Asymmetric shocks are diminishing. • Countries can be divided into three groups -Prime candidates for EMU (Austria, Belgium, Netherlands, Ireland, Switzerland) -Countries that shows little convergence (U.K., Denmark, Finland, Norway, France) -Countries gradually convergence to EMU (Sweden, Italy, Greece, Portugal, Spain) • Symbiotic relationship between economic integration and monetary integration.
Kwan (1998)	• Descriptive – highlight on the OCA theory by considering the costs and benefits to a member countries (within a regional perspective to a yen bloc)	• Country: East Asian • Sample period: year 1993 (trade structures), annually data over 1982 to 1996 (inflation rates), and monthly data over January 1991 to December 1994 (volatility of countries currency) • Variables: trade structures (import and export for primary commodities, other manufactures and machinery), inflation rates, volatility of countries currency.	• Japan's trade structure is similar with NIEs but for economic structure, Japan has a dissimilar economic structure with East Asian. • Based on the criteria of similarity in inflation rate, low-inflation countries (Singapore, Taiwan, Malaysia, Thailand, and South Korea) are more suitable candidates to have a Yen as a single currency. • China might replace Japan because its economy has improved and its closer linkage with neighboring countries.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Jonung and Sjoholm (1999)	• Descriptive study: 1. Country-specific criteria - the degree of wage and price flexibility - the degree of product diversification 2. Union-specific criteria - degree of factor flexibility -similarity of production structure -cyclical covariation in economic activity -similarity of inflation -similarity of economic policy -political and other factors	• Countries: Finland and Sweden • Sample period: 1995 and 1996 (criteria 1), 1993(criteria 2), 1994 and 1995 (criteria 2), 1993 (criteria 4), 1961-1995 (criteria 5), 1962 and 1994 (criteria 6), 1961-1995 (criteria 7) • Variables: real wages, total manufacturing production, number of foreign citizens, total migration, total industrial production, GDP growth, rate of inflation, budget deficit as a fraction of the GDP	• Country-specific criteria -wage flexibility is higher in Finland than in Sweden (inflexibility), but the degree of wage flexibility is rather low in both countries. -the degree of product diversification is low in both countries. • Union-specific criteria - The migration of labour between both countries is relatively large. -Both have similar manufacturing structures. -Correlation between countries is very high. -Rate of inflation between countries is similar. -Sweden's fiscal policy was similar to Finland only during the 1960s and 1970s. • Both countries are suitable for OCA.
Patrick (2000)	• ADF and PP unit root tests • Johansen cointegration test • Kalman Filter test	• Countries: CARICOM (Barbados, Guyana, Jamaica, Eastern Caribbean, The Bahamas, Belize and Suriname) • Sample period: 1967 to 1996. • Variables: nominal and real exchange rate	• All of the logged nominal exchange rates and real exchange rates are stationary at $I(1)$ except Guyana Dollar is stationary at $I(2)$. • Both of the logged nominal exchange rates and real exchange rate showed at least one and three cointegrating vectors among the variables, respectively. • There is only little evidence of exchange rate convergence in CARICOM.
Afxentiou (2000)	• Descriptive study (Steps towards an Economic Union, Function of the Maastricht Convergence Criteria and the costs and benefits of Monetary Union)	• -	• The five Maastricht convergence criteria are the preconditions for the euro success. • It is difficult to estimate the costs and benefits of monetary unions correctly.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Mkenda (2001)	• G-PPP hypothesis • ADF test • Cointegration test	• Countries: East African Community (EAC) which included Kenya, Tanzania, and Uganda. • Sample period: annually data over 1981 to 1998 (entire period), sub-period over 1981 to 1990 and 1990 to 1998. • Variables: real exchange rate	• Real exchange rate is barely stationary. • Cointegration test: o Full sample period: real exchange rates in EAC are inter-related. o Period from 1981 to 1990 – no cointegration between the real exchange rates. o Period from 1990 to 1998 – there are cointegration between the real exchange rates. • EAC constitute an OCA and they share the similar shocks.
Alesina, Barro and Tenreyro (2002)	-Theoretical model of Alesina and Barro (2002)	• Countries: United States, European countries and Japan • Sample period: annually data over 1960 to 1997 • Variables: real per capita GDP, real exchange rate, GDP deflator, exports, imports	• There is an existence of well-defined dollar and euro areas but not Yen area (pros and cons). • Formation of currency union raises the bilateral trade and co-movement of prices.
Kempa (2002)	• ADF and PP unit root test • Structural VAR	• Countries: European Union • Sample period: Quarterly data over 1973:Q1 to 1997Q4 • Variables: bilateral real exchange rates, CPI, and real GDP	• Data were stationary in first difference. • Convergence is occurs for European Union in run-up to monetary union.
Bowman (2003)	• OLS regression analysis • Johansen cointegration analysis	• Countries: Indonesia, Thailand, Singapore, the Philippines, Taiwan, South Korea, Malaysia, Australia, Japan • Sample period: daily data over 1 January 1992 to 1 January 2002. • Variables: daily currency	• Both Australia and Japan have raises however US have decrease their linkage with the Asian currencies. • The Australian dollar and Japanese Yen indicates more influence in the East Asian currencies in the post-crisis.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Kim and Chow (2003)	• Variance decompositions analysis (using structural VAR model)	• Countries: fifteen European countries (Austria, Belgium, Denmark, France, Ireland, Italy, the Netherlands, Finland, Greece, Norway, Portugal, Spain, Sweden, Switzerland, and UK) and seven East Asian countries (Hong Kong, Indonesia, South Korea, Malaysia, the Philippines, Singapore, and Taiwan). • Sample period: Quarterly data over 1965:1 to 1997:1 for Europe (except Austria and Denmark - over 1968:1 to 1997:1); quarterly data is over 1971:1 to 1997:1 for East Asian (except the Philippines-1981:1 to 1997:1; Hong Kong (1982:1 to 1997:1); and Indonesia (1979:1 to 1997:1) • Variables: industrial production (domestic outputs)	• - In the first European group (EMU members), regional shocks are dominant. - In the second European group (other countries in Europe), country-specific shocks are dominant. - In the East Asian group, country-specific shocks are dominant. • So, common currency peg in East Asian would be more costly and difficult to sustain compared to EMU countries.
Angresano (2004)	-evolutionary-institutional perspective towards economies	• Countries: EU, ASEAN and three Northeast Asian countries (China, Japan, and South Korea)	• Integration can serve as a foreign policy instrument than an economic one. • Net benefits of forming currency union are decrease because the political differences among the ASEAN + 3 nations and they need to give up macroeconomic policy independence. • The derivation of benefits from integration has cost EU members some national sovereignty and maybe identity.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Kwack (2004)	• Descriptive (GDP size and openness, direction of trade and FDI) • Correlation coefficients from the VAR model (measure similarities in economic structures and responses to common shocks) • Impulse response functions from the VAR models (measure the speed of adjustment to shocks) • Descriptive (assessment)	• Countries: 10 East Asian (China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, and Taiwan) • Sample period: annually data over 1987 to 1997 (measure GDP size and openness), over 1980 to 2000 (measure direction of trade and FDI), over 1975 to 2001 (measure similarities in economic structures and responses to common shocks), over 1963 to 2001 (measure the speed of adjustment to shocks) • Variables: GDP, import, export, direction of East Asia trade, Foreign Direct Investment (FDI) inflow, demand shocks, and supply shocks	• The intra-regional export and import share of East Asian in the total of East Asian exports and imports are large and growing. FDI inflows to East Asian countries have greatly increased. • The responses to external shocks were more symmetrical in the East Asian countries. • The speeds of adjustment were found to be high. • East Asian has not reached the stage to form an OCA and a viable option is the formation of a quasi-monetary blocs.
Zhang, Sato and McAleer (2004)	• Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test • VAR method • Variance decomposition analysis • Impulse response analysis	• Countries: 10 East Asian (Japan, China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand, Taiwan) • Sample period: Quarterly and seasonally unadjusted, except for real Gross Domestic Product (GDP), over 1980 (1) to 2000 (3) • Variables: Real GDP, consumer price index (CPI), real exchange rate	• Most variables were integrated of order 1. • Some sub-regions were feasible to form as OCA, such as among some Asian NIEs and ASEAN countries. • In both sample period (1980Q1 – 1997Q1 and 1980Q1 – 2000Q3), supply shocks are the main shocks for the variability of real output (real GDP) in all the East Asian countries. • Size of the underlying shocks in East Asian is bigger than in Europe but the speed of adjustments to shocks is faster in East Asian compared to Europe.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Dutta (2005)	Descriptive study	• Countries: EU 25 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovenia), United States • Sample period: annually data on 1960, 1970, 1980, 1990, 2000, 2003 (population, GDP, imports, exports); monthly data over January 1999 to December 2001 (Exchange rate); Quarterly data over 1999Q1 to 2004Q4 (exchange rate) • Variables: population, GDP, imports, exports, exchange rates, sectoral shares (agriculture, industry and services)	• Continental economic regions are likely to be the order of the new economic paradigm for economics of globalization. • continental economic regions will have competitive shares of world output and trade and contribute competitive shares to the capital funds of international financial institution (The World Bank and IMF), and make economic decisions based on economic merits of the issues confronting each regional compact. • The world economic will no longer be grouped into one of price-takers and one of price-makers.
Karras (2005)	• New Keynesian monetary policy model (by Clarida, Gali and Gertler, 1999) • Three filtering methods (differencing, the Hodrick-Prescott filter, and the Band-Pass filter)	• Countries: 18 Asian economies (Australia, Bangladesh, China, Hong Kong, Indonesia, India, Japan, Korea, Sri Lanka, Malaysia, Nepal, New Zealand, Pakistan, the Philippines, Papua New Guinea, Singapore, Thailand, and Taiwan • Sample period: Annually data over 1960 to 2001 • Variables: real GDP, nominal exchange rate, and CPI	• The costs and benefits adopting Yen vary substantially across the countries but are often positively related.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Ahn, Kim and Chang (2006)	• Bayoumi and Eichengreen's (1994) structural VAR procedure (measure correlation of supply shocks) • Generalized Purchasing Power Parity (G-PPP) hypothesis • ADF and KPSS unit root test • Johansen's maximum likelihood approach • Johansen's test procedure	• Countries: five Northeast Asia countries (China, Hong Kong SAR, Japan, Korea, Taiwan), five Southeast Asia countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand), and two Asia-Pacific countries (Australia and New Zealand). • Sample period: annually data for all variables over 1960 to 2002. But due to the lack of relevant data, the sample periods for China, Malaysia and Hong Kong SAR are 1979-2002, 1970-2002, and 1961-2002, respectively. However, there is a monthly data for the national currency prices of the Japanese yen. • Variables: real GDP, GDP deflator (1950=100), bilateral real exchange rate, consumer price indices (1995=100), national currency prices of the Japanese Yen	• Three Northeast Asia countries (Hong Kong SAR, Korea, and Taiwan) and four Southeast Asia countries (Indonesia, Malaysia, Singapore, and Thailand) have good reason to form an OCA in terms of the correlations. Moreover, they face smaller supply shocks and faster speed of adjustment to shocks, except Thailand and Taiwan. • Data are stationary in the first differenced. • G-PPP fails to hold for all the possible groups except for Japan/Korea and Japan/Taiwan. • Japan are found as a biggest candidate group from the 12 East Asian countries. In addition, Northeast Asia and Southeast Asia also pass the G-PPP test.
Furceri and Karras (2006)	• New Keynesian monetary policy model (by Clarida, Gali, and Gertler, 1999) • HP filter	• Countries: 30 European countries (the 12 current EMU countries, the 3 old (pre-2004) EU countries which have not adopted the euro, the 10 new (2004) EU members, and 5 prospective members) • Sample period: annually data over 1980 to 2003 (with the exceptions of Croatia, the Slovak Republic, and Slovenia) • Variables: CPI, real GDP	• Old EU counties attain the smoothest cyclical fluctuations, while the highest standard deviations are observed in new and prospective member countries. • Some new EU countries were well synchronized with the EMU, and have even higher correlations compare to some of the old members. But, several new EU countries show negative correlations, as majority prospective EU members. • The new EU members are similar to the old members in term of price stability. • Positive relation between costs and benefits

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Huang and Guo (2006)	• PP unit root test • Correlation coefficient from Structural VAR • Impulse response coefficients • Impulse response analysis	• Countries: nine East Asian countries (Thailand, Indonesia, Malaysia, the Philippines, Singapore, China, Hong Kong, Japan and Korea) and nine European Monetary Union countries are adopted as benchmarks (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal and Spain). • Sample period: Annual data for full sample period which covers 1970 to 2002 and sub-period covers 1979-1998. • Variables: world real GDP, domestic real GDP, CPI fixed at 1995=100, real effective exchange rates (REER)	• Data are stationary in the first differenced. • There are significant and positive correlations of underlying shocks among Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand. • Size of underlying shocks is smaller in East Asian than in EMU. • Cost for Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand to relinquish control over their exchange rate are relatively small.
Sahin (2006)	• Descriptive technique -traditional approach (discussion on important criteria-similarity in inflation and degree of openness) -cost-benefit approach • Genetic optimization method	• Countries: MENA countries (Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, Turkey, United Arab Emirates, Yemen) • Sample period: annually data over 1970 to 1999 • Variables: inflation rates, export, import and GDP	• MENA countries have the possibility to form a currency area and they should consider it.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Rana (2007)	• Trade intensity index (measure trade integration) • Descriptive (measure financial integration) • Hodrick-Prescott filter (measure synchronization of East Asian business cycles) • VAR analysis (measure synchronization of East Asian business cycles) • Multiple regression analysis (measure relationship between trade intensity and synchronization)	• Countries: ASEAN+3, Hong Kong, Taipei, South Asia, European Union (EU25), and NAFTA (overall countries used in the paper) • Sample period: annually data over 1980 to 2006 (measure trade integration), annually data in range of 2000 to 2005 (measure financial integration), annually data over 1989 to 2003 (used for Hodrick-Prescott filter), monthly data over January 2989 to December 2004 (used for VAR analysis), annually data over 1993 to 2004 for entire sample period, over 1993 to 1997 for pre-crisis period, and over 1998 to 2004 for post-crisis period (used for multiple regression analysis) • Variables: import, export, international bonds, fund to borrowers, prime lending market rates, money market rates, portfolio investment, GDP, industrial production.	• The level of trade integration in the ASEAN and East Asian regions are quite high. • Financial integration started to increase in East Asian. • The correlation is relatively lower. • In compared with pre-crisis period, the correlation of industrial production between all possible pairs of East Asian countries has increased in the post-crisis period. • For the entire sample period and post-crisis period, bilateral trade intensity is significant on business cycle synchronization. However, this is not true during pre-crisis period.
Bacha (2008)	• Pearson pairwise correlation • Impulse response functions (VAR model) • Variance decomposition	• Countries: ten MENA (Middle East and North Africa) countries which included four Agadir (Egypt, Morocco, Tunisia, Jordan) and six GCC countries (Saudi, UAE, Kuwait, Oman, Qatar, Bahrain) • Sample period: annually data over 1970 to2003 • Variables: GDP growth, inflation, money growth and short-term interest rates	• For GCC countries: strong relationship among monetary variables, symmetrical response to common external shocks without UAE, no influence of countries on each other within the bloc. • For Agadir countries: no correlation on real output growth and only some correlation among monetary variables, no symmetry in response to external shocks, not much influence among countries (concerned on real GDP growth).

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Dauti and Herzog (2008)	• Empirical assessment -Five convergence criteria based on Maastricht Treaty • Economic assessment -The Balasa Samuelson (BS) Effect -The Pass through Effect of the exchange rate on inflation. • Correlation • Granger causality test • Wald test • VAR	• Countries: Macedonia • Sample period: January 1999 to December 2008 (analysis on VAR). Overall data is from 1998 to 2008 • Variables: interest rate, REER, nominal effective exchange rate (NEER), producer prices, retail prices, CPI, real GDP, GDP per capita, government balance, government debt, GDP deflator, unemployment rate, employment rate, M4, current account, goods balance, capital and financial account, direct and portfolio investment, direct investment, portfolio investment	• Empirical assessment -GDP is insufficient, unemployment is high, current account deficit and external debt are increase and FDI is decrease. • Economic assessment - REER (Macedonian Denar) is favorable from the aspect of the competitiveness level of the economy. -Correlation between the movement or changes in the exchange rate and the prices of the producers of industrial products and retail prices did not show any significant relationship. -Macedonia is not ready to participate in the EMU.
Kawai (2008)	• Descriptive study	• Countries: East Asian, China, Japan, Korea • Sample period: annually data over 1980 to 2007 • Variables: intraregional trade share, FDI inflows, cross-border portfolio investment flows, Public sector debt, fiscal balance general government, CPI inflation rate, interest rate, status of bilateral swap arrangements(BSAs) under Chiang Mai (CMI)	• China needs to achieve further financial sector reform and capital account liberalization (because it is not well integrated in terms of financial and macroeconomic activity) to integrate itself fully with other East Asian countries. • Some East Asian countries (Japan, Korea, Singapore, Malaysia and Thailand) are well-integrated and can form a currency area. • There were some challenges for East Asia(refer Kawai, 2008)

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Meissner and Oomes (2008)	• Panel multinomial logit approach	• Countries: Latin America, Sub-Saharan Africa, East Asia Pacific, Eastern/central Europe and Middle East/North Africa • Sample period: annually data over 1980 to 1998 • Variables: level of total gross outstanding claims which included loans, securities and other liabilities (measure currency denomination of debt), total imports and exports divided by PPP adjusted GDP (measure openness), total of gross capital inflows and outflows divided by nominal GDP (measure capital account openness), M2, the proportion of M2 in the total monetary stock (measure financial development), money supply, real output (measure nominal shocks and real shocks respectively), GDP, and population	• Due to the record[26], Panel multinomial logit approach explains the determinants of anchor choice is the existence of trade network externalities as well as other determinants which are the symmetry of output shocks and the currency denomination of liabilities.
Ricci (2008)	-monetary model of trade with nominal rigidities (allows for a comprehensive consideration of the monetary and real arguments recommended by the literature on OCA and monetary union)	Countries: EMU, Commonwealth of Independent States (CIS)	• The degree of openness has an ambiguous impact on the net benefits when both real and monetary shocks are added. • The theoretical analysis of an OCA is far from complete because lack of some useful information. • Dynamic effects should not be underestimated when assessing the desirability of a currency area. • OCA arguments show a different findings across group of countries when discuss on the process of European monetary integration and the implications for the optimality of exchange rate regimes of neighboring economies.

[26] Almost all countries have chosen to peg to United States dollar and Euro as anchors have converge over the last 50 years.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Swofford (2008)	• Revealed preference tests	• Countries: China, Hong Kong, India, Japan, Korea, Malaysia, Singapore and Thailand • Sample period: Annually data over 1992 to 2003 • Variables: population, private consumption, CPI, money, quasi money, deposit rate, and a benchmark interest rate (government bond and the dollar exchange rate)	• The data of all countries and several groupings in this study were consistent with the microeconomic foundations of a common currency area.
Zhang, Sato and McAleer (2008)	• PP test • Johansen cointegration test • Correlation (VAR model) • Impulse response function (VAR model) – measure size and speed of adjustment from shocks.	• Countries: Chinese Trio (Hong Kong, Taiwan, China Mainland) • Sample period: quarterly data over 1980Q4 to 2004Q4 • Variables: real GDP, REER, M2 (money supply)	• Data were stationary in first-differences. • No cointegrating relationship. • Symmetric of shocks between countries was increasing. • The size of shocks was similar and small. • Speed of adjustment to shocks is very fast and the adjustment process is similar. • It is feasible for Chinese trio to form a currency union.
Banik, Biswas and Criddle (2009)	• A state space approach	• Countries: Bangladesh, India and Pakistan • Sample period: quarterly data over 1980Q1 to 2001Q4 • Variables: real output - Index of industrial production (IPP)	• There is a shared latent dynamic linkage in long-term trends in the growth of industrial production for all three countries and the frequency dynamics about the trend is high. • Presence of common trend and co-movement of outputs. • All three countries are good candidates to form an OCA.

Table 2.1: Summary of Literature Reviews on Theoretical Framework (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Zhao and Kim (2009)	• PP and ADF test • Cointegration test based on Engle and Granger (1987) • Variance decomposition (VAR model) – reported only for domestic output	• Countries: CFA franc zone countries (Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Republic of the Congo, Cote d'Ivoire, Gabon, Guinea-Bissau, Mali, Niger, Senegal, Togo) • Sample period: annually data over 1970 to 2004 • Variables: domestic, regional and global output	• There were unit roots for variables in most of the countries. • Non-cointegration of global, regional and local outputs could not be rejected. • Country-specific shocks is the dominant shock for domestic output in CFA franc-zone countries but regional shocks is said to be more important for EMU. • CFA franc-zone countries are likely to be subjected to asymmetric shocks and thus they are not feasible to form an OCA.
Azali, Wong, Lee and Shafinaz (2010)	• ADF tests • Auto-Regressive Distributed Lag (ARDL) Bound Testing Approach	• Countries: ASEAN 5 (Malaysia, Thailand, Singapore, Indonesia and the Philippines) • Sample period: annually data over 1978 to 2004 • Variables: GDP per capita, interest rate, inflation rate, debt ratio, exchange rate, surplus (or deficit) ratio	• Data are stationary at first difference. • Presence of long run relationship between variables in the Maastricht criteria. • Interest rate, inflation rate and debt ratio have a negative relationship with economy growth however the exchange rate, surplus (or deficit) ratio shown a positive relationship with economic growth. • ASEAN 5 has potential to form a single currency.

Table 2.2: Summary of Literature Reviews on Testing Procedure

Authors (year)	Methodology	Data	Findings/ Conclusions
Granger (1981)	• Descriptive study (method)	• -	• Noted that prior analysis of time series data are needed before model specification. • Suggested relationship between cointegration and error correction models.
Engle and Granger (1987)	• Descriptive study (method)	• -	• Two steps of cointegration were proposed. • Engle-granger test is a single equation method which allows for only one cointegration vector. • Existence of cointegration relationship between variables implies causality.
Johansen (1988)	• Descriptive study (method)	• -	• Based on vector autoregressions (VAR) system and test for the existence of cointegration relationship. • The asymptotic distribution are found for the test statistic and the first are described by a natural multivariate version of the usual test for unit root in an autoregressive process and the other is a χ^2 test.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Bayoumi and Eichengreen (1994)	• The aggregate supply and demand model (estimate according to VAR approach developed by Blanchard and Quah (1989)) • Correlation • Impulse response function	• Countries: Western Europe (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom); Asia (Australia, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, the Philippines, Singapore, Taiwan, and Thailand); Americas (Argentina, Bolivia, Brazil, Canada, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, the United States, Uruguay, and Venezuela); US (New England, Mideast, Great Lakes, Plains, Southeast, Far West, and West) • Sample period: annually data over 1960 to 1990 (European); annually data over 1969 to 1989 (Asia and Americas); annually data over 1963 to 1986 (US) • Variables: real GDP, nominal GDP, GDP deflator	• The correlation result shows that Austria, Belgium, Denmark, France, Germany, the Netherlands, Switzerland from European; Japan, Korea, Taiwan from Northeast Asian; and Hong Kong, Indonesia, Malaysia, Singapore, Thailand from Southeast Asian have a similar underlying disturbance. • All United States regions show the underlying shocks are correlated, except West. • For supply shocks, Europe and Asia show similar size of shocks but the Americas experience almost twice as large. • For demand shocks, Europe shows the smallest size of shocks, followed by Asia and lastly Europe. • The United States regions' size of disturbance is similar to Europe. • The speed of adjustment from shocks is fastest in Asia. • The United States regions' speed of adjustment shows that United States is potential to participant in monetary unions.
Frankel and Wei (1994)	• OLS regression	• Countries: Korea, Singapore, Hong Kong, Taiwan, Malaysia, Indonesia, the Philippines, Thailand, China, Japan, German, Australia, New Zealand and United States • Sample period: 1972 to 1992 • Variable: exchange rates	• There is little evidence of Yen bloc and East Asia countries maintain strong relationship with the United States.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Aggarwal and Mougoue (1996)	• Statistical properties • Park and Sung unit root test • Cointegration test	• Countries: NIEs (Hong Kong, South Korea, Singapore, and Taiwan) and four ASEAN countries (Malaysia, the Philippines, Thailand, and Singapore) • Sample period: daily data over 3 October 1983 to 7 February 1992 • Variables: exchange rates	• Exchange rate changes for all the currencies depart significantly from normality. • Single unit root is present in the logarithms of each of the exchange rates in differenced series. • There is a cointegrating vector for each set of currencies with the Japanese Yen
Kwan (1996)	• Descriptive study • OLS regression	• Countries: South Korea, Taiwan, Hong Kong, Singapore, Indonesia, Malaysia, the Philippines, Thailand, China, Japan, German and United States • Sample period: o 1975 to 1995 (descriptive study) o 1st week of January to 3rd week of August, 1995 (OLS regression) • Variable: o exchange rates, trade value, trade structure, inflation (descriptive study) o exchange rates (OLS regression)	• The Asian NIEs (Hong Kong, Singapore, South Korea and Taiwan) is suitable candidates to join a Yen bloc compared to ASEAN and China.
Tse and Ng (1997)	• ADF unit root test • Maximum likelihood approach from Johansen cointegration test	• Countries: Japan, Malaysia, the Philippines, Singapore, Thailand, South Korea, and Taiwan • Sample period: daily data over 27 September 1982 to 30 June 1994 (entire period/period II), daily data over 27 September 1982 to 22 December 1989 (sub-period/ period I) • Variables: nominal exchange rate	• Logarithmic nominal exchange rates of each of the seven countries currencies contain one unit root. • If the South Korean Won and the Taiwan dollar are excluded from the system, the remaining currencies are not cointegrated. Otherwise, there is cointegration among the currencies.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Kwan (1998)	• Descriptive – highlight on the OCA theory by considering the costs and benefits to a member countries (within a regional perspective to a yen bloc)	• Country: East Asian • Sample period: year 1993 (trade structures), annually data over 1982 to 1996 (inflation rates), and monthly data over January 1991 to December 1994 (volatility of countries currency) • Variables: trade structures (import and export for primary commodities, other manufactures and machinery), inflation rates, volatility of countries currency.	• Japan's trade structure is similar with NIEs but for economic structure, Japan has a dissimilar economic structure with East Asian. • Based on the criteria of similarity in inflation rate, low-inflation countries (Singapore, Taiwan, Malaysia, Thailand, and South Korea) are more suitable candidates to have a Yen as a single currency. • China might replace Japan because its economy has improved and its closer linkage with neighboring countries.
Liang (1999)	• Generalized Purchasing Power Parity (G-PPP) hypothesis • ADF and PP test • Johansen (1988), and Johansen and Juselius (1990) cointegration test	• Countries: China, Hong Kong SAR, Japan, United States • Sample period: Monthly data over January 1979 to June 1998 • Variables: real exchange rate, consumer price index (CPI)	• The RERs of China, Hong Kong SAR and Japan against the United States dollar are all nonstationary. • Using G-PPP criterion, China and Hong Kong SAR is not suitable to form an OCA by themselves. • Common trends are found only when Japan and the United States are added. • The long run elasticity between the RERs of Hong Kong SAR and China against the United States dollar is negative.
Gan (2000)	• OLS regression • Wald test	• Countries: Thailand, Malaysia, the Philippines, Indonesia, Korea, Taiwan, Singapore, Japan, United States • Sample period: January 2, 1995 to July 1, 1997. • Variable: exchange rates	• The Yen gained a greater weight in the currency basket after the abandonment of the quasi-dollar peg. • Korean Won and Taiwan dollar fail to reject the null hypothesis of Wald test which is no structural change.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Mkenda (2001)	• G-PPP hypothesis • ADF test • Cointegration test	• Countries: East African Community (EAC) which included Kenya, Tanzania, and Uganda. • Sample period: annually data over 1981 to 1998 (entire period), sub-period over 1981 to 1990 and 1990 to 1998. • Variables: real exchange rate	• Real exchange rate is barely stationary. • Cointegration test: o Full sample period: real exchange rates in EAC are inter-related. o Period from 1981 to 1990 – no cointegration between the real exchange rates. o Period from 1990 to 1998 – there are cointegration between the real exchange rates. • EAC constitute an OCA and they share the similar shocks.
Kempa (2002)	• ADF and PP unit root test • Structural VAR	• Countries: European Union • Sample period: Quarterly data over 1973:Q1 to 1997Q4 • Variables: bilateral real exchange rates, CPI, and real GDP	• Data were stationary in first difference. • Convergence is occurs for European Union in run-up to monetary union.
Bowman (2003)	• OLS regression analysis • Johansen cointegration analysis	• Countries: Indonesia, Thailand, Singapore, the Philippines, Taiwan, South Korea, Malaysia, Australia, Japan • Sample period: daily data over 1 January 1992 to 1 January 2002. • Variables: daily currency	• Both Australia and Japan have raises however US have decrease their linkage with the Asian currencies. • The Australian dollar and Japanese Yen indicates more influence in the East Asian currencies in the post-crisis.
Esaka (2003)	• OLS regression • CUSUMSQ test and Chow test (stability) • Time-varying parameter model by using the Kalman filter technique	• Countries: Thailand, Korea, Singapore, Malaysia, Indonesia, the Philippines, Japan, USA, German • Sample period: monthly data over 1980 (1) to 1997 (6) • Variable: nominal exchange rate	• Assumed that the weights were constant. • The weights were not constant but varied over time. • The weights of the United States dollar were large but were small for the weights of the Japanese Yen (raised in some countries in the early 1990s - Korea, Malaysia and Singapore).

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Kim and Chow (2003)	• Variance decompositions analysis (using structural VAR model)	• Countries: fifteen European countries (Austria, Belgium, Denmark, France, Ireland, Italy, the Netherlands, Finland, Greece, Norway, Portugal, Spain, Sweden, Switzerland, and UK) and seven East Asian countries (Hong Kong, Indonesia, South Korea, Malaysia, the Philippines, Singapore, and Taiwan). • Sample period: Quarterly data over 1965:1 to 1997:1 for Europe (except Austria and Denmark - over 1968:1 to 1997:1); quarterly data is over 1971:1 to 1997:1 for East Asian (except the Philippines-1981:1 to 1997:1; Hong Kong (1982:1 to 1997:1); and Indonesia (1979:1 to 1997:1) • Variables: industrial production (domestic outputs)	• - In the first European group (EMU members), regional shocks are dominant. - In the second European group (other countries in Europe), country-specific shocks are dominant. - In the East Asian group, country-specific shocks are dominant. • So, common currency peg in East Asian would be more costly and difficult to sustain compared to EMU countries.
Yelten (2003)	• ADF test • Sjaastad model (regression analysis)	• Countries: Thailand, Korea, and Singapore, Germany, Japan, USA • Sample period: monthly data over 1980 (1) to 1997 (1) • Variables: export and import prices (Thailand, Korea, and Singapore), CPI (Germany, Japan, and United States of America), exchange rate average (all countries)	• Data were stationary in the first differences. • Therefore, Thailand and Korea are suggested to have a basket of currencies includes the dollar, mark and Yen would more appropriate than pegging to a single currency. Yet, Singapore was more appropriate to pegging to the United States dollar alone.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Zhang, Sato and McAleer (2004)	• Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test • VAR method • Variance decomposition analysis • Impulse response analysis	• Countries: 10 East Asian (Japan, China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand, Taiwan) • Sample period: Quarterly and seasonally unadjusted, except for real Gross Domestic Product (GDP), over 1980 (1) to 2000 (3) • Variables: Real GDP, consumer price index (CPI), real exchange rate	• Most variables were integrated of order 1. • Some sub-regions were feasible to form as OCA, such as among some Asian NIEs and ASEAN countries. • In both sample period (1980Q1 – 1997Q1 and 1980Q1 – 2000Q3), supply shocks are the main shocks for the variability of real output (real GDP) in all the East Asian countries. • Size of the underlying shocks in East Asian is bigger than in Europe but the speed of adjustments to shocks is faster in East Asian compared to Europe.
Kwack (2004)	• Descriptive (GDP size and openness, direction of trade and FDI) • Correlation coefficients from the VAR model (measure similarities in economic structures and responses to common shocks) • Impulse response functions from the VAR models (measure the speed of adjustment to shocks) • Descriptive (assessment)	• Countries: 10 East Asian (China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, and Taiwan) • Sample period: annually data over 1987 to 1997 (measure GDP size and openness), over 1980 to 2000 (measure direction of trade and FDI), over 1975 to 2001 (measure similarities in economic structures and responses to common shocks), over 1963 to 2001 (measure the speed of adjustment to shocks) • Variables: GDP, import, export, direction of East Asia trade, Foreign Direct Investment (FDI) inflow, demand shocks, and supply shocks	• Market size is large and growing while openness rose with viewed as high. - The intra-regional export and import share of East Asian in the total of East Asian exports and imports are large and growing. • The responses to external shocks becoming more symmetrical in the East Asian countries. • The speeds of adjustment are found to be high. • East Asian has not reached the stage to form an OCA and a viable option is the formation of a quasi-monetary blocs.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Bystrom, Olofsdotter, Soderstrom (2005)	• Cross-sectional correlation (Solnik and Roulet, 2000)	• Countries: China (Beijing, Tianjin, Shenyang, Shanghai, Nanjing, Jinan, Wuhan, Guangzhou, Chengdu and Xian branch), Hong Kong and Macao • Sample period: annually data over 1991 to 2001 • Variables: degree of product variation, economic size (GDP), degree of openness (imports, export, GDP), similarity in production structure, co-variation in output growth, similar inflation rates (CPI), co-variation in external trade, co-variation in regional budget (regional fiscal incomes and expenditures)	• China is more appropriate to form a currency union at the end of the observed period than in the beginning. • Hong Kong and Macao are not likely to be suitable candidates in the currency area. • Final findings show that there might be other groups of regions that could be closer to OCA than the current Yuan area.
Lim (2005)	• Second-order autoregression (Alesina et al.) - measure co-movement of prices • Statistical test (Verspagen) – test for converging trend • ADF unit root test - determine the order of integration • Johansen cointegration test – cointegrating relationship and common trends.	• Countries: Japan, Hong Kong, South Korea and ASEAN-5 (Malaysia, Singapore, Indonesia, Thailand, the Philippines) • Sample period: monthly data over 1990 (1) to 2001 (12) • Variable: real exchange rates	• Both the United States dollar and Japanese Yen can be a suitable common currency for the six East Asian countries (Hong Kong, South Korea, Malaysia, Singapore, Thailand, and the Philippines). • There is a stable currency movement between each currency and the Japanese Yen over the study period. • Data are stationary in the first differences. • Only 10 pairs of East Asian currencies was convergence and only Hong Kong had a long run cointegrating relationship with the Japanese Yen.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Saxena (2005)	• Descriptive technique - Intra-regional trade - labor mobility -fiscal transfers -geo-political factors • To measure shocks affecting SAARC - unit root tests - Pairwise correlation (VAR) - impulse response functions (VAR)	• countries: Bangladesh, Bhutan, India, Sri Lanka, Maldives, Nepal, Pakistan • Sample period: annually data over 1971 to 2003 • Variables: export, import, GDP, CPI, GDP deflator, labor data	• descriptive technique - Majority countries show the intra-regional trade is small. - Labor mobility is varies across borders in SAARC countries. - There is no official fiscal transfer mechanisms exist and it needs to be addressed when the formal negotiations for common currency start. - The export performance of the region was affected by weak growth of economy since 2000. Besides, SAARC are hard to access to some markets due to the forming of a regional economic blocs and growing protectionism in both the developed and developing regions. • To measure shocks affecting SAARC - The size of both shocks considered small and the speed of adjustment is fast.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Ahn, Kim and Chang (2006)	• Bayoumi and Eichengreen's (1994) structural VAR procedure (measure correlation of supply shocks) • Generalized Purchasing Power Parity (G-PPP) hypothesis • ADF and KPSS unit root test • Johansen's maximum likelihood approach • Johansen's test procedure	• Countries: five Northeast Asia countries (China, Hong Kong SAR, Japan, Korea, Taiwan), five Southeast Asia countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand), and two Asia-Pacific countries (Australia and New Zealand). • Sample period: annually data for all variables over 1960 to 2002. But,, the sample periods for China, Malaysia and Hong Kong SAR are 1979-2002, 1970-2002, and 1961-2002, respectively. There is a monthly data for the national currency prices of the Japanese yen. • Variables: real GDP, GDP deflator (1950=100), bilateral real exchange rate, consumer price indices (1995=100), national currency prices of the Japanese Yen	• Three Northeast Asia countries (Hong Kong SAR, Korea, and Taiwan) and four Southeast Asia countries (Indonesia, Malaysia, Singapore, and Thailand) have good reason to form an OCA in terms of the correlations. Moreover, they face smaller supply shocks and faster speed of adjustment to shocks, except Thailand and Taiwan. • Data are stationary in the first differenced. • G-PPP fails to hold for all the possible groups except for Japan/Korea and Japan/Taiwan. • Japan are found as a biggest candidate group from the 12 East Asian countries. In addition, Northeast Asia and Southeast Asia also pass the G-PPP test.
Huang and Guo (2006)	• PP unit root test • Correlation coefficient from Structural VAR • Impulse response coefficients • Impulse response analysis	• Countries: Thailand, Indonesia, Malaysia, the Philippines, Singapore, China, Hong Kong, Japan and Korea; Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal and Spain). • Sample period: Annual data for full sample period which covers 1970 to 2002 and sub-period covers 1979-1998. • Variables: world real GDP, domestic real GDP, CPI fixed at 1995=100, real effective exchange rates (REER)	• Data are stationary in the first differenced. • There are significant and positive correlations of underlying shocks among Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand. • Size of underlying shocks is smaller in East Asian than in EMU. • Cost for Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand to relinquish control over their exchange rate are relatively small.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Masron and Yusop (2006)	• PP unit root tests • Johansen cointegration test • Error correction model (ECM) • Cointegration prosedur –long run equations • Granger causality based on VECM	• Countries: ASEAN-5 • Sample period: annually data over 1967 to 2002 • Variables: bilateral trade (IT), asymmetric shocks (AS), GDP per capita (SIZE), exchange rate	• All variables are integrated of order one. • All variables are cointegrated. • Further evidence that there is long run equilibrium among variables. • IT shows a negative relationship with exchange rate volatility. However, AS and SIZE shows a positive relationship. • Shows the short run impacts of exchange rate volatility on IT and SIZE are negative while impact on AS is positive.
Rana (2007)	• Trade intensity index (measure trade integration) • Descriptive (measure financial integration) • Hodrick-Prescott filter (measure synchronization of East Asian business cycles) • VAR analysis (measure synchronization of East Asian business cycles) • Multiple regression analysis (measure relationship between trade intensity and synchronization)	• Countries: ASEAN+3, Hong Kong, Taipei, South Asia, European Union (EU25), and NAFTA (overall countries used in the paper) • Sample period: annually data over 1980 to 2006 (measure trade integration), annually data in range of 2000 to 2005 (measure financial integration), annually data over 1989 to 2003 (used for Hodrick-Prescott filter), monthly data over January 2989 to December 2004 (used for VAR analysis), annually data over 1993 to 2004 for entire sample period, over 1993 to 1997 for pre-crisis period, and over 1998 to 2004 for post-crisis period (used for multiple regression analysis) • Variables: import, export, international bonds, fund to borrowers, prime lending market rates, money market rates, portfolio investment, GDP, industrial production.	• The level of trade integration in the ASEAN and East Asian regions are quite high. • Financial integration started to increase in East Asian. • The correlation is relatively lower. • In compared with pre-crisis period, the correlation of industrial production between all possible pairs of East Asian countries has increased in the post-crisis period. • For the entire sample period and post-crisis period, bilateral trade intensity is significant on business cycle synchronization. However, this is not true during pre-crisis period.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Dauti and Herzog (2008)	• Empirical assessment -Five convergence criteria based on Maastricht Treaty • Economic assessment -The Balasa Samuelson (BS) Effect -The Pass through Effect of the exchange rate on inflation. • Correlation • Granger causality test • Wald test • VAR	• Countries: Macedonia • Sample period: January 1999 to December 2008 (analysis on VAR). Overall data is from 1998 to 2008 • Variables: interest rate, REER, NEER, producer prices, retail prices, CPI, real GDP, GDP per capita, government balance, government debt, GDP deflator, unemployment rate, employment rate, M4, current account, goods balance, capital and financial account, direct investment, and portfolio investment	• Empirical assessment -GDP is insufficient, unemployment is high, current account deficit and external debt are increase and FDI is decrease. • Economic assessment - REER (Macedonian Denar) is favorable from the aspect of the competitiveness level of the economy. -Correlation between the movement or changes in the exchange rate and the prices of the producers of industrial products and retail prices did not show any significant relationship. -Macedonia is not ready to participate in the EMU.
Neves, Stocco and Silva (2008)	• G-PPP hypothesis • Dickey-Pantula (DP), ADF, PP, Elliott-Rothenberg-Stock (ERS) • Unit root tests within structural breaks included Lee-Strazicich minimum Lagrange multiplier, Zivot-Andrews and Perron (1997) • Johansen, Mosconi and Nielsen (2000) cointegration test which allowing for two breaks in the longrun relationship. • Johansen (1988, 1991) maximum likelihood without breaks.	• Countries: Mercosur's member (Argentina, Brazil, Paraguay, Uruguay), Venezuela and USA (as a benchmark countries), Bolivia and Chile (only used in stationary tests). • Sample period: quarterly data over 1973Q3 to 2006Q3. • Variables: CPI and average dollar price	• DP tests: the series did not present two or more unit roots. • ADF and PP tests: rejected the null of unit root for Bolivia and Chile at first difference. • Null of non-cointegration could be rejected for Mercosur and there are large cross-country differences in Mercosur.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Zhang, Sato and McAleer (2008)	• PP test • Johansen cointegration test • Correlation (VAR model) • Impulse response function (VAR model) – measure size and speed of adjustment from shocks.	• Countries: Chinese Trio (Hong Kong, Taiwan, China Mainland) • Sample period: quarterly data over 1980Q4 to 2004Q4 • Variables: real GDP, REER, M2 (money supply)	• Data were stationary in first-differences. • No cointegrating relationship. • Symmetric of shocks between countries was increasing. • The size of shocks was similar and small. • Speed of adjustment to shocks is very fast and the adjustment process is similar. • It is feasible for Chinese trio to form a currency union.
Azali, Royfaizal, Lee (2009)	• DF and ADF test • Johansen-Juselius likelihood cointegration test • Exclusion restriction test (used because not all currencies will enter the cointegration vector) • Johansen-Juselius likelihood cointegration test (re-estimated for the remaining countries) • Exclusion restriction test (for remaining countries) • Granger causality test (based on VECM model)	• Countries: Asian (Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Korea, India) • Sample period: daily data over 1st November 1988 to 31st December 2007 (pre-crisis data is from 1st November 1988 to 13th May 1997; data during crisis is from 14th May 1997 to 31st August 1998; and post-crisis data is from 1st September 1998 to 31st December 2007) • Variables: exchange rates	• Currencies are integrated of order one, I (1). • No cointegration among the currencies in the pre-crisis period but cointegrated with one cointegrating vector during crisis and post-crisis periods. • During the crisis period, the unidirectional causal relationship is runs from Korea Won to Indonesian Rupiah and also from Indonesian Rupiah to the Philippines Peso. Won indirectly granger caused changes in the Peso. • In terms of post-crisis, Ringgit and Won have a bidirectional relationship. Unidirectional causal relationship runs from Singapore dollar to Malaysian Ringgit, Korea Won and the Philippines Peso; and from the Philippines Peso to Malaysia Ringgit and Korea Won. • Yen is a potential alternative currency in the future.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Chen, Peng and Shu (2009)	• OLS regression	• Countries: United States, Europe, China, Japan, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand. • Sample period: two sample periods which are 1/1/1999 to 20/7/2005 and 22/7/2005 to 12/2/2009 • Variable: Exchange rate of Asian currencies.	• The Chinese Renminbi has significant impact on Asian Currencies. • The Chinese Renminbi is a potential candidate to be a reserve currency compared to Japanese Yen and British Pound.
Lee and Azali (2009)	• Correlation (VAR model) • Impulse function analysis (VAR model)	• Countries: ASEAN (Indonesia, Malaysia, the Philippines, Singapore and Thailand), China, Japan, and Korea and European countries (as a comparison) • Sample period: annually data over 1960 to 1997 (before crisis) and annually data over 1960 to 2006. • Variables: GDP and GDP deflator	• As compared to European countries, the size of shocks is larger however the speed of adjustment is faster in East Asian. • Only some sub-groups in East Asian countries show that the correlation of supply shocks is highly symmetrical (better candidates for a currency union). • The demand shocks are less symmetric than the supply shocks in East Asian countries.
Zhao and Kim (2009)	• PP and ADF test • Cointegration test based on Engle and Granger (1987) • Variance decomposition (VAR model) – reported only for domestic output	• Countries: CFA franc zone countries (Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Republic of the Congo, Cote d'Ivoire, Gabon, Guinea-Bissau, Mali, Niger, Senegal, Togo) • Sample period: annually data over 1970 to 2004 • Variables: domestic, regional and global output	• There were unit roots for variables in most of the countries. • Non-cointegration of global, regional and local outputs could not be rejected. • Country-specific shocks is the dominant shock for domestic output in CFA franc-zone countries but regional shocks is said to be more important for EMU. • CFA franc-zone countries are likely to be subjected to asymmetric shocks and thus they are not feasible to form an OCA.

Table 2.2: Summary of Literature Reviews on Testing Procedure (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Azali, Wong, Lee and Shafinaz (2010)	• ADF tests • Auto-Regressive Distributed Lag (ARDL) Bound Testing Approach	• Countries: ASEAN 5 (Malaysia, Thailand, Singapore, Indonesia and the Philippines) • Sample period: annually data over 1978 to 2004 • Variables: GDP per capita, interest rate, inflation rate, debt ratio, exchange rate, surplus (or deficit) ratio	• Data are stationary at first difference. • Presence of long run relationship between variables in the Maastricht criteria. • Interest rate, inflation rate and debt ratio have a negative relationship with economy growth however the exchange rate, surplus (or deficit) ratio shown a positive relationship with economic growth. • ASEAN 5 has potential to form a single currency.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose

Authors (year)	Methodology	Data	Findings/ Conclusions
Kwan (1998)	• Descriptive – highlight on the OCA theory by considering the costs and benefits to a member countries (within a regional perspective to a yen bloc)	• Country: East Asian • Sample period: year 1993 (trade structures), annually data over 1982 to 1996 (inflation rates), and monthly data over January 1991 to December 1994 (volatility of countries currency) • Variables: trade structures (import and export for primary commodities, other manufactures and machinery), inflation rates, volatility of countries currency.	• Japan's trade structure is similar with NIEs but for economic structure, Japan has a dissimilar economic structure with East Asian. • Based on the criteria of similarity in inflation rate, low-inflation countries (Singapore, Taiwan, Malaysia, Thailand, and South Korea) are more suitable candidates to have a Yen as a single currency. • China might replace Japan because its economy has improved and its closer linkage with neighboring countries.
Bowman (2003)	• OLS regression analysis • Johansen cointegration analysis	• Countries: Indonesia, Thailand, Singapore, the Philippines, Taiwan, South Korea, Malaysia, Australia, Japan • Sample period: daily data over 1 January 1992 to 1 January 2002. • Variables: daily currency	• Both Australia and Japan have raises however US have decrease their linkage with the Asian currencies. • The Australian dollar and Japanese Yen indicates more influence in the East Asian currencies in the post-crisis.
Zhang, Sato and McAleer (2004)	• Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test • VAR method • Variance decomposition analysis • Impulse response analysis	• Countries: 10 East Asian (Japan, China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Thailand, Taiwan) • Sample period: Quarterly and seasonally unadjusted, except for real Gross Domestic Product (GDP), over 1980 (1) to 2000 (3) • Variables: Real GDP, consumer price index (CPI), real exchange rate	• Most variables were integrated of order 1. • Some sub-regions were feasible to form as OCA, such as among some Asian NIEs and ASEAN countries. • In both sample period (1980Q1 – 1997Q1 and 1980Q1 – 2000Q3), supply shocks are the main shocks for the variability of real output (real GDP) in all the East Asian countries. • Size of the underlying shocks in East Asian is bigger than in Europe but the speed of adjustments to shocks is faster in East Asian compared to Europe.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose (continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Aminian (2005)	• Descriptive study	• Countries: Japan, China, NIEs, ASEAN • Sample period: annually data over 1980 to 1999 • Variables: **General characteristics** – populations and per capital income (measure size and level of economic development), industrial structures, the ratio of money plus quasi money to GDP (measure financial depth), exchange rate regime, economic and trade policies, trade as percentage of GDP. **Collective characteristics (OCA criteria)** – Intra-Asian migration and the ratio of FDI inflow to regional GDP (measure factor mobility), the amount of exports and imports of a country with a particular partner as a percentage of the country's GDP (measure openness and interdependence among East Asia countries), and symmetry of shocks (compare with EU countries).	• Major economic characteristics displayed good conditions to support monetary cooperation in East Asian. • East Asian countries have performed well in term of OCA criteria.
Karras (2005)	• New Keynesian monetary policy model (by Clarida, Gali and Gertler, 1999) • Three filtering methods (differencing, the Hodrick-Prescott filter, and the Band-Pass filter)	• Countries: Australia, Bangladesh, China, Hong Kong, Indonesia, India, Japan, Korea, Sri Lanka, Malaysia, Nepal, New Zealand, Pakistan, the Philippines, Papua New Guinea, Singapore, Thailand, and Taiwan • Sample period: Annually data over 1960 to 2001 • Variables: real GDP, nominal exchange rate, and CPI	• The costs and benefits adopting Yen vary substantially across the countries but are often positively related.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose(continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Kwack (2005)	• Descriptive (GDP size and openness, direction of trade and FDI) • Correlation coefficients from the VAR model (measure similarities in economic structures and responses to common shocks) • Impulse response functions from the VAR models (measure the speed of adjustment to shocks) • Descriptive (assessment)	• Countries: 10 East Asian (China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, and Taiwan) • Sample period: annually data over 1987 to 1997 (measure GDP size and openness), over 1980 to 2000 (measure direction of trade and FDI), over 1975 to 2001 (measure similarities in economic structures and responses to common shocks), over 1963 to 2001 (measure the speed of adjustment to shocks) • Variables: GDP, import, export, direction of East Asia trade, Foreign Direct Investment (FDI) inflow, demand shocks, and supply shocks.	• Market size is large and growing while openness rose with viewed as high. - The intra-regional export and import share of East Asian in the total of East Asian exports and imports are large and growing. • The responses to external shocks becoming more symmetrical in the East Asian countries. • The speeds of adjustment are found to be high. • East Asian has not reached the stage to form an OCA and a viable option is the formation of a quasi-monetary blocs.
Lim (2005)	• Second-order autoregression (Alesina et al.) - measure co-movement of prices • Statistical test (Verspagen) – test for converging trend • ADF unit root test - determine the order of integration • Johansen cointegration test – cointegrating relationship and common trends.	• Countries: Japan, Hong Kong, South Korea and ASEAN-5 (Malaysia, Singapore, Indonesia, Thailand, the Philippines) • Sample period: monthly data over 1990 (1) to 2001 (12) • Variable: real exchange rates	• Both the United States dollar and Japanese Yen can be a suitable common currency for the six East Asian countries (Hong Kong, South Korea, Malaysia, Singapore, Thailand, and the Philippines). • There is a stable currency movement between each currency and the Japanese Yen over the study period. • Data are stationary in the first differences. • Only 10 pairs of East Asian currencies was convergence and only Hong Kong had a long run cointegrating relationship with the Japanese Yen.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose(continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Ahn, Kim and Chang (2006)	• Bayoumi and Eichengreen's (1994) structural VAR procedure (measure correlation of supply shocks) • Generalized Purchasing Power Parity (G-PPP) hypothesis • ADF and KPSS unit root test • Johansen's maximum likelihood approach • Johansen's test procedure	• Countries: five Northeast Asia countries (China, Hong Kong SAR, Japan, Korea, Taiwan), five Southeast Asia countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand), and two Asia-Pacific countries (Australia and New Zealand). • Sample period: annually data for all variables over 1960 to 2002. But,, the sample periods for China, Malaysia and Hong Kong SAR are 1979-2002, 1970-2002, and 1961-2002, respectively. There is a monthly data for the national currency prices of the Japanese yen. • Variables: real GDP, GDP deflator (1950=100), bilateral real exchange rate, consumer price indices (1995=100), national currency prices of the Japanese Yen	• Three Northeast Asia countries (Hong Kong SAR, Korea, and Taiwan) and four Southeast Asia countries (Indonesia, Malaysia, Singapore, and Thailand) have good reason to form an OCA in terms of the correlations. Moreover, they face smaller supply shocks and faster speed of adjustment to shocks, except Thailand and Taiwan. • Data are stationary in the first differenced. • G-PPP fails to hold for all the possible groups except for Japan/Korea and Japan/Taiwan. • Japan are found as a biggest candidate group from the 12 East Asian countries. In addition, Northeast Asia and Southeast Asia also pass the G-PPP test.
Huang and Guo (2006)	• PP unit root test • Correlation coefficient from Structural VAR • Impulse response coefficients • Impulse response analysis	• Countries: nine East Asian countries (Thailand, Indonesia, Malaysia, the Philippines, Singapore, China, Hong Kong, Japan and Korea) and nine European Monetary Union countries (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal and Spain). • Sample period: Annual data for full sample period from 1970 to 2002 and sub-period covers 1979-1998. • Variables: world real GDP, domestic real GDP, CPI fixed at 1995=100, real effective exchange rates (REER)	• Data are stationary in the first differenced. • There are significant and positive correlations of underlying shocks among Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand. • Size of underlying shocks is smaller in East Asian than in EMU. • Cost for Hong Kong, Indonesia, Korea, Malaysia, Singapore and Thailand to relinquish control over their exchange rate are relatively small.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose(continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Rana (2007)	• Trade intensity index (measure trade integration) • Descriptive (measure financial integration) • Hodrick-Prescott filter (measure synchronization of East Asian business cycles) • VAR analysis (measure synchronization of East Asian business cycles) • Multiple regression analysis (measure relationship between trade intensity and synchronization)	• Countries: ASEAN+3, Hong Kong, Taipei, South Asia, European Union (EU25), and NAFTA (overall countries used in the paper) • Sample period: annually data over 1980 to 2006 (measure trade integration), annually data in range of 2000 to 2005 (measure financial integration), annually data over 1989 to 2003 (used for Hodrick-Prescott filter), monthly data over January 2989 to December 2004 (used for VAR analysis), annually data over 1993 to 2004 for entire sample period, over 1993 to 1997 for pre-crisis period, and over 1998 to 2004 for post-crisis period (used for multiple regression analysis) • Variables: import, export, international bonds, fund to borrowers, prime lending market rates, money market rates, portfolio investment, GDP, industrial production.	• The level of trade integration in the ASEAN and East Asian regions are quite high. • Financial integration started to increase in East Asian. • The correlation is relatively lower. • In compared with pre-crisis period, the correlation of industrial production between all possible pairs of East Asian countries has increased in the post-crisis period. • For the entire sample period and post-crisis period, bilateral trade intensity is significant on business cycle synchronization. However, this is not true during pre-crisis period.
Swofford (2008)	• Revealed preference tests	• Countries: China, Hong Kong, India, Japan, Korea, Malaysia, Singapore and Thailand • Sample period: Annually data over 1992 to 2003 • Variables: population, private consumption, CPI, money, quasi money, deposit rate, and a benchmark interest rate (government bond and the dollar exchange rate)	• The data of all countries and several groupings in this study were consistent with the microeconomic foundations of a common currency area.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose(continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Azali, Royfaizal, Lee (2009)	• DF and ADF test • Johansen-Juselius likelihood cointegration test • Exclusion restriction test (used because not all currencies will enter the cointegration vector) • Johansen-Juselius likelihood cointegration test (re-estimated for the remaining countries) • Exclusion restriction test (for remaining countries) • Granger causality test (based on VECM model)	• Countries: Asian (Indonesia, Malaysia, the Philippines, Singapore, Thailand, China, Korea, India) • Sample period: daily data over 1st November 1988 to 31st December 2007 (pre-crisis data is from 1st November 1988 to 13th May 1997; data during crisis is from 14th May 1997 to 31st August 1998; and post-crisis data is from 1st September 1998 to 31st December 2007) • Variables: exchange rates	• Currencies are integrated of order one, I (1). • No cointegration among the currencies in the pre-crisis period but cointegrated with one cointegrating vector during crisis and post-crisis periods. • During the crisis period, the unidirectional causal relationship is runs from Korea Won to Indonesian Rupiah and also from Indonesian Rupiah to the Philippines Peso. Won indirectly granger caused changes in the Peso. • In terms of post-crisis, Ringgit and Won have a bidirectional relationship. Unidirectional causal relationship runs from Singapore dollar to Malaysian Ringgit, Korea Won and the Philippines Peso; and from the Philippines Peso to Malaysia Ringgit and Korea Won. • Yen is a potential alternative currency in the future.
Chen, Peng and Shu (2009)	• OLS regression	• Countries: United States, Europe, China, Japan, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand. • Sample period: two sample periods which are 1/1/1999 to 20/7/2005 and 22/7/2005 to 12/2/2009 • Variable: Exchange rate of Asian currencies.	• Chinese Renminbi is potential to be the international currency. • The Chinese Renminbi has significant impact on Asian Currencies. • The Chinese Renminbi is a potential candidate to be a reserve currency compared to Japanese Yen and British Pound.

Table 2.3: Summary of Literature Reviews on Empirical Evidence for Feasibility of Optimum Currency Area and Which Currency to Choose(continued)

Authors (year)	Methodology	Data	Findings/ Conclusions
Shirono (2009)	• Micro-founded gravity model that emerges from a general equilibrium trade model – estimates trade effects and welfare gains for East Asian from currency union with Japan, US and China.	• Countries: Japan, China, US, Hong Kong S.A.R., Singapore, Korea, Indonesia, Malaysia, • Thailand and the Philippines. • Sample period: annually data over 1990 to 2003 • Variables: import, export, real GDP	• Between Japan and US, the trade effects are more or less the same across countries regardless of the currency union partner. But welfare gains from a bilateral currency union with Japan, rather than a union with the US, tend to be higher for five out of eight East Asian countries. • Between Japan and China, the trade effects are more or less similar across different currency union arrangements, but the average welfare gains tend to be the largest in currency unions with China. • It may become more (less) attractive for East Asian economies to form a currency union with China (Japan) if the China's (Japan's) trade share continues to increase (decrease).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter is divided into two sections which comprise of data collection and analysis tools. The data collection section provides brief information on the types of data, sources of data and the sample period. Then, the section on analysis tools provides the methods that are used to achieve the objectives of the study.

3.1 Data Collection

This study utilizes high frequency daily exchange rate data for ASEAN and a leading country currencies namely China. The exchange rates included the Brunei dollar (BND), the Cambodian Riel (KHR), the Lao Kip (LAK), the Indonesian Rupiah (IDR), the Malaysian Ringgit (MYR), the Myanmar Kyat (MMK), the Philippines Peso (PHP), the Singapore dollar (SGD), the Thai Baht (THB), the Vietnamese Dong (VND) and the Chinese Renminbi (RMB). The base currency for all the exchange rates is the US dollar, as adopted from Gan (2000).

Daily exchange rate data starting from July 21, 2005 until September 30, 2011 were used for analysis. All data were collected from OANDA which is one of the forex trading and exchange rates services website. In order to observe the exchange rate

movement of ASEAN currencies with the Chinese Renminbi, data were separated into three sample periods which are before, during and after the recent global financial crisis: (i) Pre global financial crisis spanning from 21/07/2005[27] to 06/08/2007; during global financial crisis from 07/08/2007 to 31/07/2009[28] and (ii) Post-crisis from 01/08/2009 to 30/09/2011. All exchange rates series were transformed into natural logarithms to obtain more precise result, in order to overcome the problem of heteroscedasticity and obtain elasticity (Gujarati, 1995).

3.2 Analysis Tools

To determine the potential for Chinese Renminbi to be an optimum currency for ASEAN countries, this study employs the recently developed cointegration analysis namely Auto-regressive Distributed Lag (ARDL) approach to investigate the cointegrating relationship between the currencies. Moreover, Granger causality test based on Wald test approach will be used to further examine whether the Chinese Renminbi Granger cause each of the ASEAN currencies.

3.2.1 Augmented Dickey Fuller (ADF) Unit Root Test

Generally, unit root test was used to investigate the stationary properties of the observed variables prior to conducting cointegration test. In other words, unit root test aimed to verify whether the variables used is stationary or non-stationary. One of the unit

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[27] Chinese Renminbi ended its peg to USD as at 21st July 2005.
[28] This study follows the crisis period presented in Chudik & Fratzscher (2011).

root tests that is employed in this study is Augmented Dickey Fuller (ADF) test. The ADF test is proposed by Dickey and Fuller (1970; 1981). In this study, ADF test was used to verify whether the variables in the study are integrates of the order of two, denotes $I(2)$.

In order to capture serial correlation, ADF used a parametric autoregressive. Based on the critical value or the probability value, the stationary degree can be examined. Meanwhile, the critical value is depended on the size of the sample. As a result, the null hypothesis for this test is not rejected if the t-statistic is smaller than the critical value and the data is non-stationary. However, if the ADF's value is bigger than the critical value, the null hypothesis is rejected and it reveals the data is stationary.

$$Y_t = \rho Y_{t-1} + \varepsilon_t \qquad (3.1)$$

Equation (3.1) is a unit root equation. Y_t represents variable of interest, t is time indicator, ρ is coefficient, and ε_t is error term which has zero mean and a constant variance. When coefficient correlated with Y_{t-1} and when it is equaled to one, the non-stationary variable is present. On the other hand, the unit root is attended if $|\rho|$ equal to 1. The regression model can be presented as:

$$\Delta Y_t = (\rho - 1)Y_{t-1} + \varepsilon_t = \delta Y_{t-1} + \varepsilon_t \qquad (3.2)$$

The Δ symbol in the regression (3.2) showed the test for the first difference. Besides, it can applied in testing a unit root $\delta = 0$. When the $\delta = 0$, the variable is believed to have a unit root. Furthermore, constant of time and the dummy variable can determine the non-standard and non-normal asymptotic which emphasized in the unit root test. Moreover, the data can give a clear and constant movement along the variable if it is verified as stationary.

3.2.2 Phillips-Perron (PP) Test

Phillips-Perron (PP) test is also one of the unit root tests which is normally employed before the cointegration test in order to investigate the stationary of variables. The PP test was proposed by Phillips and Perron (1988). In this study, PP test is used to verify whether the variables in the study are integrated of the order of two, denoted as *I*(2). PP test ignores every series correlation in the test regression and this makes it differ from the ADF test. The test regression is as below:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + \mu_t \ , \qquad (3.3)$$

where μ_t is *I*(0) and may be heteroskedastic. Through directly modifying the test statistics $t_{\pi=0}$ and $T_{\hat{\pi}}$, the PP test correct for any series correlation and heteroskedasticity in the errors μ_t of the test regression.

3.2.3 Auto-regressive Distributed Lag (ARDL) Approach

After the unit root test was estimated, this study utilized the Auto-regressive Distributed Lag (ARDL) approach developed by Pesaran, Shin and Smith (2001). This approach investigated the relationship between ASEAN currencies with the Chinese Renminbi. The application of Auto-regressive Distributed Lag (ARDL) approach has several advantages. Firstly, ARDL approach do not request the order of integration for the series to be non-stationary in their levels and integration order of one which denotes as *I*(1). In other words, this study can proceed to ARDL approach as long as the variable do not integrated of order two, denotes as *I*(2) or higher. This is the major benefit in contrast to those conventional types of cointegration test such as Engle-Granger (1987), Johansen (1988) and Johansen and Juselius (1990). Secondly, the cointegration relationship can be obtained by applying simple OLS with an appropriate lag length. Thirdly, the ARDL approach can distinguish dependent and independent variables which unlike the conventional type cointegration test that facing the endogeneity problem.[29]

The first step of ARDL approach is to estimate the bound testing analysis between variables by computing the F-statistics. The null hypothesis of ARDL bound testing which is no cointegrating relationship, H_0:$\lambda_1 = \lambda_2 = 0$, is tested against the alternative hypothesis of the existence of cointegrating relationship, H_1:$\lambda_1 \neq \lambda_2 \neq 0$. This test begins with the estimation of Ordinary Least Squares (OLS) technique and the variable additional test (OLS & IV) to calculate the F-statistics. Then, this study compared the

[29] See also Ghatak & Siddiki (2001); Kueh, Puah, Lau & Shazali (2007); Sari, Ewing & Soytas (2008); Kassim & Majid (2009); Chong & Puah (2009); Menyah &Rufael, (2010) and Onafowara, Owoye, & Huart (2011) for the advantages of ARDL approach.

value of the F-statistics with the critical values tabulated in Table CI(iii)[30] to confirm the existence of cointegration between the variables. After F-statistics computation, this study evaluated the F-statistics in three types of conditions for cointegration relationships identification among the currencies. The first type of condition is the results of this study will fail to reject the null hypothesis of no cointegration when the value of F-statistic falls under the lower bound critical value. The second type of condition occurs when this study rejects the null hypothesis of no cointegration as the F-statistic value exceeds the upper bound critical value. The third type of condition is the conclusion of inconclusive if the F-statistics value of this study falls between the lower bound and upper bound critical values.

Before F-statistics computation, an important step is to determine the optimal lag length. There are two types of model selection criteria are common which is the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criteria (SBC). According to Enders (2003) and Asghar and Abid (2007), SBC has superior large sample properties however AIC can perform well in small samples in comparison with SBC. Therefore, the choice of lag length is appropriate to select using the SBC as this study employs large sample size. The selection of optimum lags length generally takes place based on the Hendry's (1995) general-to-specific modeling strategy or the VAR system.

The study investigated the cointegrating relationship between ASEAN currencies with the Chinese Renminbi through bound testing. This is to investigate the existence of cointegrating relationship among variables. This study rotated each variable to become

[30] Case III: Unrestricted intercept and no trend by Pesaran et al. (2001).

dependent and independent variable while examining the relationship between variables. This procedure enables to identify the cointegrating relationship with a dependent variable followed by its forcing variables without having any prior information about the direction of cointegrating relationship between the Chinese Renminbi with each of the ASEAN currencies (Sari, Ewing and Soytas, 2008). The estimation of the cointegration relationship between ASEAN currencies with the Chinese Renminbi follows the unrestricted error correction models (UECM):

$$\Delta \ln AC_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln AC_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta \ln RMB_{t-i} + \beta_3 \ln AC_{t-1} + \beta_4 \ln RMB_{t-1} + \varepsilon_t, \text{and} \quad (3.4)$$

$$\Delta \ln RMB_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln RMB_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta \ln AC_{t-i} + \beta_3 \ln RMB_{t-1} + \beta_4 \ln AC_{t-1} + \epsilon_t , \quad (3.5)$$

where AC denotes each of the currencies for ASEAN countries however RMB is the Chinese Renminbi; Δ denotes a first difference operator; ln represents natural logarithmic transformation; α_0 is an intercept and ε_t and $\epsilon_t$are white noise error terms.

The second step in ARDL approach is to estimate the error-correction representation. Some of the studies such as Narayan and Narayan (2005); Long and Samreth (2008); Sari, Ewing and Soytas (2008); Ozturk and Acaravci (2010) and

Menyah and Rufael (2010) pointed out that if the cointegration relationship is confirmed between variables in the first step, then the study will continue the estimation to the error-correction representation. However, some of the studies such as Bahmani-Oskooee and Wang (2007), Afzal, Butt, Rehman and Begum (2009) and Chowdhury (2012) claimed that the negative signed and significant lagged error correction term (EC_t) value under the error correction representation of ARDL test is more efficient and useful to determine the cointegration relationship between variables as compared to the computed F-statistic from bound testing. Therefore, this study carried out the estimation to the second step by testing the equation (3.6) to obtain the EC_t value which denoted as Ψ regardless whether the results are cointegrated or not in the first step, which is bound testing.

$$\Delta \ln AC_t = \alpha_1 + \sum_{i=1}^{n} \beta_{1i} \Delta \ln AC_{t-i} + \sum_{i=0}^{n} \beta_{2i} \Delta \ln RMB_{t-i} + \Psi ECM_{t-1} + \xi_t \qquad (3.6)$$

Lastly, Granger causality based on Wald test (β_2's in equation 3.6) was used to further investigate whether the Chinese Renminbi have an impact toward ASEAN currencies. The null hypothesis of the Granger causality test is the Chinese Renminbi does not Granger causes the ASEAN currencies. Therefore, if the β_2'sin equation 3.6 is significant, then the null hypothesis which states that the Chinese Renminbi does not Granger cause ASEAN currencies can be rejected.

CHAPTER FOUR

EMPIRICAL RESULTS AND INTERPRETATIONS

4.0 Introduction

This chapter presents the empirical results for the study. This study aims to examine whether there is any early evidence supporting the common currency union arrangement in ASEAN region or not. Therefore, the empirical results of cointegrating relationship and Granger causality between the Chinese Renminbi with the ASEAN-10 currencies are presented. Through the empirical results of this chapter, this study aims to investigate whether the Chinese Renminbi will be the suitable anchor currency for ASEAN.

In this context, this chapter presents a battery of time series econometrics analysis outcomes. This study firstly reports the unit root test results of Augmented Dickey Fuller (ADF) test proposed by Dickey and Fuller (1970; 1981) and Phillips and Perron (PP) test proposed by Phillips and Perron (1988). The unit root test is adopted to observe the integration order of the variables as the ARDL approach cannot proceed if the variable is integrated of order two, denoted as $I(2)$, or higher. Furthermore, this study presents the results for Auto-Regressive Distributed Lag (ARDL) bound test and error correction representation of ARDL test. Lastly, the results for Granger causality test based on Wald test approach are presented.

4.1 Empirical Results and Interpretation

4.1.1 Unit Root Test

The conventional purpose of unit root testing is to determine the time series properties, in particular the integration order. This is an important step because this process distinguishes the order of integration of the series which eventually will direct the choice of subsequent testing procedure in standard time series econometrics analysis. The following step after the unit root test is the cointegration analysis. The assessments for unit root hypothesis are the determination point, whether to proceed to the cointegration analysis or either. This is because the general bivariate or multivariate cointegration tests of Engle and Granger, Johansen or Johansen and Juselius cointegration tests require series to be non-stationary in their levels and integration order of one which is denoted as $I(1)$ (Granger, 1986). On the other hand, Pesaran et al. (2001) introduced a new method of testing for cointegration namely the ARDL approach which does not require the data consistency of $I(0)$ or $I(1)$ integration order[31]. Meanwhile, Ang (2007) further reaffirms that the computed statistics provided by Pesaran et al. (2001) and Narayan (2005) are not appropriate if the variable is integrated at order of two, denoted as $I(2)$. Based on these standard pre-requirements, this study begins with unit root testing to justify the integration order of variables using the ADF and PP unit root tests.

Though there are numbers of authors[32]who claimed that ADF and PP tests contain the shortcomings of low power in small sample size, this study still adopts the ADF and

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[31] Variables can be purely $I(0)$, purely $I(1)$ or mutually cointegrated.
[32]Refer toDiebold & Rudebusch (1991), Elshareif & Tan (2009), and Jain & Sami (2011).

PP unit root tests as it deploys a larger observation of high frequency series (daily data). Besides that, PP unit root test is robust because of the unspecified autocorrelation and heteroscedasticity in the disturbance process of the test equation (Phillips & Perron, 1988). The tests for both the ADF and PP are based on the null hypothesis of whether there is unit root problem in the series. If the null hypothesis is not rejected at conventional significant levels, it can be concluded that the series contains unit root and the series is non-stationary[33]. Thus, to probe the stationary properties of the series, this study conducts the ADF and PP unit root tests. Choosing the lag length for the unit root test is important because lag length which is too small can cause bias to the test and lag length which is too large will cause the power of the test to suffer. This study selects the optimal lag length based on Schwarz's Bayesian Criteria (SBC) as this study involves a large sample size (Enders, 2003; Asghar & Abid, 2007). The SBC imposes the maximum lag lengths of 19, 19 and 20 for each variable in the pre-crisis, during crisis and the post-crisis period.

Next, it is important to identify whether interceptor time trend and intercept to be included in the unit root hypothesis testing. According to Elder and Kennedy (2001), this is deemed crucial as there is a risk of loss of power of the results when the estimation involves too many deterministic regressors. At the same time, the circumstances of lacking deterministic regressors may also cause the unit root analysis to be biased in favour of the null hypothesis. Therefore, unit root analysis with an intercept or trend and intercept is crucial to account for the alternative hypothesis competing against the null of the unit root (Elder & Kennedy, 2001). Besides, trend is important so estimation on unit

[33] Refer Dickey & Fuller (1970; 1981) and Philips & Peron (1988).

root with trend is to be considered first. For that reason, this study followed the technique used by Rapach and Weber (2004).

This study starts with a unit root hypothesis testing in level with trend and intercept. The unit root testing in level with trend and intercept reports only the t-statistic depending on the situation the probability value (p-value) of trend shows level of significance at 1%, 5% and 10%. If the trend is significant, then the test statistic (t-statistic) for unit root null will be reported. Next, the t-statistic has to check for significance level at 1%, 5% or 10% by comparing it with its critical values and if the t-statistic is greater than the critical value[34], then it can be concluded that the series is integrated at order of zero, denoted as $I(0)$. Nonetheless, if the trend is not significant, then this study proceeds to unit root hypothesis testing at level without trend. At the stage of unit root testing at level without trend, this study presents the t-statistic although the t-statistic is not significant. If the t-statistic is significant when compared with its critical values, then it can be concluded that the series is integrated at order of zero, denoted as $I(0)$, otherwise the unit root testing proceeds to the following stage of first difference form to check for stationary properties of the series[35].

At the first differencing stage, the estimation may begin with either intercept or none depending on whether the trend computation is significant in the level estimation or not (Rapach & Weber, 2004). If the results show that the series is integrated at order of zero, denoted as $I(0)$, this implies the series is stationary at $I(0)$. However, if the results

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[34] Computed t-statistic and the critical value are disregarding sign (Gujarati, 2006).
[35] Refer to Rapach& Weber (2004)

show that series is integrated at order of one, denoted as $I(1)$, this involves the series is stationary at $I(1)$. In general, this study proceeds to ARDL approach if the results show that none of the series is integrated at more than order of one. This is because the computed statistics provided by Pesaran et al. (2001) and Narayan (2005) are not appropriate if variable is integrated at order of two, denoted as $I(2)$ (Ang, 2007).

4.1.1.1 Augmented Dickey-Fuller Test Results

As mentioned in Chapter 3, a trend will only be included in the estimation of the ADF test if it significant at 10%. Otherwise, the ADF test will be estimated with intercept only. Note that, the trend component is not included in the ADF test for Indonesian Rupiah and Myanmar Kyat because it is not significant at 10% (the t-statistic of the trend component is not reported here). Having settled with the specification on whether trend needs to be included or not, the ADF test results are reported in Table 4.1, Table 4.2 and Table 4.3 for the three sample periods.

In this case, the study reports the t-statistic of the ADF test is -2.679for the case of Brunei dollar but it is smaller than the critical values of all 10%, 5% and 1% significance level. Thus, the null hypothesis of non-stationary series is not rejected. Then, it continues the estimation at first difference form. The estimation will begin with intercept or none depending on whether the trend computation is significant in the level estimation or not (Rapach & Weber, 2004). For Brunei Dollar, its trend is significant in the level estimation. Therefore, the estimation in first difference form is with intercept. This time

the null hypothesis of non-stationary can be rejected as the t-statistic value of -18.984is greater than the critical value at 1% significance level. Thus, this study concludes that Brunei dollar is stationary at first difference. In other words, its integration order is one, denoted as *I*(1).

For the case of the Cambodian Riel, the trend value is significant at the level form with trend and intercept. The null hypothesis can be rejected at 1% significance level as the t-statistic value of -12.498 is greater than the critical value at 1%. Thus, this study concludes that the Cambodian Riel is stationary at level and shows zero order of integration, which is denoted as *I*(0).

For the case of Indonesian Rupiah, it is not stationary at level. Next, analysis proceeds to first difference form. In the first difference form, the null hypothesis of non-stationary can be rejected because the value of -19.625 is greater than the critical value at the significance value of 1%. So, the Indonesian Rupiah is found to be stationary at first difference and its order of integration is one which is denoted as *I*(1).

This study also estimates the other remaining variables in all pre-crisis, during crisis and post-crisis period using the same principle. As shown in Table 4.2, the Brunei Dollar, the Indonesian Rupiah, the Malaysian Ringgit, the Myanmar Kyat, the Philippines Peso, the Singapore dollar, the Thai Baht, the Vietnamese Dong and the Chinese Renminbi are integrated at order of one, denoted as *I*(1). Meanwhile, the Cambodian Riel and the Lao Kip show an integration order of zero, denoted as *I*(0).

Table 4.1: Results of ADF Unit Root Test for the Pre-Crisis Period

Variables	Level		First difference		Conclusion
	Intercept	Trend &Intercept	Intercept	None	
LNBND	–	-2.68	-18.98***	–	*I*(1)
LNKHR	–	-12.50***	–	–	*I*(0)
LNIDR	-1.74	–	–	-19.63***	*I*(1)
LNLAK	–	-4.29***	–	–	*I*(0)
LNMYR	–	-2.61	-19.77***	–	*I*(1)
LNMMK	-2.51	–	–	-12.63***	*I*(1)
LNPHP	–	-2.20	-25.15***	–	*I*(1)
LNSGD	–	-2.41	-27.70***	–	*I*(1)
LNTHB	–	-1.76	-19.55***	–	*I*(1)
LNVND	–	-2.59	-27.76***	–	*I*(1)
LNRMB	1.95	–	–	-32.74***	*I*(1)

Critical	Level			First Difference			
Value	**10%**	**5%**	**1%**	**10%**	**5%**	**1%**	
LNBND	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNKHR	-3.130	-3.416	-3.970	–	–	–	–
LNIDR	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNLAK	-3.130	-3.416	-3.970	–	–	–	–
LNMYR	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNMMK	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNPHP	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNSGD	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNTHB	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNVND	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNRMB	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. The optimum lag length for ADF unit root test was selected based on Schwarz's Bayesian Criteria (SBC) (Enders, 2003 and Asghar & Abid, 2007). LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

The series during the crisis period is shown in Table 4.2. The results indicate an integration order of one which is denoted as *I*(1) for all currencies except the Myanmar Kyat and the Chinese Renminbi. The Myanmar Kyat and the Chinese Renminbi are integrated at order of zero, denoted as *I*(0).

Table 4.2: Results of ADF Unit Root Test for During Crisis Period

Variables	Level		First difference		Conclusion
	Intercept	Trend &Intercept	Intercept	None	
LNBND	-1.83	–	–	-18.44***	*I*(1)
LNKHR	–	-2.27	-16.07***	–	*I*(1)
LNIDR	-1.32	–	–	-26.99***	*I*(1)
LNLAK	-1.76	–	–	-18.09***	*I*(1)
LNMYR	–	-1.96	-25.78***	–	*I*(1)
LNMMK	–	-16.65***	–	–	*I*(0)
LNPHP	–	-1.94	-27.21***	–	*I*(1)
LNSGD	-1.61	–	–	-21.34***	*I*(1)
LNTHB	-1.67	–	–	-16.70***	*I*(1)
LNVND	–	-2.45	-18.53***	–	*I*(1)
LNRMB	-3.07**	–	–	–	*I*(0)

Critical	Level			First Difference			
Value	10%	5%	1%	10%	5%	1%	
LNBND	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNKHR	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNIDR	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNLAK	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNMYR	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNMMK	-3.130	-3.416	-3.971	–	–	–	–
LNPHP	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNSGD	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNTHB	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNVND	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNRMB	-2.569	-2.865	-3.439	–	–	–	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. The optimum lag length for ADF unit root test was selected based on Schwarz's Bayesian Criteria (SBC) (Enders, 2003 and Asghar & Abid, 2007). LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Table 4.3 reports the ADF test results for the post-crisis period. The Myanmar Kyat and the Philippines Peso are the only two currencies that are integrated at order of zero, *I*(0). The remaining variables are integrated at order of one, *I*(1).

Table 4.3: Results of ADF Unit Root Test for the Post-Crisis Period

Variables	Level		First difference		Conclusion
	Intercept	Trend &Intercept	Intercept	None	
LNBND	-1.34	–	–	-11.02***	*I*(1)
LNKHR	-1.72	–	–	-18.74***	*I*(1)
LNIDR	–	-2.88	-24.00***	–	*I*(1)
LNLAK	–	-2.08	-21.99***	–	*I*(1)
LNMYR	–	-2.30	-25.20***	–	*I*(1)
LNMMK	-6.35***	–	–	–	*I*(0)
LNPHP	–	-3.54**	–	–	*I*(0)
LNSGD	-1.38	–	–	-22.71***	*I*(1)
LNTHB	-1.76	–	–	-3.80***	*I*(1)
LNVND	–	-3.05	-13.02***	–	*I*(1)
LNRMB	–	-2.01	-11.19***	–	*I*(1)

Critical	Level			First Difference			
Value	10%	5%	1%	10%	5%	1%	
LNBND	-2.569	-2.865	-3.438	-1.616	-1.941	-2.568	–
LNKHR	-2.569	-2.865	-3.438	-1.616	-1.941	-2.568	–
LNIDR	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–
LNLAK	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–
LNMYR	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–
LNMMK	-2.569	-2.865	-3.438	–	–	–	–
LNPHP	-3.130	-3.416	-3.970	–	–	–	–
LNSGD	-2.569	-2.865	-3.438	-1.616	-1.941	-2.568	–
LNTHB	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNVND	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–
LNRMB	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. The optimum lag length for ADF unit root test was selected based on Schwarz's Bayesian Criteria (SBC) (Enders, 2003; and Asghar & Abid, 2007). LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

4.1.1.2 Phillips and Perron (PP) Test Results

For the estimation of the PP test, this study applies the same principle that is applied to the estimation of ADF test in deciding as of trend should be included in the estimation or not. This study reports all the PP unit root test results in Table 4.4, Table 4.5 and Table 4.6.Table 4.4 presents the results for the pre-crisis period. It shows that the

variables are some of the variables are integrated at order zero, $I(0)$ and others are integrated of order one, $I(1)$. The variables that are integrated at order of one $I(1)$ are the Indonesian Rupiah, the Philippines Peso, the Singapore dollar, the Thai Baht and the Chinese Renminbi. The rest of the currencies are integrated at order zero, $I(0)$.

Table 4.4: Results of PP Unit Root Test for the Pre-Crisis Period

Variables	Level		First difference		Conclusion
	Intercept	Trend &Intercept	Intercept	None	
LNBND	–	-3.65**	–	–	$I(0)$
LNKHR	–	-27.10***	–	–	$I(0)$
LNIDR	–	-2.31	-26.35***	–	$I(1)$
LNLAK	–	-4.32***	–	–	$I(0)$
LNMYR	–	-13.99***	–	–	$I(0)$
LNMMK	-2.80*	–	–	–	$I(0)$
LNPHP	–	-2.78	-40.51***	–	$I(1)$
LNSGD	–	-2.12	-27.58***	–	$I(1)$
LNTHB	–	-1.36	-22.36***	–	$I(1)$
LNVND	–	-16.33***	–	–	$I(0)$
LNRMB	–	-2.16	-27.80***	–	$I(1)$

Critical	Level			First Difference			
Value	10%	5%	1%	10%	5%	1%	
LNBND	-3.131	-3.416	-3.970	–	–	–	–
LNKHR	-3.131	-3.416	-3.970	–	–	–	–
LNIDR	-3.131	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNLAK	-3.131	-3.416	-3.970	–	–	–	–
LNMYR	-3.130	-3.416	-3.970	–	–	–	–
LNMMK	-2.569	-2.865	-3.439	–	–	–	–
LNPHP	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNSGD	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNTHB	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–
LNVND	-3.130	-3.416	-3.970	–	–	–	–
LNRMB	-3.130	-3.416	-3.970	-2.569	-2.865	-3.439	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Table 4.5 presents the results for the period during crisis and it shows that a majority of the variables are integrated at order of one, $I(1)$, except for the currencies of

the Cambodian Riel, the Myanmar Kyat, the Vietnamese Dong and the Chinese Renminbi, denoted as $I(0)$.

Table 4.5: Results of PP Unit Root Test for During Crisis Period

	Level		First difference		
Variables	**Intercept**	**Trend &Intercept**	**Intercept**	**None**	**Conclusion**
LNBND	-1.62	–	–	-29.28***	$I(1)$
LNKHR	–	-4.26***	–	–	$I(0)$
LNIDR	-1.30	–	–	-27.03***	$I(1)$
LNLAK	–	-1.39	-41.49***	–	$I(1)$
LNMYR	–	-2.15	-38.01***	–	$I(1)$
LNMMK	–	-17.16***	–	–	$I(0)$
LNPHP	–	-1.92	-27.23***	–	$I(1)$
LNSGD	-1.58	–	–	-21.18***	$I(1)$
LNTHB	–	-2.44	-27.64***	–	$I(1)$
LNVND	–	-5.21***	–	–	$I(0)$
LNRMB	-3.07**	–	–	–	$I(0)$

Critical	**Level**			**First Difference**			
Value	**10%**	**5%**	**1%**	**10%**	**5%**	**1%**	
LNBND	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNKHR	-3.130	-3.416	-3.971	–	–	–	–
LNIDR	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNLAK	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNMYR	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNMMK	-3.130	-3.416	-3.971				–
LNPHP	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNSGD	-2.569	-2.865	-3.439	-1.616	-1.941	-2.568	–
LNTHB	-3.130	-3.416	-3.971	-2.569	-2.865	-3.439	–
LNVND	-3.130	-3.416	-3.971	–	–	–	–
LNRMB	-2.569	-2.865	-3.439	–	–	–	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Table 4.6 shows the results for the post-crisis period. The results vary from the results of during crisis where a majority of the variables are integrated at order of zero, denoted as $I(0)$. The remaining currencies that integrated at order of one, $I(1)$, are the

Brunei dollar, the Indonesian Rupiah, the Lao Kip, the Malaysia Ringgit, the Philippines Peso, the Singapore dollar and the Thai Baht.

Table 4.6: Results of PP Unit Root Test for the Post-Crisis Period

Variables	Level		First difference		Conclusion
	Intercept	Trend &Intercept	Intercept	None	
LNBND	–	-3.19*	–	–	*I*(0)
LNKHR	–	-6.14***	–	–	*I*(0)
LNIDR	–	-3.27*	–	–	*I*(0)
LNLAK	–	-10.46***	–	–	*I*(0)
LNMYR	–	-2.75	-31.08***	–	*I*(1)
LNMMK	-20.32***	–	–	–	*I*(0)
LNPHP	–	-3.85**	–	–	*I*(0)
LNSGD	-1.38	–	–	-22.73***	*I*(1)
LNTHB	–	-6.48***	–	–	*I*(0)
LNVND	–	-11.34***	–	–	*I*(0)
LNRMB	–	-2.26	-35.11***	–	*I*(1)

Critical Value	Level			First Difference			
	10%	5%	1%	10%	5%	1%	
LNBND	-3.130	-3.416	-3.970	–	–	–	–
LNKHR	-3.130	-3.416	-3.970	–	–	–	–
LNIDR	-3.130	-3.416	-3.970	–	–	–	–
LNLAK	-3.130	-3.416	-3.970	–	–	–	–
LNMYR	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–
LNMMK	-2.569	-2.865	-3.438	–	–	–	–
LNPHP	-3.130	-3.416	-3.970	–	–	–	–
LNSGD	-2.569	-2.865	-3.438	-1.616	-1.941	-2.568	–
LNTHB	-3.130	-3.416	-3.970	–	–	–	–
LNVND	-3.130	-3.416	-3.970	–	–	–	–
LNRMB	-3.130	-3.416	-3.970	-2.569	-2.865	-3.438	–

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Overall, both the ADF and PP unit root results confirm that variables are integrated of mixed orders *I*(0) and *I*(1). With these findings, this study proceeds to ARDL testing procedures as all variables do not fulfill the requirement of conventional

type of cointegration tests such as Johansen and Juselius (JJ) cointegration test. The reason in adopting ARDL test but not JJ test is because of this study employs bivariate equation to study if the Chinese Renminbi has cointegrating relationship with each of the ASEAN currencies. The key variable of this study (Chinese Renminbi) is found to be *I*(0) during the crisis-period by both the ADF and PP tests. In multivariate equation, *I*(0) variable can be treated as exogenous variable (Asteriou & Hall, 2007). However, this situation is not applicable to bivariate equation whereby if we treat *I*(0) variable as exogenous variable, JJ estimation cannot be carried out as it needs at least two endogenous variables. So, ARDL approach which is readily available for mixed order of *I*(0) and *I*(1) variables is adopted.

4.1.2 Auto-Regressive Distributed Lag (ARDL)

Firstly, this section estimates the bound testing analysis between Chinese Renminbi and each of the ASEAN exchange rates. The null hypothesis postulates that there is no cointegration between the bivariate series. Next, this study estimates the error correction representation of the ARDL approach because it is said to be a more efficient and useful way to determine the cointegration relationship between variables (Bahmani-Oskooee and Wang, 2007; Afzal et al., 2009; and Chowdhury, 2012).

4.1.2.1 Bound Testing Results

This study employs the bound testing procedures to investigate the existence of cointegrating relationship between the Chinese Renminbi with each of the ASEAN currencies. This procedure begins with the estimation of Ordinary Least Squares (OLS) technique and the variable additional test to calculate the F-statistics. Then, this study compares the value of the F-statistics with the critical values tabulated in Table CI(iii)[36] generated by Pesaran et al. (2001) to confirm the existence of cointegration relationship between the variables. After the F-statistics computation, this study evaluates the F-statistics in three types of conditions for cointegration relationships identification among the currencies. The first type of condition is the results of this study which failed to reject the null hypothesis when the value of F-statistic falls under the lower bound critical value. The second type of condition occurs when this study rejects the null hypothesis as the F-statistic value exceeds the upper bound critical value. The third type of condition is the conclusion of inconclusive if the F-statistics value of this study falls between the lower bound and upper bound critical values.

Prior to F-statistics computation, an important step is determining the optimal lag length. There are two common types of model selection criteria which are the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criteria (SBC). According to Enders (2003), and Asghar and Abid (2007), SBC has superior large sample properties however AIC can perform well in small samples in comparison with SBC. Therefore, the choice of lag length is appropriate to be selected using the SBC as this study employs

[36] Case III: Unrestricted intercept and no trend.

large sample size. The selection of optimum lag length generally takes place based on the Hendry's (1995) general-to-specific modeling strategy or the VAR system. Following Pesaran and Pesaran (1997) and Pesaran et al. (2001), this study selects the true lag length from the unrestricted vector autoregression (VAR) system as the large sample size of high frequency series with higher number of variables certainly takes a longer time in obtaining the lag length using the general-to-specific modeling strategy. The selection through VAR model is based on the highest value of the SBC (Pesaran and Pesaran, 1997). The SBC model for lag order is as below:

$$\mathrm{SBC}_{\ell} = \ell_{\mathrm{n}}(\tilde{\theta}) - \frac{1}{2}\mathrm{p}\log \mathrm{n} \qquad (4.1)$$

whereby

p ≡ Dimension (θ) ≡ The number of freely estimated parameters

$\ell_n(\tilde{\theta})$ = the maximised value of the log-likelihood function of the model

n = sample size

The lag order is selected based on the maximum value of SBC as reported in Table 4.7, Table 4.8, and Table 4.9below:

Table 4.7: Lag Length Selection in the Pre-crisis Period for the Case of the Chinese Renminbi with ASEAN Currencies

Order	LNBND	LNKHR	LNIDR	LNLAK	LNMYR	LNMMK	LNPHP	LNSGD	LNTHB	LNVND
24	7145.3	5721.2	6792.1	7289.5	6554.2	7001.3	7072.7	7779.6	7168.3	6482.6
23	7157.4	5733.3	6804.7	7300.9	6566.6	7013.7	7084.9	7791.1	7179.5	6492.8
22	7169.8	5746.1	6817.1	7313.3	6574.0	7025.2	7097.6	7803.2	7191.4	6504.7
21	7180.5	5756.0	6825.5	7321.0	6583.3	7035.3	7107.5	7812.6	7200.2	6515.4
20	7191.9	5705.3	6836.9	7329.0	6589.1	7047.1	7116.9	7822.7	7208.6	6523.1
19	7199.3	5712.2	6845.3	7337.1	6598.4	7054.4	7125.5	7828.9	7216.1	6530.7
18	7210.2	5723.6	6857.2	7349.1	6611.0	7063.2	7137.9	7840.3	7225.9	6542.2
17	7218.9	5736.7	6866.5	7360.7	6620.7	7073.0	7145.6	7849.9	7237.5	6553.5
16	7231.4	5748.8	6877.9	7372.3	6633.4	7085.5	7156.5	7862.3	7249.5	6565.6
15	7243.9	5760.3	6890.1	7383.4	6643.6	7092.1	7167.4	7874.0	7261.2	6577.2
14	7255.8	5770.8	6900.0	7395.0	6654.9	7099.9	7179.0	7884.6	7266.8	6589.5
13	7267.9	5783.1	6911.2	7407.3	6664.7	7111.5	7190.5	7896.6	7279.3	6591.6
12	7278.3	5791.1	6921.0	7418.7	6672.5	7085.3	7201.1	7907.8	7286.0	6594.1
11	7288.8	5802.3	6933.8	7429.8	6685.1	7097.1	7214.2	7917.8	7298.1	6606.5
10	7298.1	5814.1	6945.5	7440.6	6695.9	7106.4	7224.0	7928.9	7309.3	6618.5
9	7309.4	5824.1	6956.1	7451.9	6707.3	7114.5	7234.6	7939.3	7314.4	6629.8
8	7319.9	5833.7	6966.9	7464.9	6717.2	7126.8	7246.6	7950.7	7326.6	6640.5
7	7330.6	5843.1	6975.1	7475.4	**6727.8**	7137.9	7254.1	7959.6	7337.3	**6649.6**
6	7343.2	5853.3	6987.0	7488.1	6725.9	7148.5	7265.4	7970.5	7346.7	6594.5
5	**7349.9**	5858.0	6994.8	7494.2	6716.3	7154.7	7272.4	7978.2	7353.7	6549.1
4	7349.5	5866.8	7006.1	7504.5	6721.4	**7162.3**	7283.0	7989.3	7359.6	6551.3
3	7347.6	5874.6	7003.3	7513.0	6722.2	7144.9	**7287.7**	7999.3	**7368.3**	6557.1
2	7347.8	5874.6	7004.0	7514.2	6704.3	7146.6	7282.6	7999.4	7364.1	6532.9
1	7346.5	**5877.8**	**7014.2**	**7518.0**	6668.8	7154.9	7259.3	**8003.7**	7357.6	6539.2
0	3709.2	3296.2	3196.8	4208.2	3893.7	3553.5	3657.8	3685.3	3627.3	3707.1

Notes: Order is the number of lags used in VAR system. The bolded number is the largest value of SBC. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht and VND=the Vietnamese Dong.

Table 4.8: Lag Length Selection during the Crisis Period for the Case of the Chinese Renminbi with ASEAN Currencies

Order	LNBND	LNKHR	LNIDR	LNLAK	LNMYR	LNMMK	LNPHP	LNSGD	LNTHB	LNVND
24	6441.8	6382.5	5996.5	6586.4	6210.0	6670.7	6457.0	6772.6	6238.2	6196.5
23	6453.7	6393.9	6008.9	6596.9	6218.6	6681.8	6467.3	6785.3	6250.5	6207.3
22	6464.1	6404.9	6018.2	6602.2	6230.4	6687.4	6477.0	6795.6	6260.1	6210.6
21	6474.1	6416.3	6023.4	6613.8	6241.5	6699.3	6481.9	6805.8	6266.3	6220.4
20	6486.6	6427.5	6036.5	6626.5	6252.0	6709.0	6494.3	6818.8	6279.0	6228.6
19	6494.3	6437.9	6048.4	6637.2	6262.7	6719.2	6504.7	6828.2	6289.2	6238.5
18	6505.3	6450.1	6056.2	6649.1	6274.1	6728.5	6515.4	6838.8	6301.6	6249.2
17	6517.2	6462.0	6069.1	6661.9	6285.2	6741.5	6528.0	6850.3	6311.5	6260.8
16	6527.3	6472.7	6081.1	6671.1	6297.0	6752.8	6539.6	6861.8	6324.4	6272.0
15	6539.5	6484.8	6091.4	6683.6	6309.5	6765.2	6552.4	6873.9	6337.2	6284.2
14	6551.5	6495.0	6102.5	6693.8	6318.8	6774.8	6563.2	6885.8	6346.2	6294.1
13	6564.3	6507.5	6114.5	6705.3	6328.3	6786.4	6574.8	6898.5	6358.0	6306.8
12	6576.7	6517.4	6125.1	6717.1	6341.1	6798.3	6584.5	6911.3	6359.9	6319.0
11	6587.9	6526.7	6138.1	6729.5	6350.8	6811.2	6595.8	6923.2	6369.0	6330.1
10	6596.7	6536.3	6149.9	6740.7	6362.1	6823.1	6606.5	6933.2	6371.5	6341.5
9	6609.0	6547.9	6161.0	6752.7	6371.6	6835.5	6615.3	6943.9	6382.4	6351.7
8	6621.1	6558.0	6171.1	6764.5	6383.8	6847.5	6626.5	6955.6	6394.4	6361.5
7	6633.3	6570.2	6180.2	6776.4	6392.4	6859.1	6637.7	6967.5	6398.7	6373.5
6	6643.9	6577.7	6190.6	6786.9	6403.8	6870.7	6648.2	6978.4	6409.1	6372.9
5	6655.6	6586.8	6202.3	6793.3	6412.3	6879.2	6660.1	6990.4	6405.8	6379.0
4	6666.7	6588.9	6214.5	**6800.8**	6423.0	6890.9	6671.0	7002.4	6409.5	**6382.3**
3	6674.6	**6597.7**	6222.3	6799.8	**6431.8**	6900.8	6680.5	7014.1	6420.7	6368.5
2	6682.5	6592.6	6233.5	6791.3	6429.8	6912.2	6689.1	**7023.4**	6417.8	6368.2
1	**6689.4**	6596.3	**6241.4**	6793.1	6412.3	**6923.5**	**6701.2**	7018.8	**6430.8**	6343.5
0	2687.8	3192.1	2142.4	3796.3	2574.5	4324.7	2482.2	2693.7	2774.8	2903.2

Notes: Order is the number of lags used in VAR system. The bolded number is the largest value of SBC. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht and VND=the Vietnamese Dong.

Table 4.9: Lag Length Selection in the Post-crisis Period for the Case of the Chinese Renminbi with ASEAN Currencies

Order	LNBND	LNKHR	LNIDR	LNLAK	LNMYR	LNMMK	LNPHP	LNSGD	LNTHB	LNVND
24	6832.6	6569.2	6772.4	6662.6	6686.7	7153.1	6783.8	7322.4	7218.9	6460.8
23	6843.9	6580.6	6784.3	6673.9	6697.7	7163.5	6794.9	7334.1	7227.6	6471.6
22	6855.0	6592.2	6794.8	6686.0	6706.8	7172.9	6807.2	7341.1	7237.1	6482.6
21	6865.0	6598.5	6801.2	6695.9	6700.2	7183.7	6815.6	7350.5	7221.4	6490.3
20	6875.9	6609.9	6811.7	6708.4	6711.3	7189.1	6823.0	7360.6	7226.4	6500.6
19	6887.1	6622.1	6823.9	6713.6	6723.5	7202.3	6834.4	7373.1	7234.6	6511.5
18	6899.0	6633.9	6836.2	6724.0	6736.2	7213.8	6846.8	7381.3	7247.4	6523.0
17	6910.2	6646.8	6847.0	6737.0	6749.1	7224.8	6859.8	7393.6	7256.0	6534.9
16	6922.8	6659.9	6859.8	6748.9	6760.8	7237.4	6869.9	7405.1	7268.3	6547.8
15	6933.0	6671.8	6871.8	6758.3	6771.5	7247.9	6881.1	7414.6	**7278.1**	6559.1
14	6945.1	6678.0	6882.7	6769.9	6781.2	7256.5	6889.3	7424.7	7219.9	6566.4
13	6958.2	6690.0	6893.9	6781.5	6793.7	7268.8	6901.6	7437.1	7231.8	6578.0
12	6969.0	6701.3	6906.6	6790.9	6797.8	7281.0	6912.5	7444.5	7229.8	6590.9
11	6979.6	6713.0	6918.9	6800.8	6810.2	7291.9	6921.8	7455.9	7235.3	6601.7
10	6989.3	6723.4	6930.0	6811.8	6821.5	7299.6	6932.7	7464.0	7245.6	6611.7
9	7000.2	6733.3	6940.1	6821.8	6832.6	7309.1	6944.2	7475.3	7255.5	6622.2
8	7013.4	6746.0	6952.8	6833.4	6845.3	7320.8	6955.9	7488.1	7261.8	6634.7
7	7000.6	6750.0	6952.4	**6834.3**	6840.4	7326.0	6957.3	7485.0	7033.2	6633.6
6	7001.0	6747.0	6957.8	6825.5	6846.3	7303.3	6962.2	7492.3	6991.6	6637.2
5	7007.6	6752.7	6967.3	6807.1	6853.3	7308.5	6973.2	7499.6	6820.5	6645.1
4	7018.7	**6753.6**	6973.7	6806.6	6860.9	7320.7	6985.1	7509.9	6793.2	**6652.4**
3	**7023.2**	6747.7	6980.4	6801.5	**6864.4**	7322.2	6991.7	7511.4	6799.5	6644.7
2	7014.3	6738.2	6975.7	6785.3	6852.4	7328.6	**6996.7**	**7515.1**	6729.6	6612.2
1	7004.2	6703.4	**6982.6**	6759.7	6859.8	**7336.8**	6989.5	7505.1	6734.7	6559.4
0	3987.7	3985.7	3623.4	3915.0	3467.6	5072.1	3737.0	3984.6	3557.5	3606.3

Notes: Order is the number of lags used in VAR system. The bolded number is the largest value of SBC. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht and VND=the Vietnamese Dong.

Table 4.10 shows ARDL bound test results for pre-crisis period among the ASEAN currencies with the Chinese Renminbi. The second row of Table 4.10 presents the lag length for each regression. This study obtains the results by rotating the variables both as dependent and independent variable to ensure the robustness of the purpose of the study. The results showed that there are unique cointegrating relationships between the Chinese Renminbi and the Cambodian Riel when the Cambodian Riel is a dependent variable. In this case, the forcing variable is the Chinese Renminbi. The computed F-statistic of 129.99 showed a higher value compared to the upper bound critical value of 7.84. This denotes that cointegration exists between the Cambodian Riel and the Chinese Renminbi at 1% significance level. This rejects the null hypothesis of no cointegration relationship and it confirms that the Cambodian Riel and the Chinese Renminbi have a cointegration relationship when Cambodian Riel becomes the dependent variable. This result indicates that the Chinese Renminbi is the forcing variable that moves first when a common stochastic shock hits the system. Then, the Cambodian Riel follows the changes in the Chinese Renminbi. However, the computed F-statistic of 1.98 falls under the lower bound critical value when the Chinese Renminbi becomes the dependent variable. This indicates the results are insignificant and fail to reject the null hypothesis of no cointegration relationship. Hence, there is no cointegration relationship between the Chinese Renminbi and the Cambodian Riel when the Chinese Renminbi is a dependent variable.

The outcome between the Cambodian Riel and the Chinese Renminbi are similar to the results between the Thai Baht and the Chinese Renminbi when the Thai Baht is

fixed as dependent variable. The null hypothesis is rejected at 1% level of significance. This is due to the computed F-statistic of 8.91 is higher than the upper bound critical value of 1% level of significance. Cointegration relationship exists between the variables when the Thai Baht is the dependent variable and the Chinese Renminbi is the forcing variable. In this case, the Thai Baht follows the changes in the Chinese Renminbi because this currency as a forcing variable moves first when a common stochastic shock hits the system. On the other hand, there is no cointegration relationship when the Chinese Renminbi becomes the dependent variable because the null hypothesis is not rejected. The computed F-statistic of 2.79 is below the lower bound critical value.

Next, this study discovers another set of cointegration relationships exist between the Chinese Renminbi and the Lao Kip when both variables are rotated as dependent and independent variables respectively. When the Lao Kip is dependent variable, the computed F-statistic of 12.02 shows a higher value as compared to the upper bound critical value of 7.84 at the 1% level of significance. This rejects the null hypothesis of no cointegration relationship and it confirms that the Lao Kip and the Chinese Renminbi have a cointegration relationship. Similarly, when the dependent variable is the Chinese Renminbi, the value of F-statistic is 9.32 is higher than the upper bound critical value at the 1% level of significance. This confirms the rejection of null hypothesis and there is a cointegration relationship among the variables. These two conditions show that both the Lao Kip and the Chinese Renminbi are forcing influencing each other. The currencies follow each other's changes as they move together when a common stochastic shock hits the system.

Moreover, the result between Chinese Renminbi and the Malaysian Ringgit also indicates a unique cointegrating relationship when the Chinese Renminbi becomes the dependent variable. The results are confirmed by rejecting the null hypothesis of no cointegration relationship when the computed F-statistic of 5.13 is higher than the upper bound critical value at 10% level of significance. Nevertheless, when the Malaysian Ringgit becomes a dependent variable, the result shows no cointegration relationship as the value of F-statistic falls below the lower bound critical value of all 1%, 5% and 10% level of significance. Thus the results fail to reject the null hypothesis. This finding shows the same result between the Chinese Renminbi and the Vietnamese Dong. The cointegration is found when the Chinese Renminbi becomes a dependent variable. The results are confirmed by rejecting the null hypothesis at the 10% level of significance. Conversely, when the Vietnamese Dong becomes the dependent variable, the result shows no cointegration relationship. This is because the computed F-statistic falls below the lower bound critical value. Thus, the results fail to reject the null hypothesis at 1%, 5% and 10% level of significance. In these two cases, both the Malaysian Ringgit and the Vietnamese Dong are forcing variables for the Chinese Renminbi. These two currencies will move first when a common stochastic shock hits the system. Therefore, the Chinese Renminbi follows the changes in the Malaysian Ringgit and the Vietnamese Dong.

Table 4.10: Results of Bound-testing between the Chinese Renminbi with ASEAN Currencies in the Pre-Crisis Period

Cointegration hypothesis	Optimum Lag Length (SBC)	F-statistic	Conclusion
Brunei dollar with Renminbi			
$F(LNBND_t\|LNRMB_t)$	5	1.08	Do not reject H_0
$F(LNRMB_t\|LNBND_t)$	5	4.01	Do not reject H_0
Cambodian Riel with Renminbi			
$F(LNKHR_t\|LNRMB_t)$	1	129.99	Reject H_0
$F(LNRMB_t\|LNKHR_t)$	1	1.98	Do not reject H_0
Indonesian rupiah with Renminbi			
$F(LNIDR_t\|LNRMB_t)$	1	2.90	Do not reject H_0
$F(LNRMB_t\|LNIDR_t)$	1	0.24	Do not reject H_0
Lao Kip with Renminbi			
$F(LNLAK_t\|LNRMB_t)$	1	12.02	Reject H_0
$F(LNRMB_t\|LNLAK_t)$	1	9.32	Reject H_0
Malaysian Ringgit with Renminbi			
$F(LNMYR_t\|LNRMB_t)$	7	3.13	Do not reject H_0
$F(LNRMB_t\|LNMYR_t)$	7	5.13	Reject H_0
Myanmar Kyat with Renminbi			
$F(LNMMK_t\|LNRMB_t)$	4	3.43	Do not reject H_0
$F(LNRMB_t\|LNMMK_t)$	4	2.80	Do not reject H_0
The Philippines Peso with Renminbi			
$F(LNPHP_t\|LNRMB_t)$	3	2.04	Do not reject H_0
$F(LNRMB_t\|LNPHP_t)$	3	2.31	Do not reject H_0
Singapore dollar with Renminbi			
$F(LNSGD_t\|LNRMB_t)$	1	0.58	Do not reject H_0
$F(LNRMB_t\|LNSGD_t)$	1	0.61	Do not reject H_0
Thai Baht with Renminbi			
$F(LNTHB_t\|LNRMB_t)$	3	8.91	Reject H_0
$F(LNRMB_t\|LNTHB_t)$	3	2.79	Do not reject H_0
Vietnamese Dong with Renminbi			
$F(LNVND_t\|LNRMB_t)$	7	2.76	Do not reject H_0
$F(LNRMB_t\|LNVND_t)$	7	5.12	Reject H_0

Notes: The critical values are obtained from Pesaran, et al. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend. The critical values are 4.04-4.78, 4.94-5.73, and 6.84-7.84 for 10%, 5%, and 1% significance level, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

On the other hand, the results failed to reject the null hypothesis of no cointegration relationship for the case of the Chinese Renminbi with the Brunei dollar, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Singapore dollar.

This is because the value of F-statistic falls below the lower bound critical value although this study rotates both of the Chinese Renminbi and ASEAN currencies (the Brunei dollar, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Singapore dollar) as a dependent variable. Consequently, the result showed no cointegration relationship between the variables.

Table 4.11 shows the bound testing results for the period during crisis between the Chinese Renminbi with the ASEAN currencies. The results revealed that there are unique cointegrating relationships between the Brunei dollar, the Cambodian Riel, the Indonesian Rupiah, the Malaysian Ringgit, the Philippines Peso, the Singapore dollar and the Vietnamese Dong with the Chinese Renminbi when the Chinese Renminbi is the dependent variable. The computed F-statistic exceeds the upper bound critical value. This indicates that the Brunei dollar, the Cambodian Riel, the Indonesian Rupiah, the Malaysian Ringgit, the Philippines Peso, the Singapore dollar and the Vietnamese Dong are the forcing variables. When a common stochastic shock hits the system, these seven ASEAN currencies will move first and therefore, the Chinese Renminbi is said to follow the changes in these seven ASEAN currencies. Nonetheless, when these ASEAN currencies are rotated as a dependent variable, they showed no cointegration relationship with the Chinese Renminbi as the computed F-statistic falls under the lower bound critical value.

Table 4.11: Results of Bound-testing between the Chinese Renminbi with ASEAN Currencies during Crisis Period

Cointegration hypothesis	Optimum Lag Length (SBC)	F-statistic	Conclusion
Brunei dollar with Renminbi			
$F(LNBND_t \mid LNRMB_t)$	1	2.42	Do not reject H_0
$F(LNRMB_t \mid LNBND_t)$	1	7.67	Reject H_0
Cambodian Riel with Renminbi			
$F(LNKHR_t \mid LNRMB_t)$	3	3.61	Do not reject H_0
$F(LNRMB_t \mid LNKHR_t)$	3	10.85	Reject H_0
Indonesian Rupiah with Renminbi			
$F(LNIDR_t \mid LNRMB_t)$	1	1.48	Do not reject H_0
$F(LNRMB_t \mid LNIDR_t)$	1	6.36	Reject H_0
Lao kip with Renminbi			
$F(LNLAK_t \mid LNRMB_t)$	4	6.11	Reject H_0
$F(LNRMB_t \mid LNLAK_t)$	4	6.91	Reject H_0
Malaysian Ringgit with Renminbi			
$F(LNMYR_t \mid LNRMB_t)$	3	2.68	Do not reject H_0
$F(LNRMB_t \mid LNMYR_t)$	3	9.07	Reject H_0
Myanmar Kyat with Renminbi			
$F(LNMMK_t \mid LNRMB_t)$	1	113.50	Reject H_0
$F(LNRMB_t \mid LNMMK_t)$	1	6.54	Reject H_0
The Philippines Peso with Renminbi			
$F(LNPHP_t \mid LNRMB_t)$	1	3.76	Do not reject H_0
$F(LNRMB_t \mid LNPHP_t)$	1	8.44	Reject H_0
Singapore dollar with Renminbi			
$F(LNSGD_t \mid LNRMB_t)$	2	2.44	Do not reject H_0
$F(LNRMB_t \mid LNSGD_t)$	2	8.32	Reject H_0
Thai Baht with Renminbi			
$F(LNTHB_t \mid LNRMB_t)$	1	5.09	Reject H_0
$F(LNRMB_t \mid LNTHB_t)$	1	7.35	Reject H_0
Vietnamese Dong with Renminbi			
$F(LNVND_t \mid LNRMB_t)$	4	2.54	Do not reject H_0
$F(LNRMB_t \mid LNVND_t)$	4	9.67	Reject H_0

Notes: The critical values are obtained from Pesaran, et al. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend. The critical values are 4.04-4.78, 4.94-5.73, and 6.84-7.84 for 10%, 5%, and 1% significance level, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

For the remaining variables which included the Lao Kip, the Myanmar Kyat and the Thai Baht, the results showed that the values of F-statistics are higher than the upper bound critical value of 1%, 5% and 10% although this study rotates the variables to become dependent and independent variables. Thus, it confirms the cointegration

relationship between these three variables with the Chinese Renminbi by rejecting the null hypothesis. In this case, the three ASEAN currencies and the Chinese Renminbi are the forcing variable for each other in which they move together when a common stochastic shock hit the system. Hence, they follow each other's changes in the exchange rate.

Table 4.12 shows the bound testing results for the post-crisis period between the Chinese Renminbi with the ASEAN currencies. Result points out that the Cambodian Riel has a cointegration relationship with the Chinese Renminbi when the Cambodian Riel is the dependent variable. The computed F-statistics is higher than the critical value at 10% level of significance. In this case, the Chinese Renminbi is the forcing variable that moves first when a common stochastic shock hits the system. However, the Cambodian Riel follows the changes in the Chinese Renminbi. When the regression rotates the Chinese Renminbi as a dependent variable, the result fails to reject the null hypothesis. Moreover, the Chinese Renminbi and the Myanmar Kyat also showed a unique cointegrating relationship when both variables rotated to become the dependent variable. The computed F-statistic is higher than the critical value. So, both of the currencies are the forcing variable for each other where they move at the same time when a common stochastic hits the system. As a result, the two currencies follow the change of each other. For the remaining regressions, the computed F-statistic is falls under the lower bound critical value at 10% level of significance. This implies that the result do not show any cointegration relationship between the Chinese Renminbi and the remaining currencies.

Table 4.12: Results of Bound-testing between the Chinese Renminbi with ASEAN Currencies in the Post-Crisis Period

Cointegration hypothesis	Optimum Lag Length (SBC)	F-statistic	Conclusion
Brunei dollar with Renminbi			
$F(LNBND_t \mid LNRMB_t)$	3	0.99	Do not reject H_0
$F(LNRMB_t \mid LNBND_t)$	3	1.95	Do not reject H_0
Cambodian Riel with Renminbi			
$F(LNKHR_t \mid LNRMB_t)$	4	5.00	Reject H_0
$F(LNRMB_t \mid LNKHR_t)$	4	0.44	Do not reject H_0
Indonesian Rupiah with Renminbi			
$F(LNIDR_t \mid LNRMB_t)$	1	4.02	Do not reject H_0
$F(LNRMB_t \mid LNIDR_t)$	1	0.97	Do not reject H_0
Lao Kip with Renminbi			
$F(LNLAK_t \mid LNRMB_t)$	7	0.76	Do not reject H_0
$F(LNRMB_t \mid LNLAK_t)$	7	2.06	Do not reject H_0
Malaysian Ringgit with Renminbi			
$F(LNMYR_t \mid LNRMB_t)$	3	1.55	Do not reject H_0
$F(LNRMB_t \mid LNMYR_t)$	3	2.54	Do not reject H_0
Myanmar Kyat with Renminbi			
$F(LNMMK_t \mid LNRMB_t)$	1	148.05	Reject H_0
$F(LNRMB_t \mid LNMMK_t)$	1	6.08	Reject H_0
The Philippines Peso with Renminbi			
$F(LNPHP_t \mid LNRMB_t)$	2	2.54	Do not reject H_0
$F(LNRMB_t \mid LNPHP_t)$	2	1.78	Do not reject H_0
Singapore dollar with Renminbi			
$F(LNSGD_t \mid LNRMB_t)$	2	2.01	Do not reject H_0
$F(LNRMB_t \mid LNSGD_t)$	2	2.87	Do not reject H_0
Thai Baht with Renminbi			
$F(LNTHB_t \mid LNRMB_t)$	15	1.14	Do not reject H_0
$F(LNRMB_t \mid LNTHB_t)$	15	3.61	Do not reject H_0
Vietnamese Dong with Renminbi			
$F(LNVND_t \mid LNRMB_t)$	4	1.63	Do not reject H_0
$F(LNRMB_t \mid LNVND_t)$	4	3.15	Do not reject H_0

Notes: The critical value are obtained from Pesaran, et al. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend. The critical value is 4.04-4.78, 4.94-5.73, and 6.84-7.84 for 10%, 5%, and 1% significance level, respectively. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

In sum, there are five ASEAN currencies that have a cointegrating relationship with the Chinese Renminbi for the pre-crisis period namely the Cambodian Riel, Lao Kip, Ringgit Malaysia, Thai Baht and Vietnamese Dong. All the ASEAN currencies have a

cointegration relationship with the Chinese Renminbi during the crisis period and there are two of the ASEAN currencies namely the Cambodian Riel and Myanmar Kyat have a cointegration relationship with the Chinese Renminbi for the post-crisis period. Overall, the cointegrating relationship between the ASEAN currencies with the Chinese Renminbi is considered weak especially in the post-crisis period. Therefore, this study will extend to error correction representation to obtain the EC_t value. This is because the error correction representation value is more efficient and is a useful way to determine the cointegration between variables (Bahmani-Oskooee and Wang, 2007; Afzal et al., 2009; and Chowdhury, 2012).

4.1.2.2 Error Correction Representation of ARDL Test Results

The error correction representation of ARDL test is conducted to obtain the EC_tvalue is presented in Table 4.13. A negative and significant EC_t indicates the speed of adjustment for variables to return to long run equilibrium. Higher and lower EC_t coefficient value denotes a faster and slower adjustment process to equilibrium, respectively.

Table 4.13presents the coefficient of EC_t value between the Chinese Renminbi with each of the ASEAN currencies in pre-crisis, during crisis and post-crisis period. In the pre-crisis period, there are nine ASEAN currencies that showed an EC_t coefficient in a negative sign as expected and it has a statistically significant relationship with the Chinese Renminbi. The EC_t coefficient suggests that a deviation from the long run

equilibrium level of each of the ASEAN currencies is corrected by 1%, 87%, 1%, 7%, 9%, 2%, 2%, 3% and 5% in the following year to the Brunei dollar, the Cambodian Riel, the Indonesian Rupiah, the Lao Kip, the Malaysian Ringgit, the Myanmar Kyat, the Philippines Peso, the Thai Baht and the Vietnamese Dong, respectively. Among all the ASEAN currencies, the relatively high EC_t coefficients of -0.87 for the Cambodian Riel showed the fastest adjustment process. At the same time, the EC_t coefficient implies that there is a negative but statistically insignificant relationship between the Chinese Renminbi with the Singapore dollar.

Table 4.13: Summary of Error Correction Representation (EC_t) of ARDL Test between the Chinese Renminbi with ASEAN Currencies in Three Sample Periods

Dependent variable	Coefficient		
	Pre-crisis	During crisis	Post-crisis
ΔLNBND	-0.01*	-0.01**	-0.01
ΔLNKHR	-0.87***	-0.03***	-0.07***
ΔLNIDR	-0.01**	-0.01*	-0.02***
ΔLNLAK	-0.07***	-0.07***	-0.02
ΔLNMYR	-0.09***	-0.01**	-0.01
ΔLNMMK	-0.02**	-0.56***	-0.67***
ΔLNPHP	-0.02**	-0.01**	-0.02***
ΔLNSGD	-0.01	-0.01**	0.01
ΔLNTHB	-0.03***	-0.02***	-0.01
ΔLNVND	-0.05*	-0.02**	-0.02*

Note: Asterisks (***), (**), and (*) indicate statistically significant at the 1%, 5%, and 10% significance levels, respectively. ΔLN denotes natural logged difference and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht and VND=the Vietnamese Dong.

In the during crisis period, Table 4.13presents the coefficient of EC_t value between the Chinese Renminbi with the ASAEN currencies in the third column. The result shows that all the ASEAN countries have a negative sign as expected and has a statistically significant relationship. Convergence to equilibrium from the deviation by

each of the ASEAN currencies after a shock are 1%, 3%, 1%, 7%, 1%, 56%, 1%, 1%, 2% and 2% to the Brunei dollar, the Cambodian Riel, the Indonesian Rupiah, the Lao Kip, the Malaysian Ringgit, the Myanmar Kyat, the Philippines Peso, the Thai Baht, the Singapore dollar and the Vietnamese Dong, respectively. The relatively high EC_t coefficients of the Myanmar Kyat showed the fastest adjustment process among the ASEAN currencies.

According to the last column in the Table 4.13, the coefficients of EC_t value between the Chinese Renminbi with the ASEAN currencies in the post-crisis period are reported. The result showed that only half of the ASEAN currencies show the EC_t coefficient has a correct negative sign as expected and it is statistically significance. Convergence to equilibrium in response to the disequilibrium of those five ASEAN currencies after a shock are 7%, 2%, 67%, 2%, 2% to the Cambodian Riel, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Vietnamese Dong, respectively. The relatively high EC_t coefficients of the Myanmar Kyat show the fastest adjustment process among the ASEAN currencies. For the remaining currencies, the EC_t coefficient of the Brunei dollar, the Lao Kip, the Malaysian Ringgit and the Thai Baht showed the expected negative sign but statistically insignificant. The Singapore dollar however does not show the right negative sign of EC_t coefficient and it is not statistically significant as well.

The results for pre-crisis period suggested that the Chinese Renminbi has a cointegrating relationship with all of the ASEAN currencies excluding the Singapore

dollar. During the crisis period, the Chinese Renminbi showed a cointegrating relationship with all of the ASEAN currencies. In the post-crisis period, there are only five ASEAN currencies that maintained its relationship with Chinese Renminbi namely, the Cambodian Riel, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Vietnamese Dong.

In summary, the Chinese Renminbi has a consistent cointegrating relationship with the Cambodian Riel, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Vietnamese Dong across all periods according to the error correction representation of the ARDL test results.

4.1.2.3 Diagnostic Analysis for ARDL Model

Before proceed to error correction representation of ARDL test, the diagnostic test is conducted in order to ascertain the goodness of fit for the ARDL model. The diagnostic tests that have been applied in this study included the Breusch-Godfrey serial correlation Lagrange Multiplier (LM) test, the Ramsey RESET functional form, the Jarque-Bera (JB) normality test, and the white heteroscedasticity test. The results are presented in Table 4.14 for serial correlation checking, Table 4.15 for the functional form checking, Table 4.16 for normality checking and Table 4.17 for heteroscedasticity checking.

The LM test investigates the serial correlation with the null hypothesis of no autocorrelation problem. In pre-crisis, the null hypothesis that can be rejected comprised

of the models between the Cambodian Riel, the Indonesian Rupiah, the Lao Kip, the Singapore dollar and the Thai Baht with the Chinese Renminbi. For the crisis period, there are also some models that can be rejected in the null hypothesis which included the Brunei dollar, the Cambodian Riel, the Lao Kip, the Malaysian Ringgit, the Myanmar Kyat and the Vietnamese Dong with the Chinese Renminbi. In the post-crisis period, the null hypothesis can be rejected for the models between the Cambodian Riel, Malaysian Ringgit, the Philippines Peso, the Singapore dollar and the Vietnamese Dong with the Chinese Renminbi.

Table 4.14: Serial Correlation checking for ARDL model in Three Sample Periods

	Pre-crisis	During crisis	Post-crisis
Independent variable: LNRMB			
LNBND	1.26[0.26]	5.69 [0.02]	2.28 [0.13]
LNKHR	10.88 [0.00]	4.26 [0.04]	10.05 [0.00]
LNIDR	4.03 [0.05]	0.00 [0.95]	0.05 [0.82]
LNLAK	17.02 [0.00]	7.57 [0.01]	2.17 [0.14]
LNMYR	0.75 [0.39]	3.64 [0.06]	5.06 [0.02]
LNMMK	0.77 [0.38]	3.11 [0.08]	0.24 [0.63]
LNPHP	0.00 [0.98]	0.21 [0.65]	6.52 [0.01]
LNSGD	4.61 [0.03]	1.64 [0.20]	3.42 [0.07]
LNTHB	2.87 [0.09]	0.34 [0.56]	1.79 [0.18]
LNVND	1.08 [0.30]	15.96 [0.00]	6.77 [0.01]

Notes: The figures in the bracket [...] refer to the p-value. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

The Ramsey RESET test is to reveal the misspecification problems with the null hypothesis of no misspecification problem. Based on the diagnostic result in Table 4.15, the null hypothesis can be rejected for some of the model. In the pre-crisis period, the model that can be rejected included the Cambodian Riel, the Lao Kip, the Myanmar Kyat and the Philippines Peso with the Chinese Renminbi. For the period during the crisis, the model that can be rejected are the Cambodian Riel, the Lao Kip. In the post-crisis period,

only the model of the Lao Kip with both of the Chinese Renminbi can be rejected. According to Hsieh (1988), the problem of misspecification will occur when the series is not normally distributed. Therefore, the next diagnostic checking is on the normality problem.

Table 4.15: Functional Form checking for ARDL Model in Three Sample Periods

	Pre-crisis	During crisis	Post-crisis
Independent variable: LNRMB			
LNBND	0.72[0.40]	1.19 [0.28]	0.54 [0.46]
LNKHR	5.954 [0.01]	2.74 [0.10]	2.28 [0.13]
LNIDR	0.11 [0.74]	0.23 [0.63]	2.61 [0.11]
LNLAK	7.19 [0.01]	15.44 [0.00]	9.78 [0.00]
LNMYR	1.93 [0.16]	4.54 [0.03]	0.03 [0.85]
LNMMK	38.58 [0.00]	1.72[0.07]	0.43[0.51]
LNPHP	4.71 [0.03]	2.37 [0.12]	1.12 [0.29]
LNSGD	1.18 [0.28]	0.97 [0.33]	0.00 [0.96]
LNTHB	0.27 [0.61]	1.35 [0.25]	0.29 [0.59]
LNVND	1.84 [0.18]	2.84 [0.09]	1.20 [0.27]

Notes: The figures in the bracket [...] refer to the p-value. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Table 4.16: Normality checking for ARDL Model in Three Sample Periods

	Pre-crisis	During crisis	Post-crisis
Independent variable: LNRMB			
LNBND	969.75 [0.00]	520.29 [0.00]	212.43 [0.00]
LNKHR	4340595.00 [0.00]	859.91 [0.00]	537.31[0.00]
LNIDR	103507.10 [0.00]	7130.65 [0.00]	852.44 [0.00]
LNLAK	3173.83 [0.00]	880.21 [0.00]	92.28 [0.00]
LNMYR	5682.52 [0.00]	269.79 [0.00]	750.89 [0.00]
LNMMK	541229.60 [0.00]	1845.59 [0.00]	3086.25 [0.00]
LNPHP	78236.78 [0.00]	234.09 [0.00]	1339.58 [0.00]
LNSGD	14476.23 [0.00]	518.79 [0.00]	1413.26 [0.00]
LNTHB	744.83 [0.00]	38761.29 [0.00]	323.30 [0.00]
LNVND	129.22 [0.00]	677.36 [0.00]	8486.51 [0.00]

Notes: The figures in the bracket [...] refer to the p-value. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

The JB test is to examine the normality problem of the model with the null hypothesis of no normality problem. The result in Table 4.16 indicates that the entire model in the pre-crisis period, during crisis period and the post-crisis period can be rejected at 1 percent level of significance. This may be due to the exchange rates in this study which are not normally distributed, like many other exchange rates. There are numerous studies which showed that the exchange rate variables are not normally distributed such as Friedman and Vandersteel (1982); Boothe and Glassman (1987); Hsieh (1988); and Coppes (1995). Boothe and Glasaman (1987) stated that non-normality of exchange rates will probably not be a problem in the estimation of exchange rate model.

Table 4.17: Heteroscedasticity checking for ARDL Model in Three Sample Periods

	Pre-crisis	During crisis	Post-crisis
Independent variable: LNRMB			
LNBND	92.20 [0.00]	27.46 [0.00]	23.73 [0.00]
LNKHR	1.36 [0.85]	41.97 [0.00]	28.41 [0.00]
LNIDR	6.34 [0.10]	16.90 [0.00]	14.97 [0.00]
LNLAK	14.80 [0.02]	29.79 [0.00]	72.76 [0.00]
LNMYR	49.62 [0.00]	76.69 [0.00]	55.45 [0.00]
LNMMK	19.98 [0.01]	28.81 [0.00]	9.61 [0.05]
LNPHP	30.21 [0.00]	5.84 [0.21]	46.03 [0.00]
LNSGD	118.07 [0.00]	70.92 [0.00]	79.68 [0.00]
LNTHB	50.26 [0.00]	24.01 [0.00]	49.24 [0.00]
LNVND	14.11 [0.17]	62.10 [0.00]	6.16 [0.52]

Notes: The figures in the bracket [...] refer to the p-value. LN denotes natural logarithm and BND=the Brunei dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

Table 4.17 presented the results for white heteroscedasticity test which investigates the heteroscedasticity problem with the null hypothesis of no heteroscedasticity problem. In the pre-crisis period, the null hypothesis cannot be rejected

for the model of the Cambodian Riel and the Vietnamese Dong with the Chinese Renminbi. During the crisis period, there is only one model that cannot be rejected which is the Myanmar Kyat with the Chinese Renminbi. In the post-crisis period, only the model of the Vietnamese Dong with the Chinese Renminbi cannot be rejected. According to Shrestha and Chowdhury (2005), it is normal to identify heteroscedasticity if the series are in mixed order of integration. This is consistent with the unit root findings in this study whereby the variables are in mixed order of integration

4.1.2.4 Granger Causality Test Results

Table 4.18 shows the short-run Granger causality test results based on Wald test in three sample periods. The first null hypothesis is the Chinese Renminbi does not Granger cause ASEAN currencies. The second null hypothesis is ASEAN currencies does not Granger cause the Chinese Renminbi. The rejection of null hypothesis is based on the significant of probability value at 1%, 5% and 10%. According to the Pre-crisis results, the Chinese Renminbi has causal impact towards six of the ASEAN currencies, namely the Cambodian Riel, Lao Kip, Malaysian Ringgit, Philippines Peso, Thai Baht and Vietnamese Dong. The null hypotheses of Chinese Renminbi does not Granger causal each of the six ASEAN currencies are rejected at 1% level of significance except for the Philippines Peso, where its null hypothesis is rejected at 5% level of significance. On the other hand, the Cambodian Riel, Philippines Peso, Singapore Dollar, Thai Baht and Vietnamese Dong Granger causes the Chinese Renminbi. The null hypothesis is rejected at 10% level of significance for the Cambodian Riel, Philippines Peso, and

Singapore dollar. However, the null hypothesis is rejected at 1% level of significance for the Thai Baht and Vietnamese Dong.

The results during crisis period showed that the Chinese Renminbi has causal impact towards each of the ASEAN currencies with the only exception which is the Cambodian Riel. The null hypotheses of Chinese Renminbi does not Granger cause the Brunei dollar, Lao Kip, Malaysian Ringgit, Myanmar Kyat and the Singapore dollar are rejected at 1% level of significance. However, the null hypothesis can be rejected at 5% level of significance included the Cambodian Riel, Philippines Peso, Thai Baht and Vietnamese Dong. On the other hand, all the ASEAN currencies Granger causes the Chinese Renminbi. The null hypothesis of ASEAN currencies does not Granger cause the Chinese Renminbi are rejected at 1% level of significance for all currencies except the Indonesian Rupiah where the null hypothesis of Indonesian Rupiah does not Granger cause the Chinese Renminbi is rejected at 10% level of significance.

For the post crisis period, the results illustrated that the Chinese Renminbi Granger causes the Brunei dollar, Cambodian Riel, Lao Kip, Myanmar Kyat, Singapore dollar and Vietnamese Dong at 1% level of significance. Moreover, Chinese Renminbi Granger causes the Indonesian Rupiah and Philippines Peso at 10% and 5% level of significance, respectively. This showed that the Chinese Renminbi has Granger cause towards eight of the ASEAN currencies. On the other hand, all the ASEAN currencies except the Indonesian Rupiah Granger causes the Chinese Renminbi. To conclude, there is existed causal impact from the Chinese Renminbi towards the majority of ASEAN currencies for the three sample periods.

Table 4.18: Granger Causality Test (Wald Test Approach) Results in Three Sample Period

Null Hypothesis	Chi-square [Prob]		
	Pre-crisis	During crisis	Post-crisis
LNRMB does not Granger cause LNBND	2.37[0.124]	41.61[0.000]***	109.22[0.000]***
LNBND does not Granger cause LNRMB	0.98[0.322]	41.61[0.000]***	65.78[0.000]***
LNRMB does not Granger cause LNKHR	65.63[0.000]***	5.18[0.023]**	30.53[0.000]***
LNKHR does not Granger cause LNRMB	3.64[0.056]*	10.80[0.001]***	30.18[0.000]***
LNRMB does not Granger cause LNIDR	0.91[0.340]	1.30[0.255]	3.11[0.078]*
LNIDR does not Granger cause LNRMB	0.56[0.456]	3.80[0.051]*	2.51[0.113]
LNRMB does not Granger cause LNLAK	24.96[0.000]***	14.84[0.000]***	9.29[0.002]***
LNLAK does not Granger cause LNRMB	1.92[0.166]	7.36[0.007]***	7.25[0.007]***
LNRMB does not Granger cause LNMYR	8.95[0.003]***	8.36[0.004]***	0.10[0.757]
LNMYR does not Granger cause LNRMB	1.40[0.237]	17.11[0.000]***	5.44[0.020]**
LNRMB does not Granger cause LNMMK	0.44[0.505]	31.73[0.000]***	20.37[0.000]***
LNMMK does not Granger cause LNRMB	0.22[0.638]	8.57[0.003]***	20.37[0.000]***
LNRMB does not Granger cause LNPHP	4.80[0.028]**	6.72[0.010]**	3.87[0.049]**
LNPHP does not Granger cause LNRMB	3.71[0.054]*	9.16[0.002]***	5.02[0.025]**
LNRMB does not Granger cause LNSGD	0.02[0.886]	74.93[0.000]***	41.39[0.000]***
LNSGD does not Granger cause LNRMB	3.33[0.068]*	77.53[0.000]***	47.09[0.000]***
LNRMB does not Granger cause LNTHB	20.17[0.000]***	4.31[0.038]**	0.28[0.598]
LNTHB does not Granger cause LNRMB	8.31[0.004]***	7.23[0.007]***	7.67[0.006]***
LNRMB does not Granger cause LNVND	16.32[0.000]***	5.04[0.025]**	13.61[0.000]***
LNVND does not Granger cause LNRMB	26.44[0.000]***	7.05[0.008]***	18.43[0.000]***

Notes: Asterisks (***), (**) and (*) indicate significance at the 1%, 5% and 10% significance levels, respectively. The [Prob] refer to the p-value. LN denotes natural logarithm and BND=the Brunei Dollar, KHR=the Cambodian Riel, IDR=the Indonesian Rupiah, LAK=the Lao Kip, MYR=the Malaysian Ringgit, MMK=the Myanmar Kyat, PHP=the Philippines Peso, SGD=the Singapore dollar, THB=the Thai Baht, VND=the Vietnamese Dong and RMB=the Chinese Renminbi.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.0 Introduction

This chapter concludes the study in five sub-parts which includes review of the study, summary of the findings, policy implications, recommendations for future research and the concluding remarks.

5.1 Review of the Study

The suitability for Asian countries to form a common currency has long been discussed by the economists. The financial crisis in 1997, the launch of Euro and recent global financial crisis again gave a great interest to economists to study the suitability in forming a common currency in Asia. After a number of relevant studies and efforts of integration in ASEAN countries, most economists have started to research for suitable anchor currency for the region. Previous studies suggested that the most developed country's currency in Asia and the currency from the country that had the highest trade and investment activities with Asia was the Japanese Yen. Hence, the formation of yen-bloc had come into the picture. However, this study attempts to investigate the possibility of the Chinese Renminbi as the anchor currency. China is now the fastest growing economy and the country has also emerged as the largest trading partner for ASEAN.

To be the common currency, the very basic consideration is that Chinese Renminbi must at least exhibit cointegrating relationship with each of the ASEAN currencies. The procedure to ascertain the suitability of the Chinese Renminbi is to investigate whether the exchange rates of ASEAN countries have a cointegrating relationship with the Chinese Renminbi and to examine the influence of the Chinese Renminbi on the ASEAN currencies. The variables in this study included the Chinese Renminbi (RMB) and the exchange rates of ASEAN countries namely the Brunei dollar (BND), the Cambodian Riel (KHR), the Indonesian Rupiah (IDR), the Lao Kip (LAK), the Malaysian Ringgit (MYR), the Myanmar Kyat (MMK), the Philippines Peso (PHP), the Singapore dollar (SGD), the Thai Baht (THB) and the Vietnamese Dong (VND).

This study reviewed various related literatures in Chapter Two. Based on the literature review, there is a lack of research on investigating the exchange rate cointegrating relationship in identifying the possibility of Renminbi bloc formation in ASEAN. Besides, previous studies focused on Yen bloc with a little discussion on the possibility of Renminbi bloc. However, some researchers believed that the Chinese Renminbi is able to replace the Japanese Yen and making the Renminbi bloc a possibility with further efforts. Therefore, previous related researches provide an idea for this study to fill up the literature gap in examining relationship of the ASEAN exchange rates with the Chinese Renminbi.

In Chapter Three, the data collection and analysis procedures of the study were reported. The daily exchange rates data spanned from July 21, 2005 to September 30,

2011 were collected from OANDA which is one of the forex trading and exchange rates services website. These data was separated into three sample periods in order to observe the influence and relationship between the Chinese Renminbi with ASEAN currencies. The three sample periods are before, during and after the recent global financial crisis. Moreover, the data set are said to be transformed into natural logarithms in order to obtain more precise result, overcome and overcoming the problem of heteroscedasticity and obtaining elasticity (Gujarati, 1995). Analysis tools which include the order of integration test, cointegration test and Granger causality tests were also presented in this chapter. Before proceed to ARDL bound test, two unit root tests were included namely ADF and PP test. After that, ARDL bound test and error correction representation are also utilized in this study in order to investigate whether the Chinese Renminbi has a cointegrating relationship with the ASEAN exchange rates. After that, Granger causality test was used to examine whether the Chinese Renminbi Granger cause each of the ASEAN currencies.

5.2 Major Findings and Discussion

The results of analysis were reported in Chapter 4.The ADF and PP unit root tests were done to confirm that the variables in this study were not integrated at order of two, denoted as $I(2)$. Otherwise, the computed statistics provided by Pesaran et al. (2001) were not appropriate if the variable is integrated at order of two (Ang, 2007). Variables that are integrated at order two, denoted as $I(2)$ also cannot apply the ARDL test because the test is only applicable for those variables that are not integrated at more than order of one. As

a matter of fact, the result in this study showed that none of the variables was integrated at order of two.

The analysis proceeded to the ARDL bound test in order to investigate the existence of cointegration relationship between the Chinese Renminbi with each of the ASEAN currencies. The ARDL bound test result showed that the Chinese Renminbi had cointegration relationship with few of the ASEAN currencies even after the global financial crisis period. Next, this study extended to error correction representation of ARDL test to obtain the EC_t value although some variables showed no cointegration relationship based on the bound testing results. This is because the EC_t value is more efficient and useful to determine the cointegration relationship between variables (Bahmani-Oskooee and Wang, 2007; Afzal et al., 2009; and Chowdhury, 2012).

From the error correction representation of ARDL test results, the Chinese Renminbi showed a relationship with numerous similar ASEAN currencies in all the sample periods. In specific, the Chinese Renminbi is found to have cointegration relationship with less ASEAN currencies in the post-crisis period compared to the pre- and during crisis, probably due to the global financial crisis. However, the Chinese Renminbi was reported to still consistently have a cointegration relationship with half of the ASEAN currencies, namely the Cambodian Riel, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Vietnamese Dong in all periods.

Lastly, the results from Granger causality test showed that the Chinese Renminbi does Granger cause the majority ASEAN currencies in the three sample periods. In the pre-crisis period, the Chinese Renminbi has causal impact on six ASEAN currencies namely the Cambodian Riel, the Lao Kip, the Malaysian Ringgit, the Philippines Peso, the Thai Baht and the Vietnamese Dong. Besides, the Chinese Renminbi has causal impact on all the ASEAN currencies except the Indonesian Rupiah for the crisis period. In the post crisis, the Chinese Renminbi do not Granger cause to only the Malaysian Ringgit and the Thai Baht. The results is similar with Chen et al. (2009) where the authors tested the impacts of USD, Euro, Japanese Yen and Chinese Renminbi on selected Asian currencies before and after China reformed. The result showed that the Chinese Renminbi had significant impact on ASEAN currencies[37] after the China reformation in July 2005. In this study, the Granger causality results showed that the Chinese Renminbi Granger cause more ASEAN currencies after the global financial crisis. This means the Chinese Renminbi has become more influential to the ASEAN countries as compared to the pre- and during-crisis period.

In conclusion, this study finds some evidence of the cointegrating and causality relationships between the Chinese Renminbi and the ASEAN currencies.

[37]Hong Kong, India, Indonesia.Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand.

5.3 Implications of the Study

There are several policies recommendations can be made according to the findings of this study. In particular, this study found evidence of the cointegrating and causality relationships between the Chinese Renminbi and ASEAN currencies. According to the overall empirical result, the formation of Renminbi bloc can be considered with some of the ASEAN countries. Currencies that are influenced by the Chinese Renminbi based on the Granger causality test and at the same time showing cointegrating relationship based on error correction representation of the ARDL approach after the crisis period could be considered to form a Renminbi bloc. Those currencies included the Cambodian Riel, the Indonesian Rupiah, the Myanmar Kyat, the Philippines Peso and the Vietnamese Dong. The formation of the Renminbi bloc will be the first step towards the monetary union. Even though not all of the ASEAN members are found to be prepared to adopt the Chinese Renminbi for the time being, with the speedy growth of China and its influence such as trade and investment in ASEAN, the currency is believed to be listed at the top of the list for ASEAN's future optimum currency. However, the findings of financial integration among these ASEAN countries and China can only be taken as the preliminary evidence supporting the idea of Renminbi bloc. Importantly, more researches need to be done in examining the fulfillment of these countries on the OCA criteria.

In the interim, China should deepen its financial market development in ASEAN especially with countries that are currently less influenced by China. This can be prepared through the increase use of the Renminbi currency in the trade and investment activity

with those countries. This can drive China to play a more important role and increase its financial tie with the ASEAN countries. Furthermore, China is able to enhance its financial integration and cooperation with ASEAN. Financial integration and cooperation can prevent large swings in the exchange rate among the region (Chen et al., 2009). In this case, ASEAN region can gain benefits and the countries will be more dependent on China. Thus, the Chinese Renminbi is strengthened and it has larger potential to become a common currency for the region.

Moreover, the European crisis provided a lesson to ASEAN region whereby the regional financial architecture has to be strengthen through regional monetary and financial cooperation in order to avoid the debt as how it was experienced by the European countries. The regional monetary and financial cooperation have to keep track with the real economies of ASEAN. In order to have a better monetary and financial cooperation in ASEAN, there are several suggestions from Volz (2012) that can be focused on. Volz (2012) claimed that the debt crisis in the Euro zone was naturally caused by the deficiency of policy response and weak financial cooperation among the European countries. The experience of Euro zone countries brings a significant lesson to the rest of world countries for better economic integration arrangements. From the European experience, it is clear that South East Asian countries should go for regionalism that focuses on strengthening the regional financial architecture. This can be reached by shaping ASEAN's own model of financial cooperation in step by step through reconsidering the cost and benefits of monetary cooperation in the region. Importantly,

establishment of early warning system and crisis resolution mechanism should be considered before any deeper economic integration arrangements.

Furthermore, increased the cointegrating relationship between Chinese Renminbi and ASEAN currencies are applicable in regard to management of exchange rate. Looking beyond the global financial crisis, ASEAN needs to undertake greater exchange rate management. According to Rana (1998), an inappropriate exchange rate policy may lead to financial crisis although it is said not to be a foundation of the crisis in Asia. Thus, ASEAN can follow the step before the formation of EURO which is Exchange Rate Mechanism (ERM) where the stable and flexible of intra-regional exchange rates in ASEAN against the major currencies is important.

5.4 Limitations and Recommendations for Future Studies

This study has employed the exchange rate variables to investigate the currencies relationship between the sample countries of ASEAN with China. The results are subjected to some limitations which firstly will be on the usage of bivariate equation with long sample span and high frequency data set that used in estimation. This might probably the reason for some of the models suffering from statistical problem. Secondly, the currencies of other Asian economies are widely excluded in this examination. Based on these limitations, future study can provide more findings by including other explanatory variables in analyzing the relationship between the Chinese Renminbi and ASEAN currencies or even other Asian currencies. Also, future study may consider to

uses other estimation methods like non-linear approach in the study. Furthermore, this study recommends studies with the inclusion of larger sample currencies, with exchange rates determinants in a panel data analysis to observe the conditional convergence. In addition, it will be impressive if there is an analysis on the forecasting beyond the sample period by employing impulse response functions and variance decomposition analysis. Since, there are some complexity in analyzing in a panel framework, future study will be more significant by deriving the evidence from various series of examination such as from the cross sectional analysis, time series as well as the panel data analysis. Through this, future study can provide more findings by including other variables stated in the OCA criteria. These measures can ensure that the possibility for the Chinese Renminbi as a common currency in ASEAN be more clearly verified.

5.5 Concluding Remarks

In conclusion, this study aims to investigate the possibility of the Chinese Renminbi to become a common currency in ASEAN by examining its cointegrating and causal relationships with each of the ASEAN currencies. The empirical results showed that not all ASEAN countries are ready to accept the Chinese Renminbi as a common currency for the region. However, Renminbi plays a more influential role in affecting the movement of ASEAN currencies after the global financial crisis.

This finding is consistent with some previous study. Kwan (1998) highlighted on the performance of China and stated that the country might be a leading economic power

in East Asia. The author also pointed out that the Chinese Renminbi will be a key currency for the region. Besides, Shirono (2009) also suggested currency union with the Chinese Renminbi as there will be larger welfare gains for East Asia. On the other hand, this study showed different findings with Azali et al. (2009). Azali et al. (2009) showed Japan is financially integrated in the long run with the Philippines, Malaysia and Singapore. Thus, Azali et al. (2009) highly recommended Japanese Yen as a vehicle currency for ASEAN. But this study recommended the Chinese Renminbi. These two studies separately considered different anchor currency, however.

Overall, although there is some evidence of linkage between the Chinese Renminbi with ASEAN currencies, the optimum currency area in ASEAN is a challenging mission. Thus, ASEAN members should work together in order to eliminate all problems and difficulties. Even though the empirical findings confirmed that not all ASEAN members are found to be prepared to adopt the Chinese Renminbi for the time being, however with the speedy growth of China and its influence activities such as trade and investment in ASEAN, the currency is believed to be listed at the top in the list for ASEAN's future optimum currency consideration. With this, the findings of this study implies that the formation of Asian economic community (AEC) needs to be held back until China's economy becomes more prominent and of greater influence in the region.

REFERENCES

Alesina, A., Barro, R. & Tenreyro, S. (2002). *Optimal Currency Areas*. NBER Working Papers, 9072.

Afxentiou, P.C. (2000). Convergence, the Maastricht Criteria, and Their Benefits. *The Brown Journal of World Affairs,* 7:245 - 254.

Afzal, M., Butt, A.R., Rehman, H.U. & Begum, I. (2009). A Dynamic Analysis of the Relationship among Human Development, Exports and Economic Growth in Pakistan. *The Pakistan Development Review*, 48:885-920.

Agarwal, A., Penm, J.H.W., Wong, W.K. & Martin, L.N. (2004). ASEAN Dollar: A Common Currency Establishment for Stronger Economic Growth of ASEAN Region. *Finance India*, 18:453 - 481.

Aggarwal, R. & Mougoue, M. (1993). Cointegration among Southeast Asian and Japanese Currencies: Preliminary Evidence of a Yen bloc? *Economics Letters*, 41:161 - 166.

Aggarwal, R. & Mougoue, M. (1996). Cointegration among Asian Currencies: Evidence of the Increasing Influence of the Japanese Yen. *Japan and the World Economy,* 8:291 - 308.

Ahn, C., Kim, H.B. & Chang, D. (2006). Is East Asia Fit for an Optimum Currency Area? An Assessment of the Economic Feasibility of a Higher Degree of Monetary Cooperation in East Asia.*The Developing Economies,* 44:288 - 305.

Aminian, N. (2005). Economic Integration and Prospects for Regional Monetary Cooperation in East Asia. *Structural Change and Economic Dynamics,* 16:91 - 110.

Andrews, D.W.K. (1991). Heteroscedasticity and Autocorrelation Consistent Covariance Matrix Estimation. *Econometrica*, 59:817 – 858.

Ang, J.B. (2007).CO2 Emission, Energy Consumption, and Output in France. *Energy Policy*, 35:4772-4778.

Angresano, J. (2004). European Union Integration Lessons for ASEAN+3: The Importance of Contextual Specificity. *Journal of Asian Economics*, 14:909 - 926.

Anon. (2011).China and Philippines. *Ministry of Foreign Affairs of the People's Republic of China.* The Department of Asian Affairs.

Asghar, Z. & Abid, I. (2007).*Performance of Lag Length selection Criteria in Three Different Situations.* Munich Personal RePEc Archive (MPRA) Paper, 40042.

Asteriou, D. & Hall, S.G. (2007). Applied Econometrics: A Modern Approach using Eviews and Microfit Revised Edition. In *Cointegration and Error-Correction Models.* New York: Palgrave Macmillan Publishing.

Azali, M., Wong, K.K.S., Lee, C. & Shafinaz, A.N. (2010). The ASEAN-5 Future Currency: Maastricht Criteria. *The Empirical Economic Letters,* 9:379 - 386.

Azali M., Royfaizal, R.C. & Lee, C. (2009). Japanese Yen as an Alternative Vehicle Currency in Asian. *ICFAI University Journal of Monetary of Economics,* 7:6 - 16.

Bacha, O, I. (2008). A Common Currency Area for MENA Countries? A VAR Analysis of Viability. *International Journal of Emerging Markets,* 3:197 - 215.

Bahmani-Oskooee, M. and Wang, Y. (2007). How Stable is the Demand for Money in China. *Japan of Economic Development*, 32:21-33.

Banik, N., Biswas, B. & Criddle, K.R. (2009).Optimum Currency Area in South Asia: A State Space Approach. *International Review of Economics & Finance*.18:502 - 510.

Bayoumi, T. & Eichengreen.B.(1994).*"One Money or Many? Analyzing the Prospects for Monetary Unification in Various Parts of the World,"* Princeton Studies in International Finance No. 76.

Bayoumi, T. & Eichengreen, B. (1997). Ever Closer to Heaven? An Optimum Currency Area Index for European Countries. *European Economic Review,* 41:761 - 770.

Bayoumi, T. & Mauro, P. (2001). The Suitability of ASEAN for a Regional Currency Arrangement. *The World Economy,* 24:933 - 954.

Bloomberg. (2010). Yuan Strengthens Most Since 2005 After China Signals End to Peg. Available at: http://www.businessweek.com/news/2010-06-21/yuan-strengthens-most-since-2005-after-china-signals-end-to-peg.html

Boothe, P. & Glassman, D. (1987). The Statistical Distribution of Exchange Rates: Empirical Evidence and Economic Implications. *Journal of International Economics,* 22: 297 - 319.

Bowman, C. (2003). Yen block or Koala bloc? Currency Relationships after the East Asian Crisis. *Japan and the World Economy,* 17:83 - 96.

Bunyaratavej, K. & Hahn, E.D. (2003). Convergence and its Implications for a Common Currency in ASEAN. *ASEAN Economic Bulletin,* 20:49 - 59.

Bystrom, H.N.E., Olofsdotter, K. & Soderstrom, L. (2005). Is China an Optimum Currency Area? *Journal of Asian Economics,* 16:612 - 634.

Channel News Asia. (2010). China starts trading Malaysian Ringgit against Yuan. Available at: http://www.channelnewsasia.com/stories/afp_asiapacific_business/view/1075970/1/.html

Chen, H., Peng, W. & Shu, C. (2009). *The Potential of the Renminbi as an International Currency.* BIS Asian Research Program Research Papers.

Chong, F. & Puah, C.H. (2009).The Time Series Behaviour of Volume, Initial Return and Economic Condition of the Malaysian IPO Market.*International Review of Business Research Papers,* 5:409 - 417.

Chowdhury, K. (2012). The Real Exchange Rate and the Balassa-Samuelson Hypothesis in SAARC countries: An Appraisal. *Journal of the Asia Pasific Economy*, 17:52-73.

Chudik, A. & Fratzscher, M. (2011).*Identifying the Global Transmission of the 2007-09 Financial Crisis in a GVAR Model.* Working Paper Series 1285, European Central Bank.

Coppes, R.C. (1995). Are Exchange Rate Changes Normally Distributed? *Economics Letters,* 47: 117 - 121.

Dauti, B. & Herzog, B. (2008).*Economic Convergence between Macedonia and European Monetary Union Member States. The Five Maastricht Criteria.*Munich Personal RePEc Archive (MPRA) Paper, 21222.

Dickey, D.A. & Fuller, W.A. (1979).Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association,* 74:427 - 431.

Dickey, D.A. & Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica,* 49:1057 - 1072.

Dickey, D.A. & Pantula, S. (1987). Determining the Order of Differencing in Autoregressive Processes. *Journal of Business and Economic Statistics,* 5:455 - 461.

Diebold, F.X. & Rudebusch, G.D. (1991). On the Power Properties of Dickey-Fuller Tests against Fractional Alternatives, *Economics Letters*, forthcoming.

Dorrucci, E., Firpo, S., Fratzscher, M. & Mongelli, F.P. (2004). The Link between Institutional and Economic Integration: Insights for Latin America from the European Experience. *Open Economies Review,* 15:239 - 260.

Dutta, M. (2005). The Theory of Optimum Currency Area Revisited: Lessons from the Euro/ Dollar competitive currency regimes. *Journal of Asian Economics,* 16:352 - 375.

Elder, J. & Kennedy, P.E. (2001). Testing for Unit Roots: What Should Students be Taught? *Journal of Economic Education,* 32:137-146.

Elliott, G., Rothenberg, T.J. & Stock, J.H. (1996). Efficient Tests for an Autoregrssive Unit Root. *Econometrica,* 64:813 - 836.

Elshareif, E.E. & Tan, H.B. (2009). The Information in the Longer Maturity Term Structure about Future Short-Term Interest Rate in Japan and Selected ASIAN Emerging Financial Markets. *European Journal of Scientific Research,* 38:362 - 372.

Enders, W. (2003). Applied Econometric Time Series, 2nd Edition. Wiley United States.

Engle, R.F. & Granger, C.W.J. (1987). Cointegration and Error Correlation Representation: Estimation and Testing. *Econometrica,* 55:251 - 276.

Esaka, T. (2003). Was it really a dollar peg?: The exchange rate policies of East Asian countries, 1980–1997. *Journal of Asian Economics,* 13:787 - 809.

Frankel, J.A. & Wei, S. (1994). Yen bloc or dollar bloc? Exchange rate policies of the East Asian economies. In: Ito, T. & Krueger, A.O. (Eds.), *Macroeconomic Linkage: Savings, Exchange Rates and Capital Flows.* University of Chicago Press, 295 - 329.

Fratzscher, M. & Mehl, A. (2011).*China's Dominance Hypothesis and the Emergence of a Tripolar Global Currency System.* ECB Working Paper No. 1392.

Friedman, D. & Vandersteel, S. (1982). Short-Run Fluctuations in Foreign Exchange Rates: Evidence from the data 1973-79. *Journal of International Economics,* 13: 171 - 186.

Furceri, D. & Karras, G. (2006). Are the New EU Members Ready for the EURO?: A comparison of Costs and Benefits. *Journal of Policy Modeling,* 28:25 - 38.

Gan, W.B. (2000). Exchange-rate Policy in East Asia After the Fall: How Much Have Things Changed? *Journal of Asian Economics,* 11:403 - 430.

Ghatak, S. & Siddiki, J. (2001).The Use of ARDL Approach in Estimating Virtual Exchange Rates in India. *Journal of Applied Statistics,* 28:573 - 583.

Granger, C.W.J. (1981). Some Properties of Time Series Data and Their Use in Econometric Model Specification. *Journal of Econometric,* 16:121 - 130.

Gujarati, D.N. (1995). *Basic Econometrics*.3rd ed., McGraw-Hill, US. pp. 719-720.

Gujarati, D.N. (2006). Essentials of Econometrics, 3rd ed., McGraw-Hill, New York.pp. 476.

Hall, F.G., Robertson, D. & Wickens, M.R. (1992).Measuring Convergence of the EC Economies. *The Manchester School of Economic and Social Science*, 60:99 - 111.

Hall, S.G. & Haldane, A.V. (1991). Sterling Relationship with the Dollar and the Deutsche Mark; 1976-89. *Economic Journal,* 101:436 - 443.

Hendry, D.F. (1995). *Dynamic Econometrics*, Oxford University Press.

Horvath, J. (2003). *Optimum Currency Area Theory: A Selection Review*. BOFIT Discussion Papers 15/2003, Bank of Finland, Institute for Economies in Transition.

Horvath, R. & Komarek, L. (2002).*Optimum Currency Area Theory: A Framework for Discussion about Monetary Integration.* Warwick Economic Research Papers, No. 647.

Hsieh, D.A. (1988). The Statistical Properties of Daily Foreign Exchange Rates: 1974-1983. *Journal of International Economics,* 24: 129 - 145.

Huang, F. (2011). The Impact of the Global Financial Crisis on Japan's Higher Education. *Higher Education Policy,* 24:275 - 283.

Huang, Y. & Guo, F. (2006). Is Currency Union a Feasible Option in East Asia? A Multivariate Structural VAR Approach. *Research in International Business and Finance*, 20:77 - 94.

International Monetary Fund. *International Financial Statistic, various issues.* Washington DC: New York.

International Monetary Fund(IMF). 2009a. *World Economic Outlook.* Washington, DC: IMF.

Ishiyama, Y. (1975). *The Theory of Optimum Currency Areas: A Survey.* IMF Staff Papers, 22:344 - 383.

Jain, V. & Sami, J. (2011).Understanding Sustainability of Trade Balance in Singapore Empirical Evidence from Co-integration Analysis. In *the 10th International Conference on Operations and Quantitative Management (ICOQM)*, pp. 201-206.

Jeon, B.N. & Zhang, H.F. (2007). A Currency Union or an Exchange Rate Union: Evidence from Northeast Asia. *Journal of Economic Integration,* 22:256 - 287.

Johansen, S. (1988).Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control,* 12:231-254.

Johansen, S. & Juselius, K. (1990).Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money. *Oxford Bulletin of Economics & Statistics,* 52:169 - 210.

Johansen, S., Mosconi R. & Nielsen, B. (2000). Cointegration analysis in the presence of structural breaks in the deterministic trend. *The Econometrics Journal,* 3:216 - 249.

Jonung, L. & Sjoholm, F. (1999). Should Finland and Sweden Form a Monetary Union? *The World Economy,* 22:683 - 700.

Karras, G. (2005). Is There a Yen Optimum Currency Area? Evidence from 18 Asian and Pacific Economies.*Japan and the World Economy,* 17:456 - 469.

Kassim, S. & Majid, M.S.A. (2009). The Role of Bank Loans and Deposits in the Monetary Transmission Mechanism in Malaysia. *International Journal of Banking and Finance,* 6:37 - 59.

Kawai, M. (2008).Toward a Regional Exchange Rate Regime in East Asia. *Pacific Economic Review,* 13:83 - 103.

Kawai, M. & Takagi, S. (2009). *Why was Japan Hit So Hard by the Global Financial Crisis?* Asian Development Bank Institute Working Paper Series, 153.

Kearney, C & Muckley, C. (2007).Reassessing the evidence of an Emerging Yen Block in North and Southeast Asia. *International Review of Economics and Finance*, 16: 255 - 271.

Kempa, B. (2002). Is Europe converging to optimality? On dynamic aspects of optimum currency areas. *Journal of Economic Studies,* 29:109 - 120.

Kenen, P.B. (1969). The Theory of Optimum Currency Areas: An Eclectic View. In: *Monetary Problems of the International Economy,* Mundell and Swobodia ed., University of Chicago Press.

Kenen, P.B. & Meade, E.E. (2008).*Regional Monetary Integration*, Cambridge University Press. pp. 177.

Kim, Y. & Chow, H, K. (2003). Optimum Currency Area in Europe: An Alternative assessment. *Economics Letters,* 81:297 - 304.

Kueh, J.S.W., Puah, C.H., Lau, E.P.H. & Shazali, A.M. (2007). FDI-Trade Nexus: Empirical Analysis on ASEAN-5. *Global Review of Business and Economic Research,* 3:143 - 153.

Kwack, S,Y. (2004). An Optimum Currency Area in East Asia: Feasibility, Coordination, and Leadership Role. *Journal of Asian Economics,* 1:153 - 169.

Kwan, C,H. (1996). A Yen Bloc in Asia: An Integrative Approach. *Journal of the Asia-Pacific Economy,* 1:1 - 21.

Kwan, C,H. (1998). The Theory of Optimum Currency Areas and the Possibility of Forming a Yen Bloc in Asia. *Journal of Asian Economics,* 9:555 - 580.

Lee, G.H.Y. & Azali, M. (2009).*Optimum Currency Areas in East Asia: A Structural VAR Approach.* Monash Economics Working Papers No. 19-09.

Lee, J. & Strazicich, M.C. (2003).Minimum Lagrange Multiplier Unit Root Test with Two Structural Breaks. *The Review of Economics and Statistics,* 85:1082 - 1089.

Lee, J. & Strazicich, M.C. (2004).*Minimum LM Unit Root Test with One Structural Break.* Working Papers No. 04-17.

Lew, Y.S. & Ku, A.T.L. (2006). Are Countries of Association of South East Asia Nations (ASEAN) Candidates of Optimum Currency Area for Monetary Union? A Structural VAR Approach. *Review of Applied Economics,* 2: 217 - 228.

Liang, H. 1999. *Do Hong Kong SAR and China Constitute an Optimal Currency Area? An Empirical Test of the Generalized Purchasing Power Parity Hypothesis.* IMF Working Paper No. 99/79.

Lim, L.K. (2005). A Dollar or Yen Currency Union in East Asia. *Mathematics and Computers in Simulation,* 68:509 - 518.

Long, D. & Samreth, S. (2008). The Monetary Model of Exchange Rate: Evidence from the Philippines using ARDL Approach. *Economics Bulletin,* 6:1 - 13.

Madhur, S. (2002). *Costs and Benefits of a Common Currency for ASEAN.* Economics and Research Department (ERD) Working Paper Series No. 12.

Maes, I. (1992). Optimum Currency Area Theory and European Monetary Integration. *Tijdschrift voor Economie en Management,* 37:137 - 152.

Masron,T.A. & Yusop, Y. (2006). Optimum Currency Area Criteria and Volatility in ASEAN. *Asian Academy of Management Journal of Accounting and Finance,* 2:1 - 17.

McKinnon, R.I. (1963). Optimum Currency Areas. *American Economic Review*, 53:717 - 725.

Meissner, C. & Oomes, N. (2008).*Why do Countries Peg the Way they Peg? The Determinants of Anchor Currency Choice.* IMF Working Paper No. 08/132. IMF, Washington D. C.

Menyah, K. & Rufael, Y.W. (2010).Energy Consumption, Pollutant Emissions and Economic Growth in South Africa. *Energy Economics,* 32:1374-1382.

Mkenda, B. (2001). Is East Africa an Optimal Currency Area? Göteborg University Department of Economics Working Paper, No. 41.

Minescu, A.M. (2011). The Debt Crisis – Causes and Implications. *Economics Sciences Series,*63:95 - 104.

Mundell, R.A. (1961). A Theory of Optimum Currency Area. *American Economic Review,* 51:657 - 665.

Mundell, R.A. (2003). Prospects for an Asian Currency Area. *Journal of Asian Economics,* 14:1 - 10.

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

Narayan, P.K. & Narayan, S. (2005). Estimating Income and Price Elasticities of Imports for Fiji in a Cointegration Framework. *Economic Modeling,* 22:423 - 438.

Neves, J.A., Stocco, L. & Silva, S.D. (2008). Is Mercosur an Optimum Currency Area? An Assessment Using Generalized Purchasing Power Parity. *Economics Bulletin,* 6:1 - 13.

Onafowara, O.A., Owoye, O. & Huart, F. (2011). The Temporal Relationship between Saving and Investment: Evidence from Advanced EU Countries. *International Journal of Business and Social Science,* 2:1 - 12.

Ozturk, I. & Acaravci, A. (2010). An Application of Thirlwall's Law to the South African Economy: Evidence from ARDL Bounds Testing Approach. *African Journal of Business Management,* 4:262 - 266.

Park, J.Y. & Sung, J. (1994). Testing for Unit Roots in Models with Structural Change. *Econometric Theory,* Cambridge University Press, 10: 917 - 936.

Patrick, K. (2000). *Exchange Rate Convergence in CARICOM.* Country Economist, Economics and programming Department.

Perron, P. (1997). Further Evidence on Breaking Trend Function in Macroeconomic Variables. *Journal of Econometrics,* 80:355 - 385.

Pesaran, M.H. & B. Pesaran, (1997). *Working with Microfit 4.0: Interactive Econometric Analysis*, Oxford University Press. pp. 353-354.

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

Phillips, P.C.B. & Perron, P. (1988). Testing for a Unit Root in Time Series Regression. *Biometrika,* 75:335 – 346.

Prasad, E. & Ye, S.L. (2012). *The Renminbi's Role in the Global Monetary System.* Discussion Paper series IZA DP No. 6335.

Rana, P.B. (1998). *The East Asian Financial Crisis-Implications for Exchange Rate Management.* Economics and Development Resource Center (EDRC) Briefing Notes No. 5.

Rana, P.B. (2007). Economic Integration and Synchronization of Business Cycles in East Asia. *Journal of Asian Economics,* 18:711 - 725.

Rapach, D.E. & Weber, C.E. (2004). Are Real Interest Rates really Nonstationary? New Evidence from Tests with Good Size and Power. *Journal of Macroeconomics,* 26:409 - 430.

Ricci, L.A. (2008). A Model of an Optimum Currency Area. *Economics-The Open-Access, open-Assessment E-Journal,* 2:1 - 31.

Sahin, H. (2006). MENA Countries as Optimal Currency Areas: Reality or Dream. *Journal of Policy Modeling,* 28:511 - 521.

Sari, R., Ewing, B.T. & Soytas, U. (2008). The Relationship between Disaggregate Energy Consumption and Industrial Production in the United States: An ARDL Approach. *Energy Economics,* 30:2302 - 2313.

Saxena, S.C. (2005). Can South Asia Adopt a Common Currency? *Journal of Asian Economics,* 16:635 - 662.

Shirono, K. (2009). *Yen Bloc or Yuan Bloc: An Analysis of Currency Arrangements in East Asia.* IMF Working Paper No. 09/03, IMF, Washington D. C.

Shrestha, M.B. & Chowdhury, K. (2005). *ARDL Modelling Approach to Testing the Financial Liberalisation Hypothesis.* Economics Working Paper Series 2005, University of Wollongong.

Sotharitho, A. (2010). Trade, FDI, and ODA between Cambodia and China/Japan/Korea. *In Economic Relations of Chine, Japan and Korea with the Mekong River Basin Countries*, edited by Mitsuhiro Kagami, BRC Research report No.3.

Stott, D.A. (2008). The Japan-Indonesia Economic Partnership: Agreement between Equals? *Asia-Pasific Journal: Japan Focus.*

Swofford, J.L. (2008). Tests of Microeconomic Foundations of Asian Common Currency Area.*Journal of Asian Economics,* 19:254 - 258.

Tse, Y.K. & Ng, L.K. (1997).The cointegration of Asian Currencies Revisited. *Japan and the World Economy,* 9:109 - 114.

Vannarith, C. (2009). *Cambodia: Between China and Japan.* Cambodian Institute for Cooperation and Peace (CICP) Working Paper No. 31.

Verspagen, B. (1994). Technology growth: the complex dynamics of convergence and divergence. In: Silverberg G. & Soete, L. (Eds.). *The Economics of Growth and Technical Change: Technologies, Nations, Agents,* Edward Elgar, England. pp.154 - 181.

Yelten, E.S. (2003). Real Effects of Movements in Nominal Exchange rates: Application to the Asian crisis. *Journal of Applied Economics,* 6:341 - 359.

Zhang, Z. & Ow, C.H. (1996). Trade Interdependence and Direct Foreign Investment between ASEAN and China. *World Development,* 24:155 - 170.

Zhang, Z., Sato, K. & McAleer, M. (2004). Asian Monetary Integration: A Structural VAR Approach. *Mathematics and Computers in Simulation,* 64:447 - 458.

Zhang, Z., Sato, K. & McAleer, M. (2008). Is Greater China a Currency Union? A Tale of the Chinese Trio. *Mathematics and Computers in Simulation,* 78:319 - 327.

Zhao, X.D. & Kim, Y.B. (2009). Is the CFA Franc Zone an Optimum Currency Area? *World Development,* 37:1877 - 1886.

Zhou, S. (1998). Exchange Rate Systems and Linkages in the Pacific Basin. *Atlantic Economic Journal,* 26:66 - 84.

Zivot, E. & Andrews, D.W.K. (1992). Further Evidence on the Great Crash, The Oil-Price Shock, and the Unit-Root Hypothesis. *Journal of Business & Economic Statistics*, 10:251 - 270.