CENTRALIZED RESERVES POOLING FOR THE ASEAN-5 TO CHINA AND INDIA

AHMAD SAZALI BIN ZAKARIA

MASTER OF ECONOMICS

UNIVERSITI UTARA MALAYSIA

2011

CENTRALIZED RESERVES POOLING FOR THE ASEAN-5 TO CHINA AND INDIA

A thesis submitted to the Graduate Studies Unit, Academic Affairs Department in partial fulfillment of the requirements for the degree of Master of Economics, Universiti Utara Malaysia.

By

AHMAD SAZALI BIN ZAKARIA

PERMISSION TO USE

In presenting this research in partial fulfillment of the requirements for a postgraduate degree from Universiti Utara Malaysia, I agree that the library of the University, Perpustakaan Sultanah Bahiyah, may make it freely available for inspection. I further agree that permission for copying this research paper in any manner, in whole or in part, for scholarly purposes may be granted by my supervisor or the Dean, Research and Graduate Studies, College of Arts and Sciences, Universiti Utara Malaysia. It is understood that any copying or publication or use of this research paper or parts thereof for financial gain shall not be allowed without written permission. It is also understood that due recognition shall be to me and to Universiti Utara Malaysia for any scholarly use which may be made of any material from my research paper.

Request for permission to copy or to make use of materials in this research paper, in whole or in part should be addressed to:

Dean,

Research and Post Graduate Studies,

College of Arts and Sciences,

Universiti Utara Malaysia

06010 UUM Sintok

Kedah Darul Aman.

ABSTRACT

With the emergence of China and India, the international reserves pooling scheme landscape of ASEAN and its relation to the global economy have changed. This study adopts the Pedroni Panel Cointegration test to examine the long run relationship between the determinants of reserves pooling in Indonesia, Malaysia, the Philippines, Singapore and Thailand (ASEAN-5) and the determinants of reserves pooling in China and India. The determinants of reserves pooling in this study are the total population of the country, real GDP per capita, the volatility of real export receipts, the share of imports in GDP, the volatility of nominal effective exchange rate and fixed capital formation to show reserves pooling behavior. Generally speaking, the results indicate that all of the determinants of reserves pooling in ASEAN-5 have different long run relationship when they are pooled to China and India. It is important to understand the determinants of reserves pooling because each determinant has a different relationship in different models of countries that they are pooled.

ABSTRAK

Dengan kemunculan China dan India, lanskap skim rizab antarabangsa berkelompok bagi ASEAN dan hubungannya dengan ekonomi global telah berubah. Kajian ini menggunapakai Ujian Panel Kointegrasi Pedroni untuk menentukan hubungan jangka panjang antara penentu-penentu rizab berkelompok bagi Indonesia, Malaysia, Filipina, Singapura dan Thailand (ASEAN-5) dengan penentu-penentu bagi rizab berkelompok bagi China dan India. Penentu-penentu rizab berkelompok dalam kajian ini adalah jumlah populasi bagi sesebuah negara, Keluaran Negara Kasar per kapita, ketidakstabilan eksport benar, peratusan import dalam Keluaran Negara Kasar, ketidakstabilan kadar tukaran efektif nominal dan formasi modal tetap. Secara umum, keputusan kajian menunjukkan bahawa semua penentu-penentu rizab berkelompok dalam ASEAN-5 mempunyai hubungan jangka panjang yang berbeza apabila ia dikelompokkan dengan China dan India. Adalah penting untuk memahami faktor-faktor penentu kepada rizab berkelompok tersebut kerana setiap penentu tersebut masing-masing mempunyai hubungan yang berbeza dalam model yang berbeza terhadap setiap negara-negara yang mana ia telah dihimpunkan.

ACKNOWLEDGMENT

بسم أللہ ألرحمن ألرحيم

First of all, thank you to Allah s.w.t because of His blessing, I am able to complete my thesis and my study within the time frame given. I also owe my debt of gratitude to Dr. Husin Abdullah as my supervisor. This thesis would not have been possible without constructive comments, suggestions and encouragement that I have received from him. My intellectual debts are to all lecturers, Dr. Norehan Abdullah, Dr. Nor Azam Abdul Razak, Assoc. Prof. Dr. Juzhar Jusoh, Mr. Sallahuddin Hassan, Dr. Ahmad Zafarullah Abdul Jalil, Assoc. Prof. Dr. Ahmad Sobri Jaafar and Assoc. Prof. Dr. Jamal Ali who taught me economics at University Utara Malaysia. I also wish to extend my thanks to all lecturers and management staffs that I have come into contact with during my studies in UUM.

Next, a note of thanks goes to my family especially my father, Zakaria Bin Ismail and my mother, Juriah Bte Ahmad for their understanding, encouragement and financial support during my study. Also not forgetting my siblings, Juliana and Ahmad Rafie for their continuous support throughout my study. Hope Allah always blesses you all.

This thesis could not have been completed without imposing on friends and colleagues for their suggestions and constructive criticism. I would like to express my deepest appreciation to those who have helped me greatly in various ways. First, I want to dedicate a million thanks to Raja Zarina Mohamad, Nur Hidayah Harun, Nurul Ain Md

Isa, Nor Ermawati Hussein, Mohd Shahidan Shaari, Diana Nabila, Mohd Ilyas Abdullah, Dayana Baba Ahmad, Ainul Yunus and Nik Surianti for always being with me in times of happiness or sadness. Thanks for your hundred percent support. Special note also goes to Mohd Sufian, Mohd Bakir, Muhiddin and all my seniors and juniors in the M.Econs program at UUM for their cheerful and very extensive help. Thank You.

TABLE OF CONTENTS

Chapter 2: Literature Review

Chapter 3: Methodology and Data

Chapter 4: Data Analysis

Chapter 5: Conclusion and Policy Recommendation

LIST OF TABLES

ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
APT	ASEAN Plus Three
AMF	ASEAN Monetary Fund
ASA	ASEAN Swap Agreement
ASEAN	Association of Southeast Asian Nations
ASEAN-5	Indonesia, Malaysia, Philippine, Singapore and Thailand
BSA	Bilateral Swap Agreement
BIS	Bank of International Settlements
CMI	Chiang Mai Initiative
FDI	Foreign Direct Investment
FMOLS	Fully Modified Ordinary Least Square
GDP	Gross Domestic Product
GNI	Gross National Income
IMF	International Monetary Fund
IPS	Im, Pesaran and Shin
LLC	Levin, Lin and Chu
OECD	Organization for Economic Co-operation and Development
SDR	Special Drawing Righs
WDI	World Development Indicator

CHAPTER 1

INTRODUCTION

1.1 Introduction

Generally, international reserves refer to those external assets that are readily available to and controlled by the monetary authorities for direct financing of payment imbalances through intervention in exchange markets to affect the currency exchange rate or other purposes.

Heller (1996) stated that there are four types of assets that qualify as international reserves. These assets are official holdings of gold, special drawing rights (SDRs), convertible foreign exchange, and the unconditional drawing rights with the International Monetary Fund (the country's reserve position in the Fund).

Hoarding reserves is very important because they are a key determinant of a country's ability to avoid economic and financial crisis. International reserves act as a shield against a balance of payments shock. Owned reserves represent a guaranteed and unconditional source of liquidity.

According to Prakash (2010), the reserve pool is not a social planner. Countries sign up to the pooling arrangement at the beginning of the period. The pool has the authority to require transfers of reserves and endowments across members of the pool, prior to the production stage. Thereafter, countries are free to produce and trade their final output with other countries in the same region, without any intervention from the pool.

International reserves are necessary financial resources of an economic region. They exist in every independent economy that does not completely close its door for international transactions. The amount held by the authorities in different economic regions varies with the arrangement of policy and objective factors.

With the memory of the 1997-1998 financial crisis still unforgettable, it is perhaps not surprising that ASEAN countries have exhibited a desire to stockpile reserves to finance international transactions, meet unexpected difficulties in their balance of payments and provide an insurance against future crises.

The history of the financial crisis provides a lesson to East Asian countries that their financial markets and institutions are inadequately prepared to handle global capital flows. Financial institutions have to be transformed and restructured, capital markets should be broadened and deepened, while supervision and regulation standards should be brought up to the international most excellent practices.

Indeed, Indonesia, the Philippines and Thailand in 1997 had to seek for international financial rescue. From the point of view of these countries, the aid provided was neither quick nor sufficient to calm down disordered markets, and the policy prescriptions imposed by the International Monetary Fund conditionality caused the economies of the countries to be submerged into unprecedentedly deep and extremely heartbreaking recessions. When hurried measures were required, the cooperation of conditionality requirements with International Monetary Fund (IMF) took time and the news that assistance was being required actually provoked the situation as it shook investor assurance further. By the time the assistance package at last took shape, a great deal of damage had already been done and restoration of confidence took a long time.

Part of the crisis was that countries in grief tended to delay approaching International Monetary Fund (IMF) for liquidity assistance only if possible in order to stay away from the austere IMF conditionality and the associated loss of confidence. The unconditional and instant expenditure of some of the funds accessible under Chiang Mai Initiative swap preparations is a partial response to these concerns.

1.2 ASEAN-5 Plus China and India Economic Integration

Regional events of the last two decades have fundamentally changed the economic landscape of ASEAN and its relationship to the global economy. China has transformed from a command economy to a model of global resource allocation based on comparative advantage. In the process, China's export competitiveness has provided new standards for efficient international division of labor. At the same time, continuous growth in its economy has also shifted attention from its export competitiveness to the new basis for ASEAN regional growth: internal demand. Over the last decade, China's absorption has become one of the most important drivers of regional growth and development.

China was ranked sixth in the global economy based on gross national income (GNI) in the last two editions of the World Development Indicators. A revised GNI estimates moved China ahead of France to become the fifth largest economy in 2004 and, according to projections, China will move ahead of the United Kingdom next year to become the fourth largest. While still a lower-middle-income country, China has a more important role in the global economy than many of the largest industrial countries. For example, China is the fourth largest receiver of foreign direct investment, its reserves are second only to those of Japan, and its merchandise exports in dollar terms exceed all

countries except for Germany and the United States (World Development Indicators Official Website, 2010).

The recent acceleration of India's growth process, with assistant economic reforms, now promises to disseminate rapid growth across the ASEAN region. East Asia has emerged as the largest trade partner of India with rapid growth of trade. India's economy is getting increasingly integrated with East Asian production chains especially in knowledge-based segments such as chip design, embedded software and Research and Development (R&D).

As these two large economies proceed in tandem, they will bestow growth leverage on their neighbours directly through bilateral trade and indirectly across a web supply chain linkages between their two economies and other places across the region and beyond. Southeast Asia is especially well situated to benefit from the corresponding expansion in China and India.

According to the Central Intelligence Agency 2010, in the financial year 2007-08, India recorded a 9.1 percent growth in its gross domestic product. This growth rate has enabled India to be counted as one of the two rapidly growing economies in the global economies where India was ranked right after China. A number of economists are of the opinion that if India can sustain this rate of development it would soon be regarded as a big name in the global economic scenario. Economic liberalization, including reduced controls on foreign trade and investment, began in early 1990s and has served to accelerate the country's growth which has averaged more than 7.1 percent annually since 1997. India has escaped the global financial crisis because of its cautious banking policies and a relatively low reliance on exports for growth.

Because of geography and an established comparative advantage in resources, commercial facilitation, and intermediate production, the ASEAN economies will emerge as a "growth bridge" between the dynamic markets of China and India. In the process, growth externalities will be transmitted to some of the lowest-income and slower-growing ASEAN economies. Indonesia, Malaysia, the Philippines, Singapore and Thailand are well positioned to become pillars of the China-India growth bridge. This kind of recruitment into more dynamic growth trends will contribute significantly and positively to growth convergence across ASEAN.

The average total annual growth of GDP for five years from 2005 to 2009 for China is 11.38 percent, India 8.22 percent, Malaysia 4.04 per cent, Philippine 4.42 percent, Singapore 6.18 percent, Thailand 2.96 percent and Indonesia 5.8 percent (World Development Indicator, 2010).

While ASEAN's long-established trade with members of the Organization for Economic Co-operation and Development (OECD) continues to be bigger and stronger, intra-ASEAN trade is accelerating as the most dynamic economies provide growth influence to their neighbours.[2] This tendency is facilitated by official efforts to liberalize trade, and private agency that propagates growth linkages over regional supply networks.

1.3 Problem Statement

International reserves pooling is an important matter that all countries need to be apprehensive about. The demand of international reserves for precautionary measures among the emerging economies is reinforced by the rapid pace of globalization and the

risk of future financial crisis arising from trade integration, financial opening, and capital flows, especially the influx of volatile short-term capital.

The precautionary motive in using reserves as a buffer stock in expectation of balance of payments problems or future currency attacks is found to be the motive underlying reserve accumulation in East Asia, at least in their initial phase of export-led growth policy. The precautionary motive is based on the theory of demand for reserves whereby a level of reserves is chosen to balance the macroeconomic adjustment costs if reserves are exhausted against the opportunity cost of holding reserves (International Monetary Fund, 2000).

The choice of currency composition of international reserves is determined by the various purposes for which reserves are held. The well-known position of the dollar reserves is due to the depth and liquidity of the US currency and the currency preference of reserve managers worldwide. This has made Asian central banks important players in the US financial market. The massive accumulation of dollars by Asian central banks has placed the Asian economies as significant players in global capital flows.

Rapid reserve accumulation is related to market failures and potential vulnerabilities in the broader monetary and financial system, such as surges and sudden stops in capital flows; the absence of automatic adjustment to imbalances; and asymmetric adjustment to shocks, with countries choosing to gear policies towards achieving external surpluses and reserve-issuing countries facing limited pressure to change course relative to others. While it has its benefits, accumulating reserves is costly—consumption and investment are predetermined as a part of national savings are invested in safe, low-yielding international assets.

At the same time, large reserve accumulation focused on a narrow supply can pose systemic costs as funds are directed to a small set of assets, potentially stoking asset bubbles, and as systemic stability relies importantly on the economies and policies of a small number of issuing countries.

Regional issues can be reviewed effectively by regional surveillance organizations. The task to be addressed includes: the gains from regional harmonization (taxation, capital controls, investment treaties, custom and quarantine procedures, etc.), the regional insolvency procedure (disputes are often between neighbours), the regional early warning model (signals may be different for different regions) and lastly the regional ownership.

According to the Institute for International Monetary Affairs (2005), Chiang Mai Initiative ASEAN plus three is weak in several points. CMI (Bilateral Swap Arrangements, BSA) triggers are "bilateral," while CMI (ASEAN Swap Arrangement, ASA) triggers are up to the coordination of chair (opt-out possible). It has to rely on IMF surveillance as long as the 90 percent disbursement is linked to IMF. ASEAN plus three Finance Ministers participate in the meeting, however, the chairs are rotated, each country does its own surveillance, and central bank governors are not involved in the Minister-level meetings, although Deputies are involved.

1.4 Objective of the Study

1.4.1 General Objective

To test the relationship of reserves pooling in five selected ASEAN countries: Indonesia, Malaysia, the Philippines, Singapore and Thailand to reserves pooling in China and India.

1.4.2 Specific Objective

The specific objectives of this study are:

1. To examine the long run relationship between the determinants of reserves pooling in ASEAN-5 and the determinants of reserves pooling in China.

2. To examine the long run relationship between the determinants of reserves pooling in ASEAN-5 and the determinants of reserves pooling in India.

3. To examine the long run relationship among the determinants of reserves pooling in ASEAN-5 and the determinants of reserves pooling in China plus India.

1.5 Significance of the Study

This study would extend the literature by making some important contributions. In order to make regional monetary cooperation effective, it seems necessary to initiate some bold institutional reforms. The 1997-1998 financial crisis encouraged ASEAN to accelerate regional financial cooperation. Financial cooperation in ASEAN-5 plus China and India is expected to complement efforts at the national level in undertaking corporate and financial sector reforms to promote macroeconomic and financial stability in the region and in the individual member countries.

At the global level, ASEAN has articulated its common position on reforming the international financial architecture. In that statement, ASEAN called for a closer and more coordinated monitoring of short-term capital flows. In particular, there should be

global agreement on the disclosure requirements for such flows and closer collaboration and information sharing among national and international regulators.

Instrument to reinforce the international financial planning would need to include a review of the roles of the international regulatory bodies, in order to enhance their capacity and capability to contain and resolve crises. ASEAN believes that global financial stability and development will play an important role in sustaining the economic resurgence of the ASEAN region. ASEAN countries have resolved to ensure that the liberalisation of capital accounts is properly sequenced so as to allow the free flow of capital while cushioning the impact of sudden shifts in capital flows.

1.6 Scope and Limitation of the Study

This study focuses on the regional reserves pooling among ASEAN-5 (Malaysia, Thailand, Singapore, Indonesia, and the Philippines) plus China and India. This research uses time series data for 15 years from 1994 to 2009. The data will be collected from various sources including the World Development Indicator, ASEAN Development Bank and International Monetary Fund.

Since the early 1990s, emerging economies have been integrating rapidly with the international financial system. Financial integration are manifested in many ways, including financial liberalization of previously closed economies, larger cross-border capital flows, entry of foreign banks, and participation of domestic firms in international markets.

As concluded by Akiko Terada-Hagiwara (2004), the two countries' (China and India) experiences suggest that liquidity management is not an easy task. It is affected by volatile exogenous factors as in India, or having to commit to the existing exchange rate policy while accommodating the development objective as in China. As capital inflows persist and reserves accumulate, sterilization policy cannot be sustainable.

The monetary authorities face a dilemma in selecting the correct policies to meet their objectives of exchange rate stability, controlling inflation, and economic growth. In this respect, it is crucial to recognize that all the objectives cannot be effectively pursued by any single economic policy. As relaxing capital controls progresses further, volatile financial flows will then challenge the still fragile domestic financial system. The strongest policy lesson is the need for more freedom in policy options, which, with a strengthened financial system, would entail a reconsideration of existing exchange rate policies and practices.

It is important that the region as a group come up with some kind of mechanisms so that ASEAN-5 plus Two can have their own alternative pool of resources that they can draw down from without having to be tied to any particular institution. They have to present a united front in the face of the pressures of the global financial turmoil.

As explained before, there are two regional financing arrangements under the Chiang Mai Initiative (CMI), namely the network of bilateral swap agreements among the ASEAN-5 countries (Indonesia, Malaysia, Singapore, Thailand and the Philippines) with China, Japan and South Korea with a combined size of $84 billion; and the $2 billion expanded ASEAN Swap Arrangement that includes all 10 ASEAN member countries.

Both facilities are aimed at providing liquidity support to members or participating countries that experience short-term balance of payments difficulties. Those facilities are also intended to be a complement to existing facilities made available by international financial institutions like the International Monetary Fund, World Bank, Chiang Mai Initiative, the Asian Development Bank, so on and so forth.

1.7 Organization of the Study

This study includes five main chapters and is organized as follows. Chapter 1 is the introduction chapter. This chapter explains the entire background of the study, the problem statement, research objectives, the importance, scope and limitation of the study. Chapter 2 provides a review of previous researches about all the variables which are chosen for the study and the theoretical framework about reserve pooling in general. Next, in chapter 3, the methods used in the study are discussed. This chapter discusses the theoretical framework, model specification, estimation techniques and the process of data collection. Some econometric tests are also explained in this chapter. In chapter 4, the findings of the econometric tests and the interpretation are discussed. Lastly, chapter 5 presents the conclusion of the study. This chapter also discusses the final results to determine whether there exists a long run relationship between the determinants of pooling reserves in selected five ASEAN countries plus China and India. Several suggestions are put forward to help future research on this topic.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Before we proceed with our study, it is important to have a general idea of the theoretical frameworks and empirical literatures on reserves pooling in Asian countries. An understanding of reserves pooling among these countries may contribute to a better policy for Asian countries in managing the reserves pooling. In the first section, we present the theoretical frameworks and then we discuss the empirical evidence provided by previous researchers from various studies about international reserves.

2.2 Theoretical Framework

Previously, the theoretical and empirical literature on reserves pooling was very limited. It was not until recently that a growing number of studies attempted to formally model and empirically estimate pooled reserves level. The recent surge of reserves in developing countries in general and developing Asia in particular has motivated researchers to explore this issue. The overall balance of evidence in this emerging literature confirms the story told by the rule of thumb for reserve adequacy, that the region's current reserve build-up has overshot its optimal level although the studies differ considerably about the extent of the overshooting.

This study follows the research of Aizenman and Marion (2002) on estimating reserves pooling. We wish to estimate reserves pooling for a panel of ASEAN-5 to China and

India and to examine whether there is a long run relationship among the determinants of reserves pooling; total population of the country, real GDP per capita, volatility of real export receipts, the share of imports and services in GDP, volatility of the nominal effective exchange rate and fixed capital formation.

$$\ln(R_{it} / P_{it} = \varepsilon_0 + \alpha_1 \ln(pop_{it}) + \alpha_2(\ln(gpc_{it}) + \alpha_3 \ln(exa_{it}) + \alpha_4 \ln(imy_{it}) + \alpha_5 \ln(neer_{it}) + \alpha_6 \ln(gfc_{it}) + \varepsilon_t \quad (2.1)$$

where: *R* is actual holdings of reserves minus gold (millions of US dollars deflated by the US GDP deflator, *P*); *pop* is the total population of the country; *gpc* is real GDP per capita; *exa* is the volatility of real export receipts; *imy* is the share of imports of goods and services in GDP; *neer* is the volatility of the nominal effective exchange rate and *gfc* is the gross fixed capital formation.

Pooled reserves should increase with the size of international transactions, so we would expect reserve holdings to be positively correlated with a country's population and standard of living. Pooled reserves should also increase with the volatility of international receipts and payments if they are intended to help cushion the economy, so we would expect reserves pooling to be positively correlated with the volatility of a country's export receipts. Pooled reserves should also increase with the vulnerability to external shocks. We therefore expect reserves pooling to be positively correlated with the average propensity to import, a measure of the economy's openness and vulnerability to external shocks. Finally, since greater exchange rate flexibility should reduce the demand for reserves because central banks no longer need a large reserves stockpile to manage a fixed exchange rate, reserves holdings should be negatively correlated with exchange rate volatility.

This study uses the panel data method to test the relationship between total population of a country, real GDP per capita, volatility of real export receipts, the share of imports and services in GDP, volatility of the nominal effective exchange rate and fixed capital formation with reserves pooling.

According to Pedroni (2000), the advantages of panel data methods include the use of data from countries (when combined in a panel) for which the span of time series data is insufficient and would thus preclude the study of many hypotheses of interest.

Other benefits include better power properties of the testing procedures (when compared to more standard times-series methods) and the fact that many of the issues studied, such as convergence of purchasing parity, lend themselves naturally to being studied in a panel context.

The panel unit root test is a continuation of the univariate unit root test but which has low power like the augmented Dickey-Fuller test (Said and Dickey, 1984). The panel unit root test has the specification for a null hypothesis and an alternative and methodology to identify problems such as heterokedasticity and different correlations. Each panel unit root test data has its own benefits and limitations and for this study we have chosen the Levin, Lin and Chu version (LLC) (2002) and Im, Pesaran and Shin (1997; IPS hereafter) which are based on the well-known Dickey-Fuller procedure. This LLC test is not only considered simple when the estimation is carried out, but has also been widely used in empirical studies and the strength of this test has been tested in various Monte Carlo tests.

Levin, Lin and Chu (2002) provide a general testing framework for panel unit root by allowing for individual fixed effects, common effects as well as different dynamics

across different group in U_{it}. The basic findings are twofold: that as both *N* and *T* go to infinity, the limiting distribution of the unit root estimator is centered and normal.

Im, Pesaran and Shin (1997) denoted IPS proposed a test for the presence of unit roots in panels that combines information from the time series dimension with that from the cross section dimension, such that fewer time observations are required for the test to have power. Since the IPS test has been found to have superior testing power by researchers in economics to analyze long-run relationships in panel data, we also employed this procedure in the study.

The advantage of the IPS method over previous panel unit root tests is that it allows the data generating processes to vary across countries with respect to ADF coefficients and error structures. This can be particularly important with respect to the number of lagged difference terms in the ADF equation. As with univariate tests, where setting the lag length can be a critical step in appropriate implementation, our experiment suggests that it is important for the IPS test to allow the lag length to vary across countries rather than imposing a uniform lag length (McCoskey and Selden, 1998).

Another advantage of the IPS test is to allow for heterogeneity in the value of ρ_i under the alternative hypothesis. The IPS tests allow for individual unit root processes so that ρ_i may vary across cross-sections. All the tests are characterized by combining individual unit root tests to derive a panel-specific result.

This study tests the long run cointegration among the determinants by using the Pedroni panel cointegration test. The concept of cointegration was first introduced by Engle and Granger (1987). Cointegration can be defined as a long run relation between integrated

variables. In other words, if a linear combination of the integrated variables of order *d*, is integrated of a smaller order than *d*, then these variables are cointegrated.

It is known that applications of a conventional time series techniques to integrated variables cause inefficient results. The regression of an integrated process on an unrelated integrated process delivers a high *t*-ratio of the slope parameter, which points out a significant relation between these unrelated processes. This is due to the fact that the variance of the regression cannot be estimated consistently. In addition, the residuals of this so-called spurious regression are non-stationary.

Pedroni (1999, 2004) extends the Engle and Granger (1987) two step strategies to panels and rely on ADF and PP principles. First, the cointegration equation is estimated separately for each panel member. Second, the residuals are examined with respect to the unit root feature. If the null hypothesis is rejected, the long-run equilibrium exists, but the cointegration vector may be different for each cross section. In addition, deterministic components are allowed to be individually specific. The residuals are pooled either along the within or the between dimension of the panel, giving rise to the panel and group mean statistics (Pedroni, 1999).

In the case of panel statistics, the first order autoregressive parameter is restricted to be the same for all cross sections. If the null is rejected, the parameter is smaller than 1 in absolute value, and the variables in question are cointegrated for all panel members. In the group statistics, the autoregressive parameter is allowed to vary over the cross section, as the statistics amount to the average of individual statistics. If the null is rejected, cointegration holds at least for one individual. Hence, group tests offer an additional source of heterogeneity among the panel members (Dreger and Reimers, 2005). To a certain limit, the statistics are distributed as standard normal with a left

hand side rejection area, except for the variance ratio test, which is right sided. Standardization factors arise from the moments of Brownian motion functionals. The factors depend on the number of regressors and whether or not constants or trends are included in the cointegration relationships.

As mentioned by Zhou Xiaouchuan (2009), an international reserve currency should first be fixed to a stable benchmark and issued according to a clear set of rules, therefore to ensure orderly supply; second, it supply should be flexible enough to allow timely adjustment according to the changing demand; third, such adjustments should be disconnected from economic conditions and sovereign interests of any single country. The acceptance of credit-based national currencies as major international reserve currencies, as is the case in the current system, is a rare special case in history. The crisis again calls for creative reform of the existing international monetary system towards an international reserve currency with a stable value, rule-based issuance and manageable supply, so as to achieve the objective of safeguarding global economic and financial stability.

Issuing countries of reserve currencies are constantly confronted with the dilemma between achieving their domestic monetary policy goals and meeting other countries' demand for reserve currencies. On the one hand, the monetary authorities cannot simply focus on domestic goals without carrying out their international responsibilities; on the other hand, they cannot pursue different domestic and international objectives at the same time.

They may either fail to adequately meet the demand of a growing global economy for liquidity as they try to ease inflation pressures at home, or create excess liquidity in the global markets by overly stimulating domestic demand. Zhou also explained the Triffin Dilemma[5] while Bretton Woods[6] system suggests the costs of such a system to the world may have exceeded its benefits. The price is becoming increasingly higher, not only for the users, but also for the issuers of the reserve currencies. Although crisis may not necessarily be an intended result of the issuing authorities, it is an inevitable outcome of the institutional flaws.

Following Aizenman and Marion (2003), Edison (2003), and Lane and Burke (2001), real *per capita* GDP and population are included to capture the size effect on international reserve holding. The implications of external debts and capital flows on the holding of international reserves have received considerable attention after the Asian financial crisis. While capital inflows can enhance economic growth by supplementing domestic savings and/or financial intermediaries and improving the efficiency of domestic financial markets, a sudden capital flow reversal can devastate an economy, trigger a crisis, and cause significant output losses.

2.3 Empirical Literatures

Aizenman and Marion (2002), present a regression for panel consisting of 122 developing countries over the 1980-1996 periods. The scale variables, population size and real per capita GDP, are positive and highly significant. The volatility of real export receipts and the vulnerability to external shocks measured by openness are also positive and highly significant. Greater exchange rate variability significantly reduces reserves holdings. These five variables account for 88 per cent of the variation in actual

reserve holdings when country fixed effects are included; they account for over 70 per cent of the variation without the fixed effects.

Leong Fee Wan and Yen Li Chee (2009) intuitively expected the signs of the coefficients of trade openness, reserve-import ratio and short term indebtedness to be positive. However, Wang's (2009) analyses reported that Japan and Korea's trade openness coefficient is negative, with Korea's being highly significant (at 1 percent level). Meanwhile, Thailand's coefficient for the reserve-import ratio is also negative despite being significant at the 5 percent level. The coefficient of short term indebtedness is negative for China and the Philippines, with the Philippines's being significant at the 1 percent level. These contradictory results could be due to the small sample size used in the estimation. Due to the unavailability of long annual time series data, the analysis was carried out on approximately 24 observations for all countries.

The low variability in nominal and real exchange rates reflects interventions in foreign exchange markets by the Central Banks in Asia. The massive accumulation of international reserves after the 1997-98 financial crises has provided major benefits by reducing the region's exchange rate variability. However, there are fixed and variable costs in reserve holdings. Reserve holdings are locked up in anticipation of future financial crises.

Aizenman and Lee (2006, 2005) provided extended discussions on the precautionary and mercantilist demands for reserves. Although both motives are likely to be in play in Asia, a systematic study of the relative importance of the two motives in Asia by Aizenman and Lee (2005) found stronger empirical support for self-insurance motive. Related to the two main benefits but somewhat different is a third benefit from reserves

exchange rate stability. A central bank may accumulate reserves as a result of foreign exchange market interventions aimed at stabilizing the exchange rate.

Indeed policy makers often rely on those simple rules instead of more rigorous econometric models to assess reserve adequacy. Nevertheless, it would be useful and interesting to apply such models to the issue of whether the region's reserves have become excessive. At the very least, we would be able to compare the results of the informal adequacy tests with those of more formal econometric analysis. The alternative, econometric approach to assessing reserve adequacy is to (i) estimate a model that relates reserve levels to various variables influencing reserves and (ii) compare actual reserve levels to reserve levels predicted by the model. Park and Estrada (2009), interpreted a positive gap between actual reserves and predicted reserves as evidence of excess reserves in the sense that reserves exceed those explained by fundamentals.

Edison (2003 used panel data for 122 emerging countries from 1980–1996. Controlling for fixed effects, the model is able to account for over 90 percent of the variation in reserves holdings. All five explanatory variables have the expected coefficient signs and all of them are significant except for export volatility. Edison then used the parameter estimates to generate out-of-sample forecasts and compared them with actual reserves data for 1997–2002. He found that while actual reserves were broadly in line with forecasts during 1997–2001, actual reserves exceeded forecasts after 2001.

Using data from more than 100 economies for the period of 1975 to 2004, Cheung and Ito (2007) conducted an extensive empirical analysis of the determinants of

international reserve holdings. Four groups of determinants, namely, traditional macro variables, financial variables, institutional variables, and dummy variables that control for individual economies' characteristics were considered. They found that the relationship between international reserves and their determinants is different between developed and developing economies and is not stable over time. The estimation results indicate that, especially during the recent period, a developed economy tends to hold a lower level of international reserves than a developing one.

CHAPTER 3

METHODOLOGY AND DATA

3.1 Introduction

This chapter focuses on the model specification based on the theoretical arguments in the literature. The study will utilize data from Indonesia, Malaysia, the Philippines, Singapore and Thailand plus China and India. The analysis uses panel data techniques estimation to investigate the relationship between pooled reserves, total population of the country, real GDP per capita, volatility of real export receipts, the share of imports and services in GDP, volatility of the nominal effective exchange rate and fixed capital formation. A brief description of data employed in the study is given at the end of this chapter.

3.2 Specification of the Model

In this section, each empirical model estimated is discussed. The empirical models are used to test the relationship between pooled reserves with total population of the country, real per capita GDP, volatility of real export receipts, the share of imports and services in GDP, volatility of the nominal effective exchange rate and fixed capital formation.

3.3 Theoretical Framework of Reserves Pooling

We follow the theoretical framework of Aizenman and Marion (2002), where pooled reserves, the actual holdings of reserves minus gold (millions of US dollars deflated by

the US GDP deflator) depend on total population of the country, real per capita GDP, the volatility of real export receipts, the share of imports of goods and services in GDP and the volatility of the nominal effective exchange rate. The model predicts that real reserve holdings should increase with the size of international transactions, so we would expect reserve holdings to be positively correlated with the country's population and standard of living. Reserve holdings should also increase with the volatility of international receipts and payments if they are intended to help cushion the economy, so we would expect reserve holdings to be positively correlated with the volatility of country's exports receipts. Reserve holdings should also increase with the vulnerability to external shocks. The reserves pooling estimation is:

$$\ln(R_{it}/P_{it}) = \alpha_0 + \alpha_1 \ln(pop_{it}) + \alpha_2 \ln(gpc_{it}) + \alpha_3 \ln(exa_{it}) + \alpha_4 \ln(imy_{it}) + \alpha_5 \ln(neer_{it}) + \alpha_6 \ln(gfc_{it}) + \varepsilon_t \quad (3.1)$$

where: *R* is actual holdings of reserves minus gold (millions of US dollars deflated by the US GDP deflator, *P*); *pop* is the total population of the country; *gpc* is real per capita GDP; *exa* is the volatility of real export receipts; *imy* is the share of imports of goods and services in GDP; *neer* is the volatility of the nominal effective exchange rate and *gfc* is the gross fixed capital formation.

3.4 Estimation Procedure

The objective of this section is to explain the relevant econometric procedures in testing panel data. The most appropriate estimation procedure will be discussed under various conditions so as to allow us to achieve the specific objective.

3.4.1 Panel Unit Root Tests

This panel unit root test is a continuation of the univariate unit root test identified earlier but which has low power like the augmented Dickey-Fuller test (Said and Dickey, 1984). The panel unit root test as above has the specification for a null hypothesis and an alternative and methodology to identify problems such as heterokedasticity and different correlations. Each panel unit root test data has its own benefits and limitations and for this study we have chosen the Levin, Lin and Chu version (LLC) (2002) and Im, Pesaran and Shin (1997; IPS hereafter) which are based on the well-known Dickey-Fuller procedure. This LLC test is not only considered simple when estimation is carried out, but has also been widely used in empirical studies and the strength of this test has been tested in various Monte Carlo tests.

3.4.1.1 Levin, Lin and Chu (LLC; 2002)

In LLC it is found that the main hypothesis of panel unit root is as follows:

$$\Delta y_{it} = \Phi_i y_{i,t-1} + \sum_{L=1}^{p_i} \rho_{i,l} \Delta y_{i,t-L} + \varepsilon_{i,t} \qquad m = 1, 2, \ldots \tag{3.2}$$

where $y_{i,t}$ refers to variable $\ln pop_{it}, \ln gpc_{it}, \ln exa_{it}, \ln imy_{it}, \ln neer_{it}, \ln gfc_{it}$ and Δ refers to the first difference. The hypothesis test is $H_0 : \Phi_i = 0$ for existence of unit root whereas $H_a : \Phi_i < 0$ for all i for non-existence of unit root. As p_i is unknown, Levin, Lin and Chu (LLC) suggest a three-step procedure in the test. In the first step, obtain the ADF regression which has been separated for each individual in the panel, generate two orthogonalized residuals. The second step requires an estimation of the

ratio of long run to short run innovation standard deviation for each individual. The last step requires us to compute the pooled *t*-statistics.

In the first step, we generate ADF regression for each individual *i*:

$$\Delta y_{it} = \Phi_i \, y_{i,t-1} + \sum_{L=1}^{p_i} \rho_{i,L} \, \Delta y_{i,t-L} + \varepsilon_{i,t} \tag{3.3}$$

The lag order for p_i is allowed to be distinguished for each individual. Campbell and Perron (1991) suggest a methodology used by Hall (1990) in choosing the appropriate lag order; that is providing a sample span of *T*, choose a lag order which maximizes P_{MAX}, and then use *t*-statistics for $\hat{\rho}_L$ to determine if the order of a smaller lag order is preferred. [*t*-statistics have a standard normal distribution in a null hypothesis ($\hat{\rho}_{iL} = 0$), when $\Phi_i = 0$ or $\Phi_i < 0$]. When the order of autogression has been determined for p_i in equation (3.3), generate two auxiliary regressions to obtain an orthogalized residual. Carry out a regression $\Delta y_{i,t}$ and $y_{i,t}$ on $\Delta y_{i,t-L}$ (L=1,…p_i), then get residuals $\hat{e}_{i,t}$ and $\hat{v}_{i,t-1}$ from these regression. Specifically, this model is shown as below:

$$\hat{e}_{i,t} = \Delta y_{i,t} - \sum_{L=1}^{pi} \hat{\pi}_{i,L} - \Delta y_{i,t-L} \tag{3.4}$$

$$\hat{v}_{i,t} = \Delta y_{i,t} - \sum_{L=1}^{pi} \tilde{\pi}_{i,L} - \Delta y_{i,t-L} \tag{3.5}$$

To control heterogeneity among individuals, LLC has normalised $\hat{e}_{i,t}$ and $\hat{v}_{i,t-1}$ through standard error regression which is obtained from equation (3.4):

$$\tilde{e}_{i,t} = \frac{\hat{e}_{i,t}}{\hat{\sigma}_{\varepsilon,i}} \quad , \quad \tilde{v}_{i,t-1} = \frac{\hat{v}_{i,t-1}}{\hat{\sigma}_{\varepsilon,i}} \tag{3.6}$$

where $\hat{\sigma}_{\varepsilon,i}$ is standardized error from estimation of equation (3.4). This value can also be calculated from regression $\hat{e}_{i,t}$ on $\hat{v}_{i,t-1}$.

$$\hat{\sigma}^2_{\varepsilon,i} = \frac{1}{T - p_i - 1} \sum_{t=p_i+2}^{T} (\hat{e}_{i,t} - \hat{\Phi}_i \hat{v}_{i,t-1})^2 \tag{3.7}$$

The second step is to estimate the ratio of long run to short run standard deviation. In this null hypothesis for unit root, long term variance for the model can be estimated as follows:

$$\hat{\sigma}_{y,t} = \frac{1}{T-1} \sum_{t=2}^{T} \Delta y^2_{i,t} + 2 \sum_{L=1}^{\bar{K}} W_{K,L} \left[\frac{1}{T-1} \sum_{t=2+L}^{T} \Delta y_{i,t} \Delta_{i,t-L} \right] \tag{3.8}$$

where *w* refers to weight. The truncation lag parameter $\bar{K}$ depends on the data.

For each individual *i*, LLC define the ratio of the long run standard deviation to innovation standard deviation as:

$$s_i = \frac{\sigma_{y,i}}{\sigma_{\varepsilon,i}} \tag{3.9}$$

and mark this estimation with $\hat{s}_i = \hat{o}y_i / \hat{\sigma}_{\varepsilon,i}$. The average standard deviation ratio is $S_N = (1/N) \sum_{i=1}^{N} S_i$, and the estimation is $\hat{S}_N = (1/N) \sum_{i=1}^{N} \hat{S}_i$. Before we proceed to the third stage, LLC reminds us that there are two items that should be noted. Firstly, the estimation for $\hat{\sigma}_{y,i}$ under a null hypothesis is $\hat{\sigma}^2_{\varepsilon,i} / (1 - \sum_{i=1}^{pi} \hat{\rho}_{i,L})^2$, and as a result of $\hat{\sigma}^2_{\varepsilon,i}$

is a constant estimation for $\hat{\sigma}^2_{\varepsilon,i}$ under the null hypothesis, thus, $\hat{s}_i$ can be estimated with $\left|1-\sum_{i=1}^{pi}\hat{\rho}_{i,L}\right|$. Secondly, the feature of size and power for panel unit root test is increased via first difference to estimate long term variance. In the null hypothesis for unit root, Schwert (1989) found long term estimation based on first difference has a smaller bias in a limited sample compared to long term variance based on residuals in level.

The third step in the LLC version of the panel unit root test is to estimate coefficient Φ and to calculate the value of statistic-*t* for panel. In this step, combine all cross-section and time series observations to estimate,

$$\tilde{e}_{i,t} = \Phi\tilde{v}_{i,t-1} + \tilde{\varepsilon}_{i,t} \tag{3.10}$$

Based on the total of observations $N\tilde{T}$, where $\tilde{T} = T - \bar{g} - 1$ is the average of the number of observations per individual in the panel, and $\bar{p} = \frac{1}{N}\sum_{i=1}^{N} p_i$ is the average interval for individual ADF regression, the conventional statistic-*t* regression to test $\Phi = 0$ is:

$$t_{\Phi} = \frac{\hat{\Phi}}{STD(\hat{\Phi})} \tag{3.11}$$

where

$$\hat{\Phi} = \frac{\sum_{i=1}^{N}\sum_{i=2+pi}^{T}\tilde{v}_{i,t-1}\tilde{e}_{i,t}}{\sum_{i=1}^{N}\sum_{t=2+pi}^{T}\tilde{v}_{i,t-1}} \tag{3.12}$$

$$STD(\hat{\Phi}) = \Phi^2_{\tilde{\varepsilon}}\left[\sum_{i=1}^{N}\sum_{t=2+pi}^{T}\tilde{v}_{i,t-1}\right] \tag{3.13}$$

$$\Phi_{\tilde{e}}^2 = \left[\frac{1}{N\tilde{T}} \sum_{i=1}^{N} \sum_{t=2+pi}^{T} (\tilde{e}_{i,t} - \hat{\Phi}\tilde{v}_{i,t-1})^2 \right] \tag{3.14}$$

In the hypothesis H_0: Φ=0, LLC states that *t*-statistic regression (t_Φ) has a normal distribution for the ADF model without intercept and trend, but diverges to a negative for the ADF model with intercept and trend.

Subsequently, the calculation of coordinated *t*-statistic is as below:

$$t_\Phi^* = \frac{t_\Phi N\tilde{T}\hat{S}_N \hat{\sigma}_{\tilde{\varepsilon}}^{-2} STD(\hat{\Phi}) \mu_{m\tilde{T}}^*}{\sigma_{m\tilde{T}}^*} \tag{3.15}$$

where tabulated mean value is adjustment for $\mu_{m\tilde{T}}^*$ and standard deviation is adjustment $\mu_{M\tilde{T}}^*$ has been given by LLC with a deterministic specification (m = 1,2,…) and time series dimension $\tilde{T}$.

Levin *et al*. (2002) state that limited tabulation for corrected statistics is normal where $N \to \infty$ and $T \to \infty$ with $\sqrt{N/T} \to 0$ or $N/T \to 0$, depends on the model specification. Furthermore, the Monte Carlo simulation shows that this test is still suitable for a moderate-sized panel (value of *N* is between 10 and 250 individuals and *T* between a span of 20 and 250) whereby they are almost similar with panel data for this study. Generally, the LLC test has been accepted as one of the panel unit root test. However, it should be mentioned that this LLC test has a homogeneity limitation, where a null hypothesis is $\Phi_i = \Phi = 0$ versus alternative hypothesis $\Phi_i < 0$ for all individual units *i*.

3.4.1.2 Im, Pesaran and Shin (IPS; 1997)

IPS begins by specifying a separate ADF regression for each cross-section with individual effects and no time trend:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \tag{3.16}$$

The null hypothesis may be written as $H_0 : \rho_i = 0, \text{for all } i = 1,\ldots N$, While the alternative hypothesis is given by:

$$H_1 : \begin{cases} \rho_i = 0 & for \quad i = 1, 2, ..., N_1 \\ \rho_i < 0 & for \quad i = N+1, N+2, ..., N, with\ 0 < N_1 \leq N. \end{cases} \tag{3.17}$$

IPS use separate unit root tests for the *N* cross-section units. Their test is based on the Augmented Dickey-fuller (ADF) statistics averaged across groups. After estimating the separate ADF regressions, the average of the *t*-statistics for p_1 from the individual ADF regressions, $t_{iT_i}(p_i)$:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}(p_i \beta_i) \tag{3.18}$$

Under the crucial assumption of cross-sectional independence, this statistic is shown to sequentially converge to a normal distribution when *T* tends to infinity, followed by *N*. A similar result is conjectured when *N* and *T* tend to infinity while the ration *N/T* tends to a finite non-negative constant (Hurlin, 2004).

In order to propose a standardization of the $\bar{t}$ statistic, IPS has to compute the value of $E(\bar{t}_{iT}(p_i, \beta_i))$ and $Var\ (\bar{t}_{iT}(p_i, \beta_i))$. The standardization of the $\bar{t}_{iT}$ statistic using the means and variances of $t_{iT}(p_i, 0)$ is evaluated by simulation under the null $\rho_i = 0$. IPS shows that a properly standardized $\bar{t}_{NT}$ statistic, denoted $W_{\bar{t}_{NT}}$, has an asymptotic

standard normal distribution under the null of non stationarity along the diagonal $N/T \to k$, with $k > 0$:

$$W_{\bar{t}_{NT}} = \frac{\sqrt{N}\left(\bar{t}_{NT} - N^{-1}\sum_{i=1}^{N} E(\bar{t}_{iT}(p_i,0)|\rho_i = 0)\right)}{\sqrt{N^{-1}\sum_{i=1}^{N} Var\,(\bar{t}_{iT}(p_i,0)|\rho_i = 0)}} \underset{T,N\to\infty}{\overset{d}{\to}} N(0,1) \qquad (3.19)$$

The expressions for the expected mean and variance of the ADF regression *t*-statistics, $E(\bar{t}_{iT}(p_i,\beta_i))$ and $Var\,(\bar{t}_{iT}(p_i,\beta_i))$, are provided by IPS for various values of T and p and differing test equation assumptions. The IPS test statistic requires specification of the number of lags and the specification of the deterministic component for each cross-section ADF equation.

3.4.2 Panel Cointegration Tests

This study applies the seven panel cointegrations by Pedroni (1999, 2004). His studies propose the appropriate tests to be applied to estimated residuals from a cointegration regression after normalizing the panel statistics with correction terms.

The procedures proposed by Pedroni make use of estimated residual from the hypothesized long-run regression of the following form (Pedroni, 1999):

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i}x_{1i,t} + \beta_{2i}x_{2i,t} + \ldots + \beta_{Mi}x_{Mi,t} + e_{i,t} \qquad (3.20)$$

for t = 1,.....,*T; i* = 1,....,*N; m* = 1, ..., *M,*

where T is the number of observations over time, N is the number of cross-sectional units in the panel, and M the number of regressors. In this set up, α_i is the member specific intercept or fixed effects parameter which varies across individual cross-

sectional units. The same is true of the slope coefficients and member specific time effects, $\delta_i t$.

The tests for the null of no cointegration are based on testing whether the error process e_{it} is stationary. This is achieved by testing whether $\rho_i = 1$ in:

$$\hat{e}_{it} = \rho_i \hat{e}_{it-1} + v_{it} \tag{3.21}$$

Pedroni (1999) has proposed seven tests which can be divided into two groups of panel cointegration statistics designed to test the null hypothesis of no cointegration between the variables in Equation (3.20) against the alternative hypothesis of cointegration. Gutierrez (2003) states that the first category of four statistics we consider is what Pedroni labels as within-dimension statistic or Panel *t*-statistic which includes a variance ratio statistic, a non-parametric Philips and Perron type ρ-statistic, a non-parametric Phillips and Perron type *t*-statistic and a Dickey-Fuller type *t*-statistic. The second category of three panel cointegration statistics is defined as a between-dimension statistic or Group *t*-statistic including a Phillips and Perron type ρ-statistic, a non-parametric Phillips and Perron type *t*-statistic and finally an Augmented Dickey-Fuller type *t*-statistic.

The first category of test uses the following specification of null and alternative hypothesis,

$$H_0 : \rho = 1, \qquad H_1 : \rho < 1. \tag{3.22}$$

While the second category of tests uses

$$H_0 : \rho_i = 1, \qquad H_1 : \rho_i < 1 \text{ for all } i. \tag{3.23}$$

Pedroni (1999) proposes the heterogeneous panel and heterogeneous group mean panel test statistics to test for panel cointegration as follows:

1. Panel *v*-statistic:

$$T^2 N^{3/2} Z_{\hat{v},N,T} = T^2 N^{3/2} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \tag{3.24}$$

2. Panel ρ-Statistic:

$$T\sqrt{N} Z_{\hat{\rho}N,T-1} = T\sqrt{N} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \tag{3.25}$$

3. Panel *t*-Statistic (non-parametric):

$$Z_{tN,T} = \left(\tilde{\sigma}_{N,T}^2 \sum_{I=1}^{N} \sum_{T=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^2 \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \tag{3.26}$$

4. Panel t-Statistic (parametric):

$$Z_{tN,T}^{*} = \left(\tilde{s}_{N,T}^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{i,t}^{*} \tag{3.27}$$

5. Group ρ-Statistic:

$$TN^{-1/2} \tilde{Z}_{\hat{\rho}N,T^{-1}} = TN^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \tag{3.28}$$

6. Group *t*-Statistic (non-parametric);

$$N^{-1/2} \tilde{Z}_{tN,T^{-1}} = N^{-1/2} \sum_{i=1}^{N} \left(\sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \tag{3.29}$$

7. Group t-Statistic (parametric):

$$N^{-1/2}\tilde{Z}^{*}_{tN,T} = N^{-1/2}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{s}_i^{*2}\hat{e}_{i,t-1}^{*2}\right)^{-1/2}\sum_{t=1}^{T}\hat{e}^{*}_{i,t-1}\Delta\hat{e}^{*}_{i,t} \tag{3.30}$$

where

$$\hat{\lambda}_i = \frac{1}{T}\sum_{s=1}^{k_i}\left(1-\frac{s}{k_i+1}\right)\sum_{t=s+1}^{T}\hat{\mu}_{i,t}\hat{\mu}_{i,t-s}, \tag{3.31}$$

$$\hat{s}_i^2 = \frac{1}{T}\sum_{t=1}^{T}\hat{\mu}_{i,t}^2,\ \ \hat{\sigma}_i^2 = \hat{s}_i^2 + 2\hat{\lambda}_i, \tag{3.32}$$

$$\tilde{\sigma}^2_{NT} = \frac{1}{T}\sum_{t=1}^{T}\hat{L}^2_{11i}\hat{\sigma}_i^2\ ,\quad \hat{s}_i^{*2} = \frac{1}{T}\sum_{t=1}^{T}\hat{\mu}_{i,t}^{*2} \tag{3.33}$$

$$\tilde{s}^{*2}_{N,T} = \frac{1}{N}\sum_{i=1}^{N}\hat{s}_i^{*2} \tag{3.34}$$

and

$$\hat{L}^2_{11i} = \frac{1}{T}\sum_{t=1}^{k_i}\hat{\eta}_{i,t}^2 + \frac{2}{T}\sum_{T=1}^{T}\left(1-\frac{s}{k_i+1}\right)\sum_{t=s+1}^{T}\hat{\eta}_{i,t}\hat{\eta}_{i,t-s} \tag{3.35}$$

and where the residuals $\hat{\mu}_{i,t}$, $\hat{\mu}^{*}_{i,t}$, and $\hat{\eta}_{i,t}$ are obtained from the following regressions:

$$\hat{e}_{i,t} = \hat{\gamma}_i\hat{e}_{i,t-1} + \hat{\mu}_{i,t} \tag{3.36}$$

$$\hat{e}_{i,t} = \hat{\gamma}_i\hat{e}_{i,t-1} + \sum_{k=1}^{K_i}\hat{\gamma}_{i,k}\Delta\hat{e}_{i,t-k} + \hat{\mu}^{*}_{i,t} \tag{3.37}$$

and

$$\Delta y_{i,t} = \sum_{m=1}^{M} \hat{b}_{mi} \Delta x_{mi,t} + \hat{\eta}_{i,t} \tag{3.38}$$

Δ is the first difference operator. Pedroni suggests some adjustments for each of all test statistics (both for panel unit root tests and panel cointegration tests) described above that produces standard normal distributions.

According to Pedroni, those seven test statistics can be rescaled so that they are distributed as standard normal. The standardization of the cointegration statistics can be expressed as

$$\frac{K_{NT} - \mu\sqrt{N}}{\sqrt{\nu}} \Rightarrow N(0,1) \tag{3.39}$$

where K_{NT} is the standardized form of the test statistic with respect to N and T. The value of the mean (μ) and the variance (ν) are tabulated in Pedroni (1999). The values of the normalized statistics are to be compared to the critical values implied by a one-tailed standard normal distribution. Consequently, for the panel variance test the right tail of the standard normal distribution (large positive value) is used to reject the null of no cointegration and for the other six tests the left tail is used (large negative value imply rejection of the null).

Harris and Sollis (2003) argue that in practice it is possible for different tests to give contradicting conclusions. Choosing which test is more appropriate is not easy. The groups mean tests particular strength is that they are less restrictive. Regarding the best way to correct for autocorrelation, non parametric tests are likely to be more robust to outliers but have poor size properties and tend to over-reject the null when it is true. The ADF-type tests have better power if the errors follow an autoregressive process.

Therefore, following other researchers, we report the adjusted values so that in all cases the reported test values can be compared to the standard normal distribution. This is the case for both the cointegration and unit root tests.

3.4.3 Fully Modified Ordinary Least Squares (FMOLS) Estimation

In this section we adopt FMOLS procedure from Christopoulos and Tsionas (2003, 2004). In order to obtain asymptotically efficient consistent estimates in panel series, non-exogeneity and serial correlation problems are tackled by employing fully modified OLS (FMOLS) introduced by Pedroni (1996). Since the explanatory variables are cointegrated with a time trend, and thus a long-run equilibrium relationship exists among these variables through the panel unit root test and panel cointegration test, we proceed to estimate the heterogenous cointegrated panels (Pedroni, 1996, 2000) by the method of fully modified OLS(FMOLS). This methodology allows for consistent and efficient estimation of cointegration vector and also addresses the problem of non-stationary regressors, as well as the problem of simultaneity biases. It is well known that OLS estimation yields biased results because the regressors are endogenously determined in the *I*(1) case.

The starting point for OLS is as in the following cointegrated system for panel data:

$$y_{it} = \alpha_i + x'_{it}\beta + e_{it} \tag{3.40}$$

$$x_{it} = x_{i,t-1} + \varepsilon_{it} \tag{3.41}$$

where $\xi_{it} = [e_{it}, \varepsilon'_{it}]$ is the stationary with covariance matrix Ω_i. The estimator β will be consistent when the error process $\omega_{it} + [e_{it}, \varepsilon'_{it}]'$ satisfies the assumption of cointegration

between y_{it} and x_{it}. The limiting distribution of OLS estimator depends upon nuisance parameters. Following Phillips and Hansen (1990), a semi-parametric correction can be made to the OLS estimator that eliminates the second order bias caused by the fact that the regressors are endogenous. Pedroni (1996, 2000) follows the same principle in the panel data context, and allows for the heterogeneity in the short run dynamics and the fixed effects. FMOLS Pedroni's estimator is constructed as follows:

$$\hat{\beta}_{FM} - \beta = \left(\sum_{i=1}^{N} \hat{\Omega}_{22i}^{-2} \sum_{t=1}^{T} (x_{it} - \hat{x}_t)^2 \right)^{-1} \sum_{i=1}^{N} \hat{\Omega}_{11i}^{-1} \hat{\Omega}_{22i}^{-1} \left(\sum_{t=1}^{T} \left(x_{it} - \bar{x}_t \right) \hat{e}_{it}^{*} - T\hat{\gamma}_i \right) \tag{3.42}$$

$$\hat{e}_{it}^{*} = e_{it} - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i}, \qquad \hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \hat{\Omega}_{22i}^{-1} \hat{\Omega}_{21i} \left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0} \right)$$

where the covariance matrix can be decomposed as $\Omega_i = \Omega_i^0 + \Gamma_i + \Gamma_i$ where Ω_i^0 is the contemporaneous covariance matrix, and Γ_i is a weighted sum of autocovariances. Also, $\hat{\Omega}_i^0$ denotes an appropriate estimator of Ω_i^0.

In testing the long run relationship among the determinants, we employed both the within-dimension and between-dimension panel FMOLS test from Pedroni (1996, 2000). An important advantage of the between-dimension estimators is that the form in which the data is pooled allows for greater flexibility in the presence of heterogeneity of the cointegrating vectors. Specifically, whereas test statistics constructed from the within-dimension estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all *I* against the alternative hypothesis $H_A : \beta_i = \beta_A \neq \beta_0$ where the value β_A is the same for all *i*, test statistics constructed from the between-dimension estimators are designed to test the null hypothesis $H_0 : \beta_i = \beta_0$ for all *i* against the alternative hypothesis

$H_A : \beta_i \neq \beta_0$, so that the values for β_i are not constrained to be the same under the alternative hypothesis.

Clearly, this is an important advantage for applications such as the present one**,** because there is no reason to believe that, if the cointegrating slopes are not equal to one, which they necessarily take on some other arbitrary common value. Another advantage of the between-dimension estimators is that the point estimates have a more useful interpretation in the event that the true cointegrating vectors are heterogeneous. Specifically, point estimates for the between-dimension estimator can be interpreted as the mean value for the cointegrating vectors. This is not true for the within-dimension estimators (Pedroni, 2001).

3.5 Sources of Data

The data used in this study is annual time series data that covered the sample period of 15 years from 1994 to 2009. The countries included in the sample are India, China Indonesia, Malaysia, Philippines, Singapore and Thailand. This study used data on exports and services (percentage of GDP), Gross Domestic Production per capita in current US dollar, gross fixed capital formation (annual percentage growth), imports of goods and services (percentage of GDP), GDP deflator (annual percentage), nominal effective exchange rate, total population, and total reserve minus gold in current US dollar. The data are obtained from various sources including the World Development Indicator, IFS, and Bank of International Settlements (BIS). The data for exports and services (percentage of GDP), Gross Domestic Production per capita in current US dollar, gross fixed capital formation (annual percentage growth), imports of goods and services (percentage of GDP), GDP deflator (annual percentage), total population, and

total reserve minus gold in current US dollar are taken from the World Development Indicator (WDI), the data for nominal effective exchange rate (NEER) of Malaysia, Singapore, China, Philippines, are taken from the IFS, whereas the NEER of Thailand, India and Indonesia are taken from Bank of International Settlements (BIS).

CHAPTER 4

DATA ANALYSIS

4.1 Introduction

This chapter discusses the results for all the regression models employed in the study. This chapter concludes with a comparison of the findings with the theoretical model proposed in Chapter 3. We performed panel cointegration tests to examine the relationship of reserves pooling in three models of reserves pooling; ASEAN-5 plus China, ASEAN-5 plus India, and ASEAN-5 plus China and India.

The ASEAN-5 plus China model consists of Indonesia, Malaysia, Philippine, Singapore, Thailand, and China. Meanwhile, the ASEAN-5 plus India consists of the ASEAN-5 countries and India. Similarly, the ASEAN-5 plus China and India consists of the ASEAN-5 countries plus China and India. This chapter presents the empirical results on the cointegration of reserve pooling among the countries in these three models. The cointegration techniques used were based on the Pedroni Panel Cointegration Test. The method used in this study is residual-based panel cointegration test developed by Pedroni. Pedroni has proposed several tests for cointegration that allow for heterogeneous slope coefficients across cross-sections.

In this study, we consider four tests namely: the panel PP-test, Panel ADF test, Group PP test, and Group ADF-test. In the null hypothesis, the residuals are non stationary (i.e., there is no cointegration relationship). In the alternative hypothesis, the residuals are stationary (i.e., there is a cointegrating relationship). The study used the two standard

method tests for Panel Unit Root Tests which are Levin, Lin and Chu (2002) and Im, Pesaran and Shin (2003).

4.2 Results for Panel Unit Root Test

As with other standard cointegration tests, it is important to know the stationarity properties of the data to ensure that no incorrect inferences are made. Testing for stationarity in panel data differs somewhat from conducting unit root tests in standard individual time series. Panel unit root test have been found to have a higher power than individual unit root ADF tests. The panel unit root tests take into account both the cross-section and time series variations in the data and these increase the power of the tests due to the increased number of observations that are available in the panel setting.

In order to determine the presence of a unit root in a panel data setting and to confirm the results from the individual unit root ADF tests, we have used the panel unit test based on Levin *et al.* (2002), Im *et al*. (1997), and applies the procedure (LLC and IPS respectively) on the panel data. The LLC and IPS tests are constructed such that the null hypothesis tested is that all the series in the panel contain a unit root against the alternative that none of the series contain a unit root. Therefore, although the test allows for heterogeneity in the panel, for example in lag order or the exact value for the autoregressive parameter, all the series must share the same stationarity properties.

When applying the LLC and IPS tests one has to be particularly careful in selecting the lag length for the ADF tests, since underestimating the true number of lags may lead to lack of explanatory power. We also employed the Akaike's Information Criterion (AIC) in choosing the appropriate number of lagged differences term for the five tests statistics.

AIC is known for its ability to select the maximum relevant lag. McKinnon's tables provide the cumulative distribution of the LLC and IPS test statistics.

Table 4.1 and Table 4.2 report the results of the LLC and IPS panel unit root tests for the data on *R*, which is actual holdings of reserves minus gold (millions of US dollars) deflated by the US GDP deflator, *P*; *pop* is the total population of the country; *gpc* is real GDP per capita; *exa* is the volatility of real export receipts; *imy* is the share of imports of goods and services in GDP; *neer* is the volatility of the nominal effective exchange rate and *gfc* is the gross fixed capital formation for both scenarios of constant and constant plus time trend term. The tests are run on a sample of seven countries over the period of 1994 to 2009.

Table 4.1: Levin, Lin & Chu (LLC) Results for reserves pooling

	LEVEL		**1st DIFERRENCE**	
Variable	**Individual intercept**	**Individual trend & intercept**	**Individual intercept**	**Individual trend & intercept**
R/P	1.498 (0.9965)	1.028 (0.8480)	-9.584* (0.0000)	-3.542* (0.0002)
POP	-1.603 (0.9387)	0.044 (0.5177)	-2.737** (0.0412)	3.330** (0.0301)
GPC	1.318 (0.9898	-0.143 (0.4431)	-6.862* (0.0000)	-7.682* (0.0000)
EXA	-1.216 (0.8217)	0.951 (0.8292)	-4.863* (0.0000)	-5.555* (0.0000)
IMY	-0.449 (0.3268)	-1.545 (0.9795)	-3.951* (0.0000)	-4.194* (0.0000)
NEER	-1.535 (0.8947)	-1.598 (0.9447)	-6.810* (0.0000)	-6.947* (0.0000)
GFC	-0.443 (0.4357)	-0.487 (0.4981)	-3.594* (0.0002)	-2.934* (0.0017)

Note: (*, **) indicates the rejection of null hypothesis of non – stationary at 1 %, 5%) significant level. ( ) indicates the probability value

Table 4.1 presents the results of the Levin, Lin and Chu (LLC) panel unit root tests at level values. Allowing for a constant but no time trend, our results indicate that all variables reject the null hypothesis of unit root in the panel unit root regression. These results clearly show that the null hypothesis of a panel unit root at the level value of the series can be rejected at various lag lengths. Next, we test for stationarity allowing for a constant plus time trend. In the absence of a constant plus time trend, we found that the null hypothesis of panel unit root is generally rejected in all series at level form and various lag lengths.

Table 4.1 also presents the results of the LLC tests at first difference allowing for a constant and a constant plus time trend. We can see that for all series the null hypothesis of a unit root is rejected at 99 percent critical value (1 per cent level) except for ln *pop* (rejected at 95 per cent critical value or 5 per cent level). Hence, based on the LLC test, there is a strong evidence that all series are in fact integrated of order one.

Table 4.2: Im, Pesaran & Shin W-stat (IPS) Results for reserves pooling

Variable	LEVEL		1st DIFERRENCE	
	Individual intercept	**Individual trend & intercept**	**Individual intercept**	**Individual trend & intercept**
R/P	1.172 (0.8794)	-0.541 (0.2943)	-9.584* (0.0000)	-4.217* (0.0000)
POP	-0.548 (0.2987)	-1.117 (0.1321)	-2.737** (0.0612)	2.631** (0.0557)
GPC	1.207 (0.9249)	12.550 (0.9946)	-6.862* (0.0000)	-5.999* (0.0000)
EXA	-1.504 (0.8617)	-0.423 (0.3362)	-4.863* (0.0000)	-5.278* (0.0000)
IMY	0.127 (0.5503)	-0.851 (0.1974)	-3.951* (0.0000)	-3.786* (0.0001)
NEER	-1.328 (0.9954)	-0.177 (0.4299)	-6.810* (0.0000)	-4.199* (0.0000)
GFC	-0.071 (01347)	-0.399 (0.6146)	-3.594* (0.0002)	-5.316* (0.0000)

Note: (*, **) indicates the rejection of null hypothesis of non – stationary at 1 %, 5%) significant level. ( ) indicates the probability value

Table 4.2 presents the results of the Im, Pesaran and Shin (IPS) panel unit root tests at level values. Allowing for a constant but no time trend, the results indicate that all variables reject the null hypothesis of unit root in the panel unit root regression. These results clearly show that the null hypothesis of a panel unit root in the level of the series can be rejected at various lag lengths. When we test for stationarity allowing for a constant plus time trend, we found that the null hypothesis of a panel unit root is generally rejected in all series at level form and various lag lengths.

Table 4.2 also presents the results of the IPS test at first difference, allowing for a constant and a constant plus time trend. We can see that for all series the null hypothesis

of unit root test is rejected at the 99 percent critical value (1 per cent level)) except for ln *pop* (rejected at the 95 percent critical value or 5 per cent level). Hence, based on the IPS test, there is a strong evidence that all series are in fact integrated of order one.

As discussed above, we can conclude that most of the variables are non-stationary in with and without time trend specifications at constant level by applying the LLC and IPS tests which are also applied for heterogeneous panel to test the series for the presence of a unit root. The results of the panel unit root tests confirm that the variables are non-stationary at level.

Based on LLC and IPS tests results discussed above, we can conclude that there is strong evidence that all the series are in fact integrated of order one. All the null hypotheses of unit roots are rejected at the 95 per cent critical value.

We can conclude that the results of panel unit root tests (LLC and IPS) reported in Table 4.1 and Table 4.2 support the hypothesis of a unit root in all variables across countries, as well as the hypothesis of zero order integration in first differences. At most of the 1 percent and 5 percent significance level, we found that all tests statistics in both with and without trends significantly confirm that all series strongly reject the null hypothesis of no unit root. The presence of unit roots in the variables also indicates that all the independent variables; ln *gpc*, ln *exa*, ln *imy*, ln *neer* and ln *gfc* and the dependent variables reserves pooling are in fact integrated of order one when the individual country data were pooled together.

Given the results of the LLC and IPS tests, it is possible to apply panel cointegration methodology in order to test for the existence of a stable long-run relation among the variables.

4.3 Cointegration Test

The non-stationarity of the variables as shown by the unit root tests raises the problem of spurious regressions. The spurious regression problem can be addressed by employing cointegration methodology. However, before the cointegration regression model can be estimated, it has to be first ascertained if the non-stationary variables are cointegrated with one another. The cointegration analysis is able to identify whether there exists a non spurious equilibrium relationship between then variables. Therefore, cointegration analysis is carried out on both individual and panel data to determine if the variables are cointegrated.

4.4 Results of Cointegration Test

After testing for the presence of unit roots, the next step is to test whether the variables are cointegrated using Pedroni's (1999, 2001, and 2004) methodology as described above. The purpose is to investigate whether a long-run steady state or cointegration exist among the variables and to confirm that the panel cointegration tests have higher testing power than conventional cointegration test. Since the variables are found to be integrated in the same order, we continue with the panel cointegration tests proposed by Pedroni (1999, 2001, and 2004). Cointegrations are carried out using a constant and a constant plus time trend. A summary of the results of cointegrations analyses are presented in Table 4.3.

Table 4.3: Results for Pedroni Cointegration Test

	ASEAN-5 plus China		ASEAN-5 plus India		ASEAN-5 plus China and India	
	Constant	Constant + Trend	Constant	Constant + Trend	Constant	Constant + Trend
Panel v-Statistic	0.472 (0.3569)	0.118 (0.3962)	1.831*** (0.0747)	2.490* (0.0180)	-1.090 (0.2203)	-1.090 (0.2527)
Panel rho-Statistic	-2.388* (0.0231)	-3.374* (0.0013)	0.872 (0.2728)	-2.097** (0.0443)	-3.464* (0.0010)	-3.464* (0.0002)
Panel PP-Statistic	-3.204* (0.0024)	-7.397* (0.0000)	-12.093* (0.0000)	-22.637* (0.0000)	-4.507* (0.0000)	-4.507* (0.0000)
Panel ADF-Statistic	-1.685*** (0.0965)	-2.720* (0.0099)	-8.212* (0.0000)	-8.714* (0.0000)	-2.506* (0.0173)	-2.506* (0.0000)
Group rho-Statistic	-3.392* (0.0013)	-4.218* (0.0001)	-1.999** (0.0541)	-2.397* (0.0226)	-2.392* (0.0228)	-2.392* (0.0157)
Group PP-Statistic	-5.000* (0.0000)	-8.487* (0.0000)	-21.133* (0.0000)	-25.459* (0.0000)	-6.083* (0.0000)	-6.083* (0.0000)
Group ADF-Statistic	-1.829*** (0.0749)	-2.945** (0.052)	-8.046* (0.0000)	-9.607* (0.0000)	-5.118* (0.0000)	-5.118* (0.0000)

Notes. All statistics are from Pedroni's procedure (1999) in which the adjusted values can be compared to the N(0,1) distribution.

Panel v is a nonparametric variance ratio statistic. Panel-*p* and panel-*t* are analogous to the nonparametric. Phillips-Perron *p* and *t* statistics respectively. Panel-*adf* is a parametric statistic based on the augmented Dickey-Fuller ADF statistic. Group-*p* is analogous to the Phillips-Perron p statistic. Group-*t* and group-*adf* are analogous to the Phillips-Perron *t* statistic and the augmented Dickey- Fuller ADF statistic respectively.

The Pedroni (2004) statistics are one-sided tests with a critical value of 1.64 ($k < -1.64$ implies rejection of the null), except the u-statistic that has a critical value of 1.64 ($k > 1.64$ suggests rejection of the null). Note that the means and variances used to calculate the Pedroni statistics are reported in Pedroni (1999).

*, **,*** indicates rejection of the null hypothesis of no-cointegration at 1% , 5% 10%, level of significance.

Including a constant term, we found that for ASEAN-5 plus China results indicate that 4 statistics reject the null by hypothesis of no cointegration at the 1 percent level of significance while another 2 statistics reject the null by hypothesis of no cointegration at

the 10 percent level of significance. Only 1 statistic (Panel v-Statistic) cannot reject the null hypothesis of no cointegration. Including a constant term, we also found that the results for ASEAN-5 plus India indicate that 4 statistics reject the null hypothesis of no cointegration at the 1 per cent significance level, 1 statistic reject the null hypothesis of no cointegration at the 5 percent significance level while 1 statistic reject the null hypothesis of no cointegration at the 10 percent level. We also found that only Panel rho-statistic cannot reject the null hypothesis of no cointegration. Besides that, in ASEAN-5 plus China and India, 6 statistics reject the null by hypothesis of no cointegration at the 1 percent significance level while only 1 statistic (Panel v-Statistic) cannot reject the null hypothesis of no cointegration.

Overall, the results of panel cointegration tests for all models, including a constant term show that the independent variables are cointegrated in the long run for the group of seven countries with respect to reserve pooling. As indicated by panel non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics as well as group statistics which are analogous to the LLC and IPS-test statistics, the null hypothesis of no cointegration is rejected at the 1 percent, 5 percent and 10 percent level of significance.

In the panel cointegration tests for ASEAN-5 plus China with a constant plus trend level, the results indicate that 5 statistics reject the null hypothesis of no cointegration at the 1 percent while 1 statistic reject the null hypothesis at the 5 percent level of significance. Panel v-Statistic failed to reject the null hypothesis of no cointegration. However, for ASEAN-5 plus India, the results indicate that all statistics reject the null hypothesis of no cointegration; 6 statistics at the 1 percent level and 1 statistic at the 5 percent level. Lastly, for ASEAN-5 plus China and India, the results indicate that 5 statistics reject the

null hypothesis of no cointegration at the 1 percent while only 1 statistic cannot reject the null hypothesis (Panel v-Statistic).

The results show that there is cointegration in the independent variables in the long run for the group of seven countries with respect to reserve pooling. However, since most of the variables are favor of cointegration, and this, combined with the fact that the according to Pedroni (1999) the panel non parametric (*t*-statistic) and parametric (*adf*-statistic) statistics are more reliable in a constant plus time trend model, we conclude that there is a long run cointegration among the variables in all countries.

Overall, in Table 4.3, we found that most of the panel statistics are more reliable in a constant plus time trend model compared to the panel statistic in a constant model. As indicated by the panel non-parametric (*t*-statistic) and parametric (*adf*-statistic) statistics as well as group statistics that are analogous to the LLC and IPS-test statistics, the null hypothesis of no cointegration is rejected at the 1 percent and 5 percent level of significance.

4.5 Panel FMOLS Estimates

This section discusses the estimated long-run equation. Following Pedroni (2000 and 2001), the cointegrated explanatory variables for the data are estimated using the Fully Modified OLS (FMOLS) technique. More or less, the cointegration vector should be common for the panel members, as fundamental economic principles are involved. Also, hypothesis testing is a critical issue. In fact, the asymptotic distribution of the Ordinary Least Squares estimator depends on nuisance parameters. In a panel environment, this

problem seems to be more serious, as the bias can accumulate with the size of the cross section.

As Pedroni (2000) showed, the problem is amplified in a panel setting by the potential dynamic heterogeneity over the cross-sectional dimension. Specifically, as this dimension increases, second order biases could be expected to occur by the poor performance of the estimators designed for large samples as they are averaged over the panel's members. For this reason, the modified FMOLS methodology to make inferences in cointegrated panels with heterogeneous dynamics as the cross-sectional dimension becomes large even with relatively short time series. The OLS estimator is a biased and inconsistent estimator when applied to cointegrated panels. Therefore, we estimate the long-run relationship using FMOLS approach suggested by Pedroni (2000, 2001). The FMOLS estimator not only generates consistent estimates of the β parameters in small samples, but it controls for the likely endogeneity of the regressors and serial correlation. The results of panel FMOLS are reported in Table 4.4.

Table 4.4: Individual FMOLS ASEAN-5 plus China

Panel member	*pop*	*gpc*	*exa*	*imy*	*neer*	*gfc*
Indonesia	-0.94	-0.03	0.16*	-0.04	0.02	0.11**
	(-0.83)	(-1.01)	(3.47)	(-0.77)	(0.33)	(2.37)
Malaysia	-1.61	-0.21*	0.52*	-0.12	0.58**	-0.01
	(-1.85)	(-3.61)	(3.30)	(-0.99)	(2.95)	(-0.02)
Philippines	0.12	-0.03	0.05	0.25**	0.51**	-0.09
	(0.13)	(-0.64)	(0.73)	(2.58)	(3.22)	(-1.17)

Singapore	-2.02	-0.03	-0.03	0.21	0.44	-0.12
	(-0.92)	(-0.22)	(-0.17)	(1.45)	(1.07)	(-1.00)
Thailand	-8.18*	-0.18*	0.21**	0.18**	0.80*	-0.06
	(-3.94)	(-4.16)	(2.12)	(2.32)	(3.80)	(-0.98)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 99% (95%) confidence level;

In Table 4.4, the individual FMOLS results for ASEAN-5 plus China show 6 variables reject the null hypothesis at the 1 percent level of significance while 5 variables reject the null hypothesis at the 5 percent level of significance. The estimated coefficient for the total population of the country (ln *pop*) for Indonesia, Malaysia, Singapore and Thailand are negative (-0.94, -1.61, -2.02 and -8.18). In contrast, the coefficient for the Philippines is positive (0.12). With regards to ln *gpc* , all the panel members show that their coefficient for ln *gpc* are negative (Indonesia: -0.03, Malaysia: -0.21, Philippines: -0.03, Singapore: -0.03 and Thailand: -0.18).

The estimated coefficient of the volatility of real export receipts (ln *exa*) for Indonesia, Malaysia, the Philippines and Thailand are positive (0.16, 0.52, 0.05, and 0.21) except for Singapore (-0.03). The estimated coefficient for the share of imports of goods and services in GDP (ln *imy*) for Indonesia and Malaysia are negative (-0.04 and -0.12) but positive for the Philippines, Singapore and Thailand (0.25, 0.21 and 0.18).

Meanwhile, the estimated coefficient for the volatility of the nominal effective exchange rate (ln *neer*) showe that all are positive ((Indonesia: 0.02, Malaysia: 0.58, Philippines: 0.51, Singapore: 0.44 and Thailand: 0.80). The estimated coefficient for the gross fixed

capital formation (ln *gfc*) for all members are negative except for Indonesia (Malaysia: -0.01 Philippines: -0.09, Singapore: -0.12, Thailand: -0.06, and Indonesia: 0.11,).

For Indonesia, the estimated coefficients for the volatility of real export receipts (ln *exa*), the volatility of the nominal effective exchange rate (ln *neer*), and the gross fixed capital formation (ln *gfc*) are positive. This situation means that real export receipts, nominal effective exchange rate and gross fixed capital formation increase the reserves pooling, which means that there is a long run cointegration among the volatility of real export receipts, the volatility of the nominal effective exchange rate, and the gross fixed capital formation in terms of reserves pooling.

For Malaysia, the estimated coefficient of the volatility of real export receipts (ln *exa*) and the volatility of the nominal effective exchange rate (ln *neer*) are positive. This finding indicates that real export receipts and nominal effective exchange rate increase the reserves pooling, which means that the volatility of real export receipts and the volatility of the nominal effective exchange rate have a long run cointegration with reserves pooling in terms of ASEAN-5 plus China.

For the Philippines the estimated coefficients of the total population of the country (ln *pop*), volatility of real export receipts (ln *exa*), share of imports of goods and services in GDP (ln *imy*), and volatility of the nominal effective exchange rate (ln *neer*) are positive. This means that total population of the country, real export receipts, share of imports of goods and services in GDP, and nominal effective exchange rate increase reserves pooling. This result means that there is a long run cointegration between the total population of the country, the volatility of real export receipts, the share of imports

of goods and services in GDP, and the volatility of the nominal effective exchange rate and reserves pooling for ASEAN-5 plus China.

For Singapore, the estimated coefficients for the share of imports of goods and services in GDP (ln *imy*) and the volatility of the nominal effective exchange rate (ln *neer*) are positive. Therefore, we can conclude that the share of imports of goods and services in GDP and nominal effective exchange rate increase the reserves pooling, meaning that there is a long run cointegration between the share of imports of goods and services in GDP and the volatility of the nominal effective exchange rate and reserves pooling in ASEAN-5 plus China.

Finally, for Thailand, the estimated coefficient for the volatility of real export receipts (ln *exa*), the share of imports of goods and services in GDP (ln *imy*), and the nominal effective exchange rate (ln *neer*) are positive. This result shows that real export receipts, the share of imports of goods and services in GDP, and the nominal effective exchange rate increase the reserves pooling. This means that there is a long run cointegration between the volatility of real export receipts and the share of imports of goods and services in GDP and reserves pooling in ASEAN-5 plus China.

Table 4.5: .ASEAN-5 plus China Panel Group FMOLS results

	pop	*gpc*	*exa*	*imy*	*neer*	*gfc*
ASEAN-5+China	-2.52*	-0.10*	0.18*	0.10**	0.47*	-0.03
	(-3.31)	(-4.32)	(4.23)	(2.05)	(5.09)	(-0.35)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 99% (95%) confidence level;

In Table 4.5, panel group FMOLS shows that 4 variables in ASEAN-5 plus China reported tests reject the null hypothesis at the 1 per cent significance level while one variable reject the null hypothesis at 5 percent level of significance. The results indicate that the estimated coefficients for total real exports, the share of imports in GDP and nominal effective exchange rate are positive (0.18, 0.10 and 0.47). This result shows that the estimated coefficients for volatility of real export receipts (ln *exa*), the share of imports of goods and services in GDP (ln *imy*) and the volatility of the nominal effective exchange rate (ln *neer*) increase reserves pooling mobility, which means that there is a long run cointegration between the variables.

Table 4.6: Individual FMOLS ASEAN-5 plus India Results

Panel member	*pop*	*gpc*	*exa*	*imy*	*neer*	*gfc*
Indonesia	1.13*	0.30*	-0.41*	-011**	0.11**	-0.51*
	(10.08)	(3.52)	(-4.24)	(-1.95)	(1.95)	(-6.25)
Malaysia	-0.54*	0.33*	0.58*	-0.57*	-0.02	-0.11**
	(-6.80)	(3.75)	(6.06)	(-6.70)	(-1.07)	(-2.96)
Philippines	0.01	0.42*	0.01	-0.12**	-0.18**	-0.40*
	(0.12)	(4.66)	(0.18)	(-2.61)	(-1.99)	(-4.21)
Singapore	0.16**	-0.01	-0.01	0.01	0.36*	0.31*
	(1.97)	(-0.09)	(-0.09)	(1.24)	(4.01)	(3.63)
Thailand	0.03	0.00	-0.00	0.00	-0.00	-0.00**
	(0.59)	(0.40)	(-0.77)	(0.62)	(0.52)	(-2.08)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 99% (95%) confidence level;

Table 4.6 shows the individual FMOLS results without time dummies. In the ASEAN-5 plus India model, , 12 variables reject the null hypothesis at the 1 percent significance level while 7 variables in the ASEAN-5 plus India model reject the null hypothesis at the 5 percent level of significance. The estimated coefficients for the total population of the country (ln *pop*) for Indonesia, the Philippines, Singapore and Thailand are positive

(1.13, 0.01, 0.16 and 0.03). In contrast, only Malaysia has a negative coefficient (-0.54) for the ln *pop*. Meanwhile, all but one panel members show postitive coefficients for ln *gpc* (Indonesia: 0.30, Malaysia: 0.33, Philippines: 0.42 and Thailand: 0.00 while Singapore -0.01).

The estimated coefficients for the volatility of real export receipts (ln *exa*) for Indonesia, Singapore and Thailand are negative (-0.41, -0.01 and -0.00). Both Malaysia and the Philippines have positive coefficients for the volatility of real export receipts (ln *exa*) (0.58 and 0.01). The estimated coefficients for the share of imports of goods and services in GDP (ln *imy*) for Indonesia, Malaysia and Philippines are negative (-0.11, -0.57, and -0.12). On the other hand, both Singapore and Thailand have positive coefficients for the share of imports of goods and services in GDP (ln *imy*) (0.01 and 0.00).

The estimated coefficients for the volatility of the nominal effective exchange rate (ln *neer*) for Indonesia and Singapore are positive (0.11 and 0.36). In contrast, the coefficients for the volatility of the nominal effective exchange rate for Malaysia, the Philippines and Thailand were negative (-0.02, -0.18 and -0.00). The estimated coefficients for the gross fixed capital formation (ln *gfc*) are negative for all members except for Singapore (Indonesia: - 0.51, Malaysia: -0.11, Philippines: -0.40, Singapore: 0.31 and Thailand: -0.00).

From the results presented above, we can conclude that the estimated coefficients for the total population of the country (ln *pop*), real GDP per capita (ln *gpc*) and volatility of the nominal effective exchange rate (ln *neer*) for Indonesia are positive. This situation means that population and real GDP per capita increase reserves mobility,

which means that there is a long run cointegration between the population of the country, real GDP per capita and the volatility of the nominal effective exchange rate with reserves pooling.

For Malaysia, the estimated coefficients for real GDP per capita (ln *gpc*) and the volatility of real export receipts (ln *exa*) are positive and statistically significant at the 1 percent significance level. This result shows that real GDP per capita and real export increase reserves pooling, which means that real GDP per capita and real export receipts have a long run cointegration with reserves pooling in ASEAN-5 plus India.

For the Philippines, the estimated coefficient for the total population of the country (ln *pop*), real GDP per capita (ln *gpc*) and volatility of real export receipts (ln *exa*) are positive. This result indicates that population, GDP and exports increase reserves pooling. This result means that there is a long run cointegration between the total population of the country, real GDP per capita and the volatility of real export receipts and reserves pooling in ASEAN-5 plus India.

For Singapore, the estimated coefficients for the total population of the country (ln *pop*), the share of imports of goods and services in GDP (ln *imy*), the volatility of the nominal effective exchange rate (ln *neer*), and the gross fixed capital formation (ln *gfc*) are positive. Therefore, from this result, we can conclude that total population of the country, real export receipts, nominal effective exchange rate and gross fix capital formation increase the reserves pooling.

Finally, for Thailand, the estimated coefficients for the total population of the country (ln *pop*), real GDP per capita (ln *gpc*) and the share of imports of goods and services in

GDP (ln *imy*) are positive. This result shows that total population of the country, real GDP per capita and share of imports of goods and services in GDP increase reserves pooling.

Table 4.7.ASEAN5-5 plus India Panel Group FMOLS results

	pop	*gpc*	*exa*	*imy*	*neer*	*gfc*
ASEAN-5+India	-0.18**	0.49*	0.02	-0.41*	0.11	-0.47*
	(2.53)	(5.51)	(0.55)	(-4.21)	(1.11)	(-5.31)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 99% (95%) confidence level;

In Table 4.7, panel group FMOLS shows that 3 variables in ASEAN-5 plus India model reject the null hypothesis at the 1 percent significance level while 1 variable rejects the null hypothesis at the 5 percent level of significance. The result shows that the estimated coefficients for the real GDP per capita, total real exports and nominal effective exchange rate are positive (0.49, 0.02 and 0.11). This result means that the estimated coefficients for real GDP per capita (ln *gpc*), the volatility of real export receipts (ln *exa*) and the volatility of the nominal effective exchange rate (ln *neer*) increase reserve pooling mobility. Alternatively, there is a long run cointegration among the variables.

Table 4.8: Individual FMOLS ASEAN-5 plus China and India results

Panel member	*pop*	*gpc*	*exa*	*imy*	*neer*	*Gfc*
China	-15.01**	-0.07	0.92**	0.85**	2.94*	-2.89*
	(-2.46)	(-0.37)	(2.31)	(2.02)	(3.30)	(-4.18)
India	0.01	0.31*	0.03	-0.51	-0.04	-0.51*
	(1.54)	(3.19)	(0.65)	(-1.53)	(-0.76)	(-5.14)
Indonesia	0.12**	-0.03	-0.03	-0.13**	-0.01	-0.01
	(2.16)	(-1.81)	(-1.88)	(-2.42)	(-0.76)	(-0.69)

Malaysia	-0.38* (-3.28)	0.04 (1.39)	0.42* (4.44)	-0.32* (-3.76)	0.07 (0.69)	0.02 (1.57)
Philippines	0.01 (0.49)	0.02 (0.76)	0.04 (0.95)	-0.10 (-1.16)	0.03 (0.42)	-0.09 (-1.62)
Singapore	-0.03 (-1.00)	0.04** (2.97)	-0.27* (-4.75)	0.23* (3.52)	-0.04 (-0.87)	0.03 (1.42)
Thailand	-0.01 (-0.18)	0.00 (0.15)	0.00 (0.15)	0.01 (0.93)	0.01 (0.01)	-0.04 (-0.60)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 99% (95%) confidence level;

In Table 4.8, for the individual FMOLS results, for ASEAN-5 plus China and India, 9 variables reject the null hypothesis at the 1 percent level of significance while 6 variables reject the null hypothesis at the 5 percent level of significance. The estimated coefficients for the total population of the country (ln *pop*) for China, Malaysia, Singapore and Thailand are negative (-15.01, -0.38, -0.03 and -0.01), but positive for India, Indonesia and the Philippines (0.01, 2.16 and 0.49). The estimated coefficients for the real GDP per capita (ln *gpc*) are positive for India, Malaysia, Philippines, Singapore and Thailand (0.31, 0.04, 0.02. 0.04 and 0.00). However, the ln *pop*s coefficients are negative for China and Indonesia (-0.07 and -0.03).

The estimated coefficients for the volatility of real export receipts (ln *exa*) for China, India, Malaysia and Thailand are positive (0.92, 0.03, 0.42, 0.04 and 0.00), but negative for Indonesia and Singapore (-0.03 and -0.27). The estimated coefficients for the share of imports of goods and services in GDP (ln *imy*) for China, Singapore and Thailand are positive (0.85, 0.23 and 0.01), but negative for India, Indonesia, Malaysia and the Philippines (-0.51, -0.13, -0.32 and -0.01).

The estimated coefficients for the volatility of the nominal effective exchange rate (ln *neer*) for China, Malaysia, Philippines and Thailand are positive (2.94, 0.07, 0.03 and

0.01), but negative for India, Indonesia and Singapore (-0.04, -0.01 and -0.04). The estimated coefficients for the gross fixed capital formation (ln *gfc*) for Malaysia and Singapore are positive (0.02 and 0.03), but negative for China, India, Indonesia, the Philippines and Thailand (-2.89, -0.51, -0.01, -0.09 and -0.04).

In conclusion, for China, the estimated coefficients of the volatility of real export receipts (ln *exa*), the share of imports of goods and services in GDP (ln *imy*) and volatility of the nominal effective exchange rate (ln *neer*) are positive. This situation means that total real exports, share of imports in GDP and nominal exchange rate increase the reserves pooling. In other words, there is a long run cointegration between these variables with reserves pooling.

For India, the estimated coefficients for the total population of the country (ln *pop*), real GDP per capita (ln *gpc*) and the volatility of real export receipts (ln *exa*) are positive. This result shows that total population of the country, real GDP per capita and the volatility of real export receipts increase reserves pooling in ASEAN-5 plus China and India. This means that there is a long run cointegration between these variables and reserves pooling.

Interestingly, for Indonesia, only the estimated coefficient for the total population of the country (ln *pop*) is positive. This result shows that only population increase reserves pooling in the ASEAN-5 plus China and India, which means that there is a long run cointegration between this variable and reserves pooling.

For Malaysia, the estimated coefficients for real GDP per capita (ln *gpc*), volatility of real export receipts (ln *exa*), volatility of the nominal effective exchange rate (ln *neer*) and gross fixed capital formation (ln *gfc*) are positive. This result shows that real GDP per capita, real export receipts, nominal effective exchange rate and the volatility of the

nominal effective exchange increase the reserves pooling in ASEAN-5 plus China and India. In other words, these variables have a long run cointegration with reserves pooling.

For the Philippines, the estimated coefficients for the total population of the country (ln *pop*), real GDP per capita (ln *gpc*), and volatility of real export receipts (ln *exa*), and volatility of the nominal effective exchange rate (ln *neer*) are positive. This means that total population of the country, real GDP per capita, real export receipts and nominal effective exchange rate increase reserves pooling in ASEAN-5 plus China and India. The results indicate that there is a long run cointegration between these variables reserves pooling.

For Singapore, the estimated coefficients for the real GDP per capita (ln *gpc*), share of imports of goods and services in GDP (ln *imy*), and gross fixed capital formation (ln *gfc*) are positive. We can therefore conclude that real GDP per capita, imports of goods and services in GDP and gross fix capital formation increase reserves pooling, which means that there is a long run cointegration between these variables and reserves pooling in ASEAN-5 plus China and India.

Lastly, for Thailand the estimated coefficients for the real GDP per capita (ln *gpc*), volatility of real export receipts (ln *exa*), share of imports of goods and services in GDP (ln *imy*), and volatility of the nominal effective exchange rate (ln *neer*) are positive. This result shows that real GDP per capita, of real export receipts, imports of goods and services and nominal effective exchange rate increase reserves pooling, which means that there is a long run cointegration between these variables and reserves pooling in ASEAN-5 plus China and India.

Table 4.9 ASEAN-5 plus China and India Panel Group FMOLS Results

	pop	*gpc*	*exa*	*imy*	*neer*	*gfc*
ASEAN5+2	-2.20 (-1.03)	0.19** (2.37)	0.15 (0.71)	0.11 (-0.91)	0.42 (0.76)	-0.41 (-0.49)

Note: Figures in parentheses are *t*-statistics; (*) and (**) significant with 95% (90%) confidence level;

In table 4.9, panel group FMOLS shows that the estimated coefficients for the real GDP per capita (ln *gpc*), volatility of real export receipts (ln *exa*), share of imports of goods and services in GDP (ln *imy*), and volatility of the nominal effective exchange rate (ln *neer*) are positive (0.19, 0.15, 0.11 and 0.42). This result shows that the real GDP per capita, the volatility of real export receipts , the imports of goods and services and the nominal effective exchange rate increase reserve pooling. This result means that there is a long run cointegration between these variables in ASEAN-5 plus China and India.

4.6 Data Analysis

Our findings are consistent with Pedroni (1996, 2001). A summary of the empirical results of the reserves pooling in ASEAN-5 plus China, ASEAN-5 plus India and ASEAN-5 plus China and India models are presented in Table 5.1.

Overall, the total population of all countries has a negative relationship with reserves pooling in ASEAN-5 plus China model except for the Philippines. However, in the ASEAN-5 plus India model, all countries show that total population has a positive relationship with reserves pooling except for Malaysia. The relationship between total population and reserves pooling also differ in ASEAN-5 plus China and India model. Therefore, we can conclude that total population has different relationship with reserves pooling in the three models of reserves pooling. Generally, total population has a negative relationship with reserves pooling in all three models.

Table 5.1: Summary of the sign of long run relationship

Determinant	FMOLS (Individual)	FMOLS (Panel Group)
	ASEAN-5 plus China	
Pop	Indo(-), Msia(-), Phil(+), Sin(-), Thai (-)	-
Gpc	Indo(-), Msia(-), Phil(-), Sin(-), Thai (-)	-
Exa	Indo(+), Msia(+), Phil(+), Sin(-), Thai (+)	+
Imy	Indo(-), Msia(-), Phil(+), Sin(+), Thai (+)	+
Neer	Indo(+), Msia(+), Phil(+), Sin(+), Thai (+)	+
Gfc	Indo(+), Msia(-), Phil(-), Sin(-), Thai (-)	-
	ASEAN-5 plus India	
Pop	Indo(+), Msia(-), Phil(+), Sin(+), Thai (+)	-
Gpc	Indo(+), Msia(+), Phil(+), Sin(-), Thai (+)	+
Exa	Indo(-), Msia(+), Phil(+), Sin(-), Thai (-)	+
Imy	Indo(-), Msia(-), Phil(-), Sin(+), Thai (+)	-
Neer	Indo(+), Msia(-), Phil(-), Sin(+), Thai (+)	+
Gfc	Indo(-), Msia(-), Phil(-), Sin(+), Thai (-)	-
	ASEAN-5 plus China and India	
Pop	Chin (-), Indi(+),Indo(+),Msia(-), Phil(+), Sin(-), Thai (-)	-
Gpc	Chin (-), Indi(+),Indo(-), Msia(+), Phil(+), Sin(+), Thai (+)	+
Exa	Chin (+), Indi(+),Indo(-), Msia(+), Phil(+), Sin(-), Thai (+)	+
Imy	Chin (+), Indi(-), Indo(-), Msia(-), Phil(-), Sin(+), Thai (+)	-
Neer	Chin (+), Indi(-), Indo(-), Msia(+), Phil(+), Sin(-), Thai (+)	+

Gfc	Chin (-), Indi(-), Indo(-), Msia(+), Phil(-), Sin(+), Thai (-)	-

The real GDP per capita also has different relationship with reserves pooling in each model of reserves pooling. Real GDP per capita is negative for all countries in the ASEAN-5 plus China model. However, all countries show positive relationship between real GDP percapita and reserves pooling except for Singapore in the ASEAN - 5 plus India model. Indeed, the relationship between the determinant and reserves pooling also differ in ASEAN-5 plus China and India model. Generally, the relationship between real GDP and reserves pooling is positive in the ASEAN-5 plus India and the ASEAN-5 plus China and India models but negative for the ASEAN-5 plus China model.

The volatility of real export receipts of Singapore has a negative relationship with reserves pooling in all models. Indonesia shows a negative relationship between volatility of real export receipts and reserves pooling in all models except for the ASEAN-5 plus China model. For Thailand, the determinant is positive in all models except for the ASEAN-5 plus India model. Generally, the volatility of real export receipts by all countries has a positive relationship with reserves pooling in all models.

The share of imports of goods and services in GDP also has a different relationship with reserves pooling in the three models. The determinant of the share of imports and goods and services in GDP for Indonesia and Malaysia shows a negative relationship with reserves pooling in all models. The determinants for Singapore and Thailand show a positive relationship with reserves pooling in all models. However, for the Philippines, the determinant shows a positive relationship with reserves pooling in all models except for the ASEAN-5 plus India model. Generally, the share of imports of

goods and services in GDP has a negative relationship with reserves pooling in all models except for the ASEAN-5 plus China model.

The volatility of nominal effective exchange rate also has a different relationship with reserves pooling in each model. The determinants for Malaysia and the Philippines are positive in all models except for the ASEAN-5 plus India model. The determinant is also positive for Singapore in the ASEAN-5 plus China and ASEAN-5 plus India models. The determinant for Indonesia is negative for all models except for the ASEAN-5 plus China and India models. For Thailand, the volatility of nominal effective exchange rate has a positive relationship with reserves pooling in all models. In general, the volatility of nominal effective exchange rate has a positive relationship with reserves pooling in all models.

Lastly, the gross fixed capital formation has a negative relationship with reserves pooling in all models for Indonesia except for the ASEAN-5 plus China model. The gross fixed capital formation has a negative relationship with reserves pooling in all models for Malaysia except for the ASEAN-5 plus China and India model. The determinant is positive for Singapore in all models except for the ASEAN-5 plus China model. For the Philippines and Thailand, the determinants are negative in all models.

The results that we obtained in the previous chapter indicate that we are successful in achieving our objective which is to test the relationship of reserves pooling in seven countries: China, India, Indonesia, Malaysia, the Philippines, Singapore and Thailand. These results may explain the long run relationship between the independent variable and the dependent variables in the three models (ASEAN-5 plus China, ASEAN-5 plus India and ASEAN-5 plus China and India).

CHAPTER 5

CONCLUSION AND POLICY RECOMMENDATION

5.1 Introduction

This chapter provides the summary, conclusion, policy implications related to the findings (as discussed in Chapter 4), limitations of the study, and suggestions for future research.

5.2 Conclusion

This study investigates reserves pooling in five selected ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand) to China and India for the period of 1994 to 2009 using panel data method. The study found that there are different links between the dependent and the independent variables, depending on the model used.

We formulated a simple reserves pooling model which is based on the work of Aizenman and Marion (2002) in which the long run relationship between total population of the country, real GDP per capita, volatility of real export receipts, the share of imports and services in GDP, volatility of the nominal effective exchange rate and gross fixed capital formation and reserves pooling was examined for a sample of ASEAN-5 plus China and India using recently developed panel cointegration methods and Fully Modified Ordinary Least Square method.

Before we test the long run relationship between the determinants, firstly, we test the statistical properties of the explanatory variables within a panel context using LLL and IPS statistics. The empirical results from the LLC test indicate that all series in the model are significant and reject the null hypothesis at 1st difference for individual intercept. All series in the model are also significant and able to reject the null hypothesis at 1st difference in terms of an individual trend and intercept. The empirical results from the IPS test also indicate that all series in the model are stationary at 1st difference for individual intercept and also for individual trend and intercept. This result means that they are stationary at 1st difference, while the results based on the tests for panel cointegration provide empirical support that the variables can be considered as a cointegrated panel system.

The first objective of this study is to examine the long run relationship between the determinants of reserves pooling in ASEAN-5 countries and the determinants of reserves pooling in China. From the test results, we found that by using panel cointegration test and FMOLS data estimates, there is a long run relationship between all determinants of the reserves pooling.

Individually, the population of Indonesia, Malaysia, Singapore and Thailand exerts negative impact on reserves pooling. The negative impact implies that when the population of these countries increases, the reserves pooling in the Asean-5 plus China will decrease. However, the population of the Philippine has a positive relationship with reserves pooling in the model, which means that when its population increases, the reserves pooling in Asean-5 plus China also increases.

The real GDP per capita of each country shows a negative impact with reserves pooling in the model. This result means that when the real GDP per capita of any country increases, the reserves pooling in ASEAN-5 plus China also decreases.

The volatility of real export receipts is positive for all countries in the Asean-5 plus China model except for Singapore. This means that when the volatility of real export receipts of Indonesia, Malaysia, the Philippines and Thailand increases, the reserves pooling in ASEAN-5 plus China also increase. On the other hand, when the volatility of real export receipts of Singapore increases, the reserves pooling in the ASEAN-5 plus China will decrease.

The share of imports and services in GDP of Indonesia and Malaysia has a negative relationship with reserves pooling in the ASEAN-5 plus China. However, the share of imports and services in GDP of the Philippines, Singapore and Thailand has a positive relationship with reserves pooling.

The volatility of the nominal effective exchange rate for all countries member has a positive relationship with the reserves pooling in the ASEAN-5 plus China model. This means that when the volatility of the nominal effective exchange rate increases, the reserves pooling in ASEAN-5 plus China also increase.

Lastly, in the ASEAN-5 plus China model, gross fixed capital formation of all countries has a negative relationship with the reserves pooling except for Indonesia. This result means that when the gross fixed capital formation of Indonesia increases, the reserves pooling in the ASEAN-5 plus China also increase. But, when the gross fixed capital formation of other countries increases, the reserves pooling in the model decrease.

By group, we can conclude that the total population of the country, real GDP per capita and the gross fixed capital formation have a negative relationship with reserves pooling

in the ASEAN-5 plus China model. In contrast, the volatility of real export receipts, the share of imports of goods and services in GDP, and the volatility of the nominal effective exchange rate have a negative relationship with reserves pooling in that model.

The second objective of this study is to examine the long run relationship between the determinants of reserves pooling in the ASEAN-5 and the determinants of reserves pooling in India. The test results show that by using panel cointegration test and FMOLS data estimates, there is also a long run relationship between all determinants of reserves pooling.

Individually, the population of all countries in the ASEAN-5 plus India model has a positive relationship with reserves pooling except for Malaysia. This means that when the population of Indonesia, the Philippines, Singapore and Thailand increases, the reserves pooling in the ASEAN-5 plus India model also increase. In contrast, when the population of Malaysia increases, the reserves pooling in that model will decrease.

The real GDP per capita of all countries is positive except for Singapore. This means that when the real GDP per capita of Indonesia, Malaysia, the Philippines and Thailand increases, the reserves pooling in the ASEAN-5 plus India also increase. In contrast, when the real GDP per capita of Singapore increases, reserves pooling in the ASEAN-5 plus India will decrease.

The volatility of real export receipts of Indonesia, Singapore and Thailand has a negative relationship with the reserves pooling in the ASEAN-5 plus India. However, the volatility of real export receipts of Malaysia and Philippine has a positive relationship with the reserves pooling in the model.

The share of imports and services in GDP of Indonesia, Malaysia and the Philippines has a negative relationship with reserves pooling. However, the share of imports and services in GDP is positive for Singapore and Thailand.

The volatility of the nominal effective exchange rate of Indonesia, Singapore and Thailand has a positive relationship with reserves pooling in the ASEAN-5 plus India model. However, the determinant is negative for Malaysia and the Philippines.

Lastly, in the ASEAN-5 plus India model, gross fixed capital formation of all countries has a negative relationship with reserves pooling except for Singapore. This means that when the gross fixed capital formation of Singapore increases, reserves pooling in the ASEAN-5 plus India will decrease. However, when gross fixed capital formation of other countries increases, reserves pooling in the model will increase.

By group, we can conclude that the total population of the country, the share of imports of goods and services in GDP and the gross fixed capital formation has a negative relationship with reserves pooling in the ASEAN-5 plus India model. In contrast, real GDP per capita and the volatility of real export receipts and the volatility of the nominal effective exchange rate have a positive relationship with reserves pooling in the model.

The third objective of the study is to examine the long run relationship between the determinants of reserves pooling in ASEAN-5 and the determinants of reserves pooling in China and India. Based on the results, we found that by using panel cointegration test and FMOLS data estimates, there is also a long run relationship between all determinants of reserves pooling in the model.

Individually, the population of China, Malaysia, Singapore and Thailand has a negative relationship with reserves pooling in this model. This means that when the population of China, Malaysia, Singapore and Thailand increase, reserves pooling in the ASEAN-5

plus China and India model will decrease. However, when the population of India, Indonesia and the Philippines increases, reserves pooling in this model will increase since this determinant has a positive relationship with reserves pooling in these countries.

The real GDP per capita of all countries is positive except for China and Indonesia. This means that when the real GDP per capita of India, Malaysia, the Philippines, Singapore and Thailand increase, reserves pooling in the ASEAN-5 plus India also increase. However, if the real GDP per capita of China and Indonesia increase, the reserves pooling in the ASEAN-5 plus China and India will decrease.

The volatility of real export receipts of all countries has a positive relationship with reserves pooling in the ASEAN-5 plus China and India except for India and Singapore. This result means that if the volatility of real export receipts of any country increases, reserves pooling in the model will increase except for India and Singapore.

The share of imports and services in GDP of China, Singapore and Thailand has a positive relationship with reserves pooling in this model. However, the share of imports and services in GDP is negative for India, Indonesia, Malaysia and the Philippines.

The volatility of the nominal effective exchange rate of China, Malaysia, the Philippines and Thailand has a positive relationship with reserves pooling in the ASEAN-5 plus China and India model. However, the determinant implies the negative relationship for India, Indonesia, Malaysia and Singapore.

Lastly, in the ASEAN-5 plus China and India model, gross fixed capital formation of all countries has a negative relationship with reserves pooling except for Malaysia and Singapore. This means that when the gross fixed capital formation of Malaysia or Singapore increases, reserves pooling in the ASEAN-5 plus India will decrease. In

contrast, when the gross fixed capital formation of other countries increases, reserves pooling in the model will also increase.

By group, we can conclude that total population of the country, share of imports of goods and services in GDP, and gross fixed capital formation have negative relationship with reserves pooling in the ASEAN-5 plus China and India model. However, real GDP per capita and the volatility of real export receipts and the volatility of the nominal effective exchange rate have positive relationship with reserves pooling in the model.

Overall, the three model of reserves pooling, ASEAN-5 plus China, ASEAN-5 plus India, and ASEAN-5 plus China and India have been tested to see if there is a statistically valid cointegrating relationship between these variables using the Pedroni (1999, 2004) test. Subsequently we attempted to estimate what that relationship might be using the within and the group mean FMOLS, also suggested by Pedroni (1996, 2001). The results show that there is a cointegrating relationship among the independent variables and reserve pooling for the equation with a constant plus time trend. Panel group FMOLS estimators consistently produce larger estimates than the within group FMOLS estimators.

5.3 Policy Recommendation

The empirical findings discussed earlier are intended to provide some guidance our policy makers in making a right decision to set up a self-managed reserve pooling mechanism governed by a legally binding single contract. The issue that needs to be discussed is whether the group should set up a new central body or secretariat to manage pooled foreign reserves.

This pooling scheme will eventually lead to an ASEAN-5 plus China and India Monetary Fund. For now, a self-managed scheme means that each participating country would continue managing their reserves at home even after committing them for the pooling arrangement. Pooled reserves would still likely be counted as part of their national reserves.

Based on the results discussed earlier, we first need to control the factors which affect reserves pooling in the ASEAN-5 plus China and India region. The first factor that needs to be scrutinized is real GDP. Real GDP is an important factor in explaining reserves pooling behavior. This is because GDP is one of the sources of international reserves. The increase in real GDP will tend to increase reserve movement. Therefore, all countries should maintain or increase their GDP growth.

Besides GDP, the volatility of real export and import receipts are also important factors which can influence reserves pooling movement. Thus, these countries have to properly control their exports and imports.

Real export and import actually play an important role in the ASEAN-5 plus China and India reserves pooling. In our case, based on our results, we found that real export has a positive impact on international pooling mobility in the ASEAN-5 plus China and India.

Due to this fact, policy makers should implement a policy that will increase real exports among these countries, for example by increasing their individual exports in products that they comparative advantage within the region. Policy makers can also alter certain trading acts to reduce restriction of multilateral trade among the region members.

Nominal effective exchange rate is also an important factor in determining reserves pooling within the ASEAN-5 plus China and India. Nominal effective exchange rate can be described as one factor in which there exist economic uncertainty. The increase

in nominal effective exchange rate will increase reserve movement among the countries within the region.

Admitting a member to the group involves a tradeoff between diversification benefits and monitoring costs, and may result in a group that consists of a limited number of countries. However, the macroeconomic risks sharing within a 'club' or 'pool' consisting of a limited number of countries is better than a worldwide club.

The study of Jeans Imbs and Paolo Mauro (2007) found that pooling risk among countries can deliver sizable welfare gains. Indeed, substantial gains can be obtained in pools consisting of a handful of countries, and marginal gains decline quickly for group beyond six or seven members. Monitoring and enforcement may be easier within smaller groups of countries and they have shown that risk sharing pools involving a handful of economies can often provide substantial welfare.

When countries have their own pooling scheme, member countries can have access to the others' reserves in times of need. At the same time, by pooling, each country is taking on the variability of their entire pool, rather than just the variability of its own reserves.

We also expect the reserve pool to facilitate trade and spur financial and economic integration in the region. For the reserve pool to be operational, a proper surveillance mechanism will have to be established to monitor the development in the region's economy and financial system.

In recognition of the financial interdependence in the ASEAN-5 region, Indonesia, Malaysia, the Philippines, Singapore and Thailand have to step up its cooperation with China and India. The ASEAN-5 plus China and India's finance and central bank authorities should propose a regional support mechanism that would include setting up a

network of Asian training and research institutes and establishing a regional financing arrangement to supplement existing international facilities. In addition, they should set up a system of monitoring capital flows and to strengthen the regional surveillance mechanism in Asia. An independent surveillance institution can overcome the institutional issues facing the ASEAN-5 plus China and India financial integration.

Sovereignty and political issues that the ASEAN-5 plus China and India countries are currently facing are much more difficult to overcome than economic issues. Political reforms and democratization can take decades. To bypass poor political fundamentals that affect the transparency of economic institutions, the introduction of an independent surveillance institution is more efficient than trying to solve sovereignty issues and institute political reforms. If the decision to reveal financial data is left to the discretion of senior officials representing individual countries, they may never reach a level of fiscal transparency sufficient such as the Chiang Mai Initiatives credit lines, which are essential for regional financial integration.

The purpose of this pool is to be an alternative source to the International Monetary Fund and therefore should be made a bit more lenient and flexible. We need to reduce our dependence on the IMF. We should stand on our own feet so that we can reduce IMF involvement in handling regional financial issues.

5.4 Limitations of the Study

There are several limitations in this study. Besides experiencing a difficulty in finding the data to complete this study, our results show that some of the signs for the variables chosen in this study do not fulfill our expectation. Therefore, future studies should be concerned about this problem and provide explanation on the reasons for this

contradition. Future studies might also want to add more variables that can affect the mobility of reserve pooling among these countries.

Furthermore, there are other variables that can be added as explanatory variables in explaining reserves pooling. Future studies might want to identify these additional variables and their relationship with reserves pooling.

Future studies may also want to use a longer duration of panel data compared to this study or separate the data into quarterly or monthly time period. A longer duration may explain the variables better. In addition, future studies might also want to focus more on establishing theoretical foundations to support the empirical results of this study.

5.5 Suggestion for Further Studies

The fact that the ASEAN economies maintain about half of the world's foreign exchange reserves suggest that first there is a potential resource misallocation with significant opportunity costs and second the region has sufficient aggregate reserves to develop a large and credible common reserve pool arrangement.

The reserves are reasonably evenly distributed across many strong currency countries including China and Singapore. This is important since if the region has a balance of "weak currency countries", creating sustainable common reserve pool would be a problem. It is highly unlikely that strong currency countries would allow their reserves to be constantly compromised by weaker currency countries.

On the other hand, if the reserves are evenly distributed among a number of "strong currency countries", they will be able to work together and to encourage the weak currency ones to implement necessary macroeconomic and structural reforms in order to

remain eligible to draw upon the common pool when needed. Member countries with somewhat smaller reserves or limited technical capacities may stand to gain further by participating in a decentralized reserve pooling mechanism since their capital contributions might be more efficiently managed.

Financial collaboration in ASEAN is expected to complement efforts at the national level in undertaking corporate and financial sector reforms to promote macroeconomic and financial stability in the region and in individual member countries. In particular, there should be a global agreement on the disclosure requirements for such flows and closer collaboration and information sharing among national and international regulators. Measures to strengthen the international financial architecture would need to include a review of the roles of the international regulatory bodies, in order to enhance their capacity and capability to contain and resolve crises. ASEAN believes that global financial stability and development will play an important role in sustaining the economic resurgence of the ASEAN region.

REFERENCES

Aizenman, J. and Marion, N. (2003). The High Demand for International Reserves in the Far East: What's Going On?. *Journal of the Japanese and International Economies*.

Aizenman, J. and Marion, N. (2004). International Reserve Holdings with Sovereign Risk and Costly Tax Collection. *The Economic Journal,*114 (July), 569-591.

Aizenman, J. and Lee, J. (2005). International Reserves: *Precautionary vs. Mercantilist Views,* Theory and Evidence. *IMF Working Paper. Washington.*

Aizenman., J., and Lee, J. (2006). Pooling Risk among Countries . *IMF Working Paper. Washington*.

Bird, G. and Rajan, R. (2003). Too much of a Good Thing? The Adequacy of International Reserves in the Aftermath of Crises. *The World Economy*.

Campbell, J.C. and Perron, P. (1991). Pitfall and Opportunities: What Macroeconomists should know about Unit Roots. *NBER Technical Working Paper.*

Cheung, Y.W. and Ito, H. (2006). Cross-sectional Analysis on the Determinants of International reserves Accumulation, *Manuscript, APEA annual conference Seattle* .

Cheung, Y.W. and Ito, H. (2007). Cross-sectional Analysis on the Determinants of International reserves. *Department of Economics. USA.*

Christopoulus,. D.K. and Tsionas, E.G. (2004). Financial Development and Economic Growth: Evidence from Panel Unit Root and Cointegration Tests. *Journal of Development Economics.*

Clark, P. (1970). Demand for International Reserves: A Cross-Country Analysis. *Canadian Journal of Economics.* Voll. 3, No.4, November, 577-94.

Dickey, D. And Fuller,W. (1979). Distribution of the Estimators for Autoregressive Times Series With a Unit Root. *Journal of the American Statistical Association.*

Dreger, and Reimers,.E.H. (2005). Health Care Expenditures in OECD Countries: A Panel Unit Root and Cointegration Analysis. *Working Paper, Institute for Economic Research.*

Edison, H. (2003). Are Foreign Exchange International Reserves in Asia Too High?. *World Economic Outlook.*

Edwin, M.T., and Anna.W. (2006). The Case for an International Reserve Diversification. *Institute for International Economics, Washington.*

Engle, R.F. and Granger, C.W.J. (1987). Co-Integration and Error Correction: Representation, Estimation and Testing. *Econometrica.*

Fee, W.L. (2006). International Reserve Accumulation in East Asia. *International Review of Business Research Paper.*

Fee, W.L. and Li, C.Y. (2009). Macroeconomic considerations in Regional Reserve Pooling. *Applied Financial Economics*.

Gutierrez, L. (2003). On the Power of Panel Cointegration Tests: A Monte Carlo Comparison. *Economics Letters.*

Hagiwara, A.T. (2004). Foreign Exchange Reserves, Exchange Rate Regimes, and Monetary Policy: Issues in Asia. *Economics and Research Department, Asian Development Bank, Manila Philippines.*

Hall, A.D. (1990). Testing for a Unit Root in Time Series with Pretest Data-based Model Selection, *North Carolina State University, Working Paper.*

Hall, A.D. (1994). Testing for a Unit Root in Time Series with Pretest Data-Based Model Selection. *Journal of Business and Economic Statistics.*

Harris, R and Solis, R. (2003). Applied Times Series Modelling and Forecasting. *John Wiley & Son, England.*

Heller, H.R. (1966). Optimal International Reserves. *Economic Journal.* Vol.76, 296-311

Hurlin, C. (2004). Testing Granger Causality in Heterogeneous Panel Data Models with Fixed Coeficients. *Document de recherché LEO.*

http://www.imf.org

http://data.worldbank.org/data-catalog/world-development-indicators

http://www.cia.gov

Imbs,. J. and Maoro,. P. (2007). Pooling Risk among Countries. *International Monetary Fund, Washington. D.C.*

Im, K., Pesaran, M.H. & Shin Y. (1996). Testing for Unit Roots in Heterogeneous Panels. *Paper presented at Panel Data Conference, Amsterdam.*

Im, K.S., Pesaran, M.H. & Shin, Y. (1997). (Testing for Unit Roots in Heterogeneous Panels. *University of Cambridge, Department of Applied Economics.*

Im, K., Pesaran, M.H. & Shin ,Y. (2003). Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics.*

IMA. (2005). Economic Surveillance and Policy Dialogue in East Asia. *Institute for International Monetary Affairs.*

IMF. (2000). Debt- and Reserve- Related Indicators of External Vulnerability. *International Monetary Fund Board Paper, Washington D.C.*

IMF. (2000). Report to the IMF Executive Board of the Quota Formula Group (Cooper Report). *International Monetary Fund. Supplements 1,2 and 3.*

IMF. (2004). Guidelines for Foreign Exchange Reserve Management. *International Monetary Fund., Washington.*

IMF. (2006). De Facto Classification of Exchange Rate Regimes and Monetary Policy Framework. *International Monetary Fund, Washington.*

IMF. (2009). Regional Economic Outlook-Asia and Pacific Global Crisis: The Asian Context. *International Monetary Fund. Washington, DC.*

Kawai, M. And Takagi, S. (2000). Proposed Strategy for a Regional Exchange Rate Arrangement in Post-Crisis East Asia.

Lane, P.R. and Burke, D. (2001). The Empirics of Foreign International Reserves. *Open Economies Review.*

Lane, P.R., and Ferretti., G.M. (2006). The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities. *IMF Working Paper*.

Levin, A., Lin, C.F. & Chu, J. (1992). Unit Root Tests in Panel Data: Asymptotic and Finite Properties. *University of San Clifornia, San Diego, Discussion Paper.*

Levin, A., Lin, C.F. & Chu, J. (2002). Unit Root Tests In Panel Data: Asymptotic and Finite-Sample Properties. *Journals of Econometrics*.

McCosky, S.K. and Selden, T.M. (1998). Health Care Expenditures and GDP: Panel Data Unit Root Test Results. *Journal Of Health Economics.*

MacKinnon, J.G. (1991). Critical Values for Co-Integration Tests. In Engle, R.F. & Granger, C.W.J (eds): Long-Run Economic Relationships. *Oxford University Press*.

Park, D., and Estrada, G.B. (2009). Are Developing Asia's Foreign Exchange Reserves Excessive? An Empirical Examination. *Asian Development Bank.*

Pedroni, P. (1999). Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors. *Oxford Nulletin of Economics and Statistics.*

Pedroni, P. (2000). Fully Modified OLS for Heterogeneous Cointegrated Panels. *Advances in Econometrics.*

Pedroni, P. (2001) Purchasing Power Parity Tests in Cointegrated Panels. *Review of Economics and Statistics.*

Pedroni, P. (2004). Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with Application to the PPP Hypothesis. *Econometric Theory.*

Perron, P. (1989). Testing for a random walk: A simulation experiment of power when the sampling interval is varied. *Advances in Econometrics and Modelling*, pp. 47-68. Kluwer Academic Publisher.

Prakash, P. (2010). Regional Reserves Pooling Arrangemnets. *International Monetary Fund. Draft:7 June, 2010.*

Phillips, and Hansen. (1990). Asymptotic properties of Residuals Based Tests for Cointegration. *Econometrica.*

Rajan, R.,Siregar, R. and Bird, G. (2003). Examining The Case For Reserve Pooling in East Asia : Empirical Analysis. *Institute of Policy Studies and School of Economics, University of Adelaide.*

Rajan, R.S., and Li, J. (2004). Can High Reserves Offset Weak Fundamentals?. *A Simple Model of Precautionary Demand for Reserves.*

Said, S E., Dickey DA. (1984). Tests for Unit Roots in Autoregressive-Moving Average Models of Unknown Order. *Biometrika.*

Schwert, G.W. (1989). Tests forUnit Roots: A Monte Carlo Investigation. *Journal of Business and Economic Statistics.*

World Bank. (2006). World Development Indicators. *The World Bank. Washington, D.C.*

Yin, W.C., Ito, H. (2007). A Cross-Country Empirical Analysis of International Reserves. *Department of Economics. USA.*

Zho, X. (2009). Reform the International Monetary System. *Essay by Governor of the People's Bank of China.*

NOTES

1. The APT countries reaffirmed at the 13th APT Summit in October 2010 in Ha Noi that APT process with ASEAN as the driving force would continue to be a main vehicle to achieve the long-term goal of building an East Asian community and contribute to the sustainable development in the region.

2. OECD has official relations with other international organizations and bodies, such as the International Labour Organization, Food and Agriculture Organization, International Monetary Fund, World Bank, International Atomic Energy Agency, and many other United Nations Bodies.

3. From mid-1996 Thailand was experiencing a sharp downturn in exports and slowdown in growth, difficulties in the property markets, a sharp fall in the stock market and weakening of the fiscal position. That was followed by a series of increasingly serious attacks on the baht.

4. Japan's unwillingness to sacrifice its close economic and military relations with US also impedes its leadership role. Japan gave up supporting a proposal for an East Asian Economic Community (EAEC) put forwarded by Malaysia in 1991 by agreeing to the Asian Pacific Economic Cooperation (APEC) and giving up its own Asian Monetary Fund (AMF) initiative. Some attribute this to links to the US.

5. The issuing countries of reserve currencies cannot maintain the value of the reserve currencies while providing liquidity to the world, still exists. When a national currency is used in pricing primary commodities, trade settlements and is adopted as a reserve currency globally, efforts of the monetary authority is issuing such a currency to address its economic imbalances by adjusting exchange rate would be made in vain, as its currency serves as a benchmark for many other currencies. While benefiting from a widely accepted reserve currency, the globalization also suffers from the flaws of such a system.

6. Bretton Woods was established in 1944, the system created an international basis for exchanging one currency to another. It also led to the creation of International Monetary Fund and the World Bank.

7. The recent literature focuses on the "precautionary" demand for international reserves, especially for developing countries under financial liberalisation or increased uncertainty in the aftermath of a financial crisis.