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Financial integration and dynamic linkage in the ASEAN-5

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FINANCIAL INTEGRATION AND DYNAMIC LINKAGE IN THE ASEAN-5

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To My Parents

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ABSTRACT

This PhD dissertation focuses on examining the state of financial integration in Indonesia, Malaysia, the Philippines, Singapore and Thailand. These countries are grouped together under the shorthand description of "ASEAN-5". The United States (US) and Japan are considered reference markets. Two main financial markets – credit and stock markets – are investigated based on the data availability and reliability.

For credit market integration, data are monthly observations of three-month real money market rates covering from January 1981 to August 2006. Empirical tests of long-term integration are conducted on the basis of the Johansen cointegration tests. Unrestricted VAR and generalised impulse response functions (IRF) forecasts are used to assess short-run dynamics. As a result, we find the ASEAN markets tend to integrate to and interact with each other rather than with the reference markets, the US and Japan. Indeed, we find the evidence of full integration or a common trend of real interest rates within the ASEAN. Singapore, the only developed financial market in the group, confirms their considerable influence to other regional markets. For the US and Japan, they have declined their impacts on the region over time, especially in the post-crisis period.

For stock market integration, data are weekly and daily price returns covering from January 1991 to December 2006. The CAPM – TGARCH model is employed to examine the degree of market integration. ADCC-MVGARCH model is conducted to estimate time-varying conditional correlations in the US, Japan and the ASEAN. Besides, news impact curve and news impact surfaces are also applied to detect asymmetric effects of news on conditional volatilities and correlations. In line with findings from credit market integration, the results of stock market integration indicate that the tendency of regionalisation has been strongly enhanced over time, especially after the Asian crisis. The ASEAN stock markets do not only increase their regional impacts but also, to some extent, have influence on the most developed financial markets in the world, such as the US and Japan.

The completion of this research may significantly contribute to the existing literature on financial integration; help regional as well as global investor manage their investment portfolios more efficiently; and, to some extent, support policy makers to negotiate and enhance the agenda of reform and cooperation in the region.

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ABF:	Asian Bond Fund.
ADB:	Asian Development Bank.
ADCC-MVGARCH:	Asymmetric Dynamic Conditional Correlations – Multivariate GARCH.
ADF:	Augmented Dickey-Fuller unit root test
AEM:	Asian Emerging Market.
AMF:	Asian Monetary Fund.
APEC:	Asia-Pacific Economy Corporation countries.
AREAER:	Annual Report on Exchange Arrangements and Exchange Restrictions.
ARMA:	Autoregressive Moving Average model.
ARV:	Autoregressive Random Variance.
ASEAN-5:	Five markets (Indonesia, Malaysia, the Philippines, Singapore and Thailand) which belong to the Association of South East Asian Nations.
BEKK:	Baba, Engle, Kraft and Kroner.
BFGS:	Broyden, Fletcher, Goldfarb and Shanno algorithm.
BIS:	Bank for International Settlements.
CAPM:	Capital Asset Pricing Model.
CAPM-TGARCH:	Capital Asset Pricing Model – Trivariate GARCH mdoel
CAR:	Capital Adequacy Ratio.
CCC:	Constant Conditional Correlation.
CID:	Covered Interest Differential.
CIP:	Covered Interest Parity.
CMI:	Chiang Mai Initiative.
DCC:	Dynamic Conditional Correlation.
EGARCH:	Exponential GARCH.
EMEAP:	Executives' Meeting of East Asia Pacific Central Banks.
ETD:	Exchange-traded Derivatives.
EWMA:	Exponentially-Weighted Moving Average.
FH:	Feldstein and Horioka.
FSDI:	Financial Sector Development Indicators.
FX:	Foreign Exchange.
GARCH:	Generalised Autoregressive Conditional Heteroscedasticity

GDC:	Generalised Dynamic Covariance model.
GDP:	Gross Domestic Product.
G-IRF:	Generalised Impulse Response Functions
IMF, IFS:	International Monetary Fund, International Financial Statistics.
LR:	Likelihood Ratio.
NASDAQ:	National Association of Securities Dealers Automated Quotation.
NPL:	Non-performing Loan.
NYSE:	New York Stock Exchange.
OECD:	Organisation for Economic Co-operation and Development.
OTC:	Over-the Counter.
PPP:	Purchasing Power Parity.
RIR:	Real Interest Rate.
SEACEN:	South East Asian Central Banks Research and Training Centre.
SEANZA:	South East Asia, New Zealand and Australia.
TVC:	Time-varying Correlation model.
UID:	Uncovered Interest Parity.
UIP:	Uncovered Interest Parity.
US:	The United States.
VAR:	Vector Autoregressive model.
VECM:	Vector Error Correction Model.
WDI:	World Development Indicators.

CHAPTER I

GENERAL INTRODUCTION

1.1 BACKGROUND

The conventional definition of financial integration is based on the law of one price, whereby identical financial assets should have the same returns in all markets (Kreinin and Officer, 1978). Figueira et al (2005) reported that the degree of financial integration over the world increased considerably during the period from 1988 to 2001. This trend was mainly driven by the growing international investments searching for high returns and diversifying risk internationally. Simultaneously, several developing countries in Eastern Europe, Latin America and East Asia encouraged capital inflows through removing restrictions on international financial transactions, deregulating domestic financial markets and improving their economic environment and prospects (Agenor, 2003).

This dissertation aims to investigate the state of financial integration in East Asia, a region of increasing importance in the world economy. Indeed, this region has become a main driver of world economic growth. East Asia accounted for 43% of global GDP (at 2000 prices in US dollar) and 15% of global trade in 2004 (Sopanha and Guerin, 2006). There have been substantial reforms and developments in domestic financial systems since the 1997 crisis. In fact, the ratio of non-performing loans to total loans in the financial system has significantly decreased (Ghosh, 2006). Indonesia and Thailand, for instance, had their ratios of 48.6% and 45.0% in 1998, but down to 7.6% and 24.0% in 2005, respectively. The capital positions of commercial banks have also been improved, mostly as a result of recapitalisation programmes and market consolidation (Jooster, 2004). Besides, East Asia has been the biggest recipient of international flows. Actually, its accumulation of international reserves amounted to over US$ 1,600 billion in 2005. These resources should help the region meet its financing needs over the next few years (Ghosh, 2006).

Another noticeable development has been the growing attention to regional cooperation since the Asian crisis. First, the Chiang Mai Initiative (CMI), established in May 2000, is a network of bilateral currency swap agreements among 13 ASEAN +3 countries (the Association of South East Asian Nations plus Japan, China and South Korea), designed to prevent currency crises in the region (Park and Wang, 2005). Second, a regional bond market has been developed in order to increase the risk-bearing capacity of the region through more diversified financial systems. Particularly, under the Executives' Meetings of East Asia Pacific Central Banks (EMEAP), two Asian Bond Funds have been launched using a portion of EMEAP's international reserves. The first of these, the Asian Bond Fund I (ABF1)—pooled $1 billion of reserves and invested in US dollar denominated government and quasi-government bonds of eight ASEAN + 3 countries. The second (ABF2) of US$ 2 billion—is investing in local currency denominated sovereign and quasi-sovereign bonds[1].

Understanding the degree of financial integration would be helpful for economists or policy-makers. First, it is clear that the macro-economic policy depends crucially on the openness of the financial system (Fleming 1971; Mundell 1963). The more mobile is capital, the more substitutable are financial assets and the less flexible is the exchange rate, the more difficult it is for a country to set its interest rates independently of interest rates in the rest of the world. One implication of integration is that the price of the goods or assets is determined by the market, and economists generally argue that outcomes in competitive markets tend to be more efficient and equitable than otherwise. Besides, policy makers in ASEAN countries are interested in identifying the degree of integration of financial markets as part of negotiating and defining an agenda of reform and liberalisation in the region (Ghosh, 2006). This is particularly difficult for trade and investment in services, since it is hard to identify legal restrictions and impediments to market access in this sector. An alternative to identifying legal restrictions explicitly is to deduce the existence of restrictions by identifying outcomes which indicate restrictions. Finally, knowing the degree of integration contributes to answering the question whether the Asian common currency is feasible. After the 1997 crisis, a discussion has started about the establishment of monetary cooperation in East Asia as an alternative to pegging solely to the US dollar. Generally, proposals for a common currency usually relate to the

[1] *<http://www.asianbondsonline.adb.org/regional/>*

Japanese yen or to a basket of the yen, the US dollar and the Euro (Hefeker and Nabor, 2005). The single currency would support the region continue its impressive developments and eliminate unnecessary additional costs of cross-border trade and investment.

There has been a growing need for investigating the integration status in East Asian financial markets after the 1997 crisis. It is worth noting that there are two notions of financial integration: global integration and regional integration. The former is relative to the openness of domestic financial systems to the rest of the world; the latter refers to East Asian financial grouping, such as a yen bloc (De Brouwer, 1999).

Frankel (1991) uses covered interest differentials to examine the state of financial integration in the group of Japan, Hong Kong, Malaysia and Singapore over the period 1982 to 1987. He reports that the null of zero differentials are rejected. Hung and Cheung (1995) apply Johansen multivariate cointegration tests to explore the inter-dependence of five major Asian emerging equity markets: Hong Kong, Korea, Singapore, Taiwan and Malaysia over the period 1981 to 1991. They find that there is no evidence of cointegration. Phylaktis (1999) also employs cointegration techniques to estimate the degree of credit market integration in a group of the US, Japan, Singapore, Malaysia, Hong Kong, Korea and Taiwan covering from 1973 to 1993. The results support evidence for real interest rate parity and market integration. Besides, she finds that both Japanese and US interest rates are main drivers of interest rates in Singapore, Hong Kong, Korea and Malaysia. Using the same approach, Ng (2002) investigates the patterns of linkages between national stock markets: Singapore, Thailand, Malaysia, Indonesia and the Philippines over the period 1987 to 1997. The author documents no evidence of long-term relationship between these markets. Phylaktis and Ravazzolo (2002) apply capital asset pricing models (CAPM) to examine regional and global linkages for the US, Japan, Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan, covering from 1981 to 1998. They find Thailand has been greatly financially integrated with the US, while Korea and Taiwan have had close links with Japan. Gerard et al (2003) test a conditional international CAPM for five East Asian markets (Japan, Hong Kong, Thailand, Malaysia and Korea), the US and World markets from 1985 to 1998. Surprisingly, they find strong evidence of regional integration. Bekaert et al (2005) employ two-factor CAPM for Indonesia, Korea, Malaysia, Philippines, Taiwan and

Thailand over the period from 1986 to 1998. They document a high level of regional integration compared to international integration, especially during the Asian crisis. Click and Plummer (2005) considered whether the ASEAN-5 markets (Indonesia, Malaysia, the Philippines, Singapore and Thailand) were integrated or segmented over the period from 1998 to 2002 by using cointegration tests. They identify only one cointegrating vector, which implies five variables of stock prices share four common trends. Ji and Kim (2005) examined the short run and long run relationships among the real interest rates of several Pacific-Basin countries with a focus on East Asia from 1980 to 2004. The results indicate that the US and Japan were the two dominant capital markets in this region before the crisis, while the US capital market dominated the region after the crisis.

Several more studies are reviewed in Chapter V of this dissertation. Generally, the literature has been inconsistent about the ongoing process of financial integration in this area so far. First, there is no clear answer for the question whether global or regional financial integration is happening in East Asian markets. Next, empirical studies are unable to conclude who the dominant player is regarding to behaviours of East Asian financial markets. Finally, the updated status of financial integration in East Asia has not fully investigated. Indeed, most of studies look at financial integration in the 1900s period or before.

This dissertation studies the ongoing process of financial integration in East Asia, specifically, focusing on the degree of global and regional financial integration as well as the state of financial linkages. As shortly introduced below and deeply discussed in Chapter 5, a variety of advanced econometric techniques are applied in order to examine the behaviour of financial integration in short-term as well as in long-term. ***The economies examined in this dissertation are Singapore, Indonesia, Malaysia, Thailand and the Philippines. These countries are grouped together under the shorthand description of "ASEAN-5".*** The United States (US) and Japan are considered reference markets. This grouping excludes Hong Kong, South Korea, Cambodia, China, Laos, Mongolia, Myanmar, North Korea, Taiwan and Vietnam which are obviously part of East Asia. These economies are not examined because much of the data required for empirical analysis is either not available for a sufficiently long period or else is not of adequate quality. Their exclusion should not mean that they are not important, or that the insights gained in this study are not applicable to them. China, in particular, presents an interesting and important case in financial development and warrants a separate study.

1.2 RESEARCH QUESTIONS, DATA AND METHODOLOGIES

1.2.1 Research Questions

Based on the availability and the reliability of data, two main financial markets are investigated: credit markets and equity markets. In order to understanding the state of financial integration in ASEAN-5 (also called ASEAN hereafter), this dissertation will focus on answering the following two research questions:

Research question 1: How had the degrees of international and regional integration in ASEAN-5 credit markets changed over the period January 1983 to August 2006?

De Brouwer (2005) states that the financial integration is inevitable for developments in East Asia. However, given lessons from the Asian crisis in 1997, he emphasises that the East Asian economies the majority of which are less developing and developing should not open to the world market too much until achieving a strong and cooperated financial system. In fact, as presented in section 1.1 and more details in Chapter III, together with developments in domestic financial systems, East Asian economies have been growing their attention to regional cooperation with several regional arrangements and cooperative frameworks. Therefore, the East Asian credit markets, particularly ASEAN-5 in this study, are expected to integrate more within the region than with the world over time. In order to answer the research question 1, six sub-questions are considered as follows:

- Q1.1. How strongly are local credit markets integrated with the global market and with the regional market?
- Q1.2. Is there any existence of a common trend between local markets and the global markets; between local markets and the regional market; and between local markets themselves in long-term?
- Q1.3. Are the real interest rate parity conditions met?
- Q1.4. How strongly are the US, Japanese and individual ASEAN credit markets linked together in short-term and who is (are) the main driver(s) of the ASEAN credit markets?
- Q1.5. How are shocks transmitted across the US, Japanese and individual ASEAN credit markets?

- ❖ Q1.6. What effects did the liberalisation process, 1997 crisis and post-1997 crisis have on the degree of international and regional integration of ASEAN credit markets?

Research question 2: How had the degrees of international and regional integration in ASEAN-5 equity markets changed over the period January 1991 to December 2006?

Similar to the case of research question 1, the ASEAN equity markets are expected to integrate more within the region than with the world over time. In order to anwer the research question 2, the following seven sub-questions are considered:

- ❖ Q2.1. To what extent are local stock markets integrated with the world and regional markets?
- ❖ Q.2.2. How is the state of market efficiency in the ASEAN?
- ❖ Q2.3. How do local volatilities respond to volatility-spillovers from the world and region?
- ❖ Q2.4. How is the return spillover across the US, Japan and the ASEAN equity markets?
- ❖ Q2.5. What is the nature of time-varying correlation structure across the equity markets of the US, Japan and ASEAN-5?
- ❖ Q2.6. What are the effects of bad news and good news on conditional volatilities and correlations in the US, Japan and ASEAN-5?
- ❖ Q2.7. What are the patterns of market integration and dynamic linkages before, during and after the Asian crisis?

1.2.2 Data

The economies examined in this dissertation are Indonesia, Malaysia, the Philippines, Singapore and Thailand. These countries are grouped together under the shorthand description of "ASEAN-5". The US and Japan are considered the reference markets. Data on credit markets are monthly observations of three-month money market rates covered from January 1983 to August 2006. All the data are collected from Datastream. This data sample is divided into three sub-samples: pre-crisis period (from January 1983 to June 1997), crisis-period (from July 1997 to December 2000) and post-crisis period (from

January 2001 to August 2006). Monthly inflation rates used for calculating real interest rates are also collected from Datastream

All data on equity market indices are sourced by Datastream and include both weekly and daily frequencies. There are two main reasons for choosing Datastream indices: first, they are broader measures of stock market returns since they also include firms with smaller capitalization and therefore provide a more accurate presentation of the whole market. Second, they tend to be more homogenous, thus allowing comparisons across markets. Moreover, it is important to emphasize that all data used here is denominated in the US dollar. Data on national equity market returns covers from January 1991 to December 2006. This data sample is divided into three sub-samples: pre-crisis period (from January 1991 to June 1997), crisis-period (from July 1997 to December 1998) and post-crisis period (from January 1999 to December 2006). The return index for ASEAN is the weighted average of individual markets reflecting the share of market capitalisation of each market (see Chapter V). Three-month U.S. Treasury Bill Rate is used as the risk-free rate and collected from Datastream.

Following Bekaert and Harvey (1995, 1997), Ng (2000) and Bekaert et al (2005), trade variables are used to model time-varying market integration parameters. The world (or the region) trade variable captures the covariance risk of market *i* with the US (or the region), being equal to the sum of exports to and imports from the US (or the region) divided by the sum of total exports and total imports in market *i*. All the trade variables are monthly data, collected from Datastream and lagged by six months. Finally, the other data including dividend yields (world, regional and local yields), 90-day Eurodollar rate, 3-month Treasury-bill yield and US 10-year Treasury bond yield are also collected from Datastream.

1.2.3 Methodologies

Research methodologies will be described in details in Chapter V. Generally, they focus on two main financial markets: credit markets and equity markets. These methodologies are selected on the basis of three main principles: 1) relevance to research questions presented in section 1.2.1, 2) capturing the data characteristics, and 3) overcoming the limitations of empirical methods discussed in section 4.5.3 as much as possible.

With respect to the credit markets, the Augmented Dickey-Fuller (ADF) unit root tests are used to examine the stationarity property of each variable. One of the key factors which affect on the selection of methodologies is the state of data. Enders (1995) reports that the presence of nonstationary variables will create what Granger and Newbold (1974) called *spurious regression*. For the spurious regression, inferences may not be correct because the residuals from the regression equation are nonstationary. Therefore, the stationarity properties of data should be tested before performing regression analysis.

The Johansen multivariate cointegration tests are employed to examine whether credit markets are integrated in long-term. The Johansen cointegration test is an increasingly popular approach relaxing impractical assumptions of interest rate parity conditions. While the interest rate parity conditions require the financial integration to be tested under a strict meaning of "the law of one price", cointegration techniques allow the interest rate differential to be fluctuated within a band. Besides, the Johansen techniques can test the state of integration in a system of many variables without much of data required in comparison with generalised autoregressive conditional heteroskedasticity (GARCH) models or other sophisticated approaches.

Short-run linkages of real interest rates are also tested by using unrestricted vector autoregressive (VAR), generalised impulse response function (G-IFR) techniques. The unrestricted VAR is useful in the case of weak cointegration in a group of variables. The G-IRF proposed by Pesaran and Shin (1998) overcomes the disadvantage of the traditional IRF and allow the results to be invariant to any ordering of the variables.

Regarding the equity markets, the capital asset pricing model (CAPM), particularly Fratzscher (2001) trivariate GARCH model, is used to examine whether equity markets are integrated globally or regionally. This model extends the traditional CAPM to two-factor model allowing individual markets to be priced by the US market and the regional market. Compared to other approaches, this model will give more clear answers of the integration direction and better fit high frequency and heteroskedasticity data.

Multivariate asymmetric dynamic conditional correlation GARCH (ADCC-MVGARCH) model (Cappiello et al, 2004) is applied to estimate time-varying conditional correlations across countries. This approach not only relaxes Bollerslev's constant correlation

assumption, but also reduces the number of estimated parameters, a noticeable improvement compared to the VECH and BEKK (acronym for Baba, Engle, Kraft and Kroner) models. Additionally, this approach also considers the asymmetric effects on conditional second moments.

Finally, news impact curves (Engle and Ng, 1993) and news impact surfaces (Kroner and Ng, 1998) are used to visualise the effects of positive and negative shocks on conditional volatilities and correlations. While the new impact curves measure how new information is incorporated into volatility estimates, the new impact surfaces describe the way joint news from different markets affect their correlations.

1.3 STRUCTURE PLAN

The rest of this dissertation is organized as follows. Chapter II presents the general theoretical framework of financial integration. In particular, this chapter introduces the definition of financial integration, potential benefits and costs from financial integration and general framework for measuring financial integration.

Chapter III draws a picture of financial developments in East Asia. First, the 1997-1998 Asian financial crisis is reviewed. Next, this chapter presents current developments of financial markets including regional cooperation agreements. Finally, challenges to the process of financial integration in East Asia are discussed.

Chapter IV reviews literature on financial integration in East Asia. The literature review is organised corresponding to methods for testing financial integration. Particularly, the literature review is composed of three main parts: 1) price/return-based studies, 2) quantity-based studies, 3) legal restriction studies. This chapter also discusses limitations of empirical studies.

Chapter V deeply explains the data and methodology applied in this dissertation to examine the degree of financial integration in East Asia. Mainly, the Johansen multivariate cointegration tests, Franzscher's CAPM and ADCC-GARCH (Cappiello et al, 2003) are used to examine the financial integration and dynamic linkages in East Asia.

Chapter VI reports, analyses and discusses empirical results of credit market integration. First, descriptive statistics are conducted to have primary views of variable behaviours over time. Second, the ADF unit root and Johansen cointegration tests are employed to examine the state of international and regional integration. And, finally, the unrestricted VAR and G-IRF are used to explore short-term dynamic linkages.

Chapter VII reports, analyses and discusses empirical results of equity market integration. Similar to Chapter 6, descriptive statistics are conducted first to have primary views of variable behaviours over time. Second, Fratzscher's CAPM is applied to estimate the degree of international and regional integration. Then, the ADCC-MVGARCH is used to investigate the nature of time-varying correlation structure across the equity markets. And, finally, robustness and specification tests are accompanied in order to achieve informative findings.

Finally, Chapter VIII presents conclusions, policy implications and recommendations for further research.

CHAPTER II

FINANCIAL INTEGRATION: THEORETICAL FRAMEWORK

2.1 INTRODUCTION

This dissertation studies the state of financial integration in East Asia in the 1983-2006 period. So far, the literature has often used 'financial integration' and 'financial openness' interchangeably (see De Brouwer 1999). However, the concepts of 'financial openness' and 'financial integration' should be clearly distinguished. These concepts will be discussed in section 2.2.

Financial integration is believed to have two major potential benefits: improving the international capital allocation and helping countries share risks better through reducing consumption volatility. Given their relative low levels of physical capital and their inherently greater volatility, developing economies seem to have the most to gain from this integration process (Obstfeld 1998; Kose et al 2003). However, a question mark about real and particular effects of financial integration on financial development has arisen following a series of financial crises including the Mexican peso crisis in December 1994, the Asian crisis in July 1997, the Russia crisis in August 1998 and the collapse of the Brazilian real in January 1999.

In addition to understanding the meaning, benefits as well as costs of financial integration, it is important to know the degree of financial integration of each country or each region. How can we measure the degree of financial integration? Several methods have been conducted to measure financial integration. Generally, they can be placed into three categories. The first category refers to the measures taking advantages of price/return-based data availability to assess the degree of financial integration. The second category involves quantity-based measures such as consumption correlations, savings-investment correlations and cross-border activities. Finally, the third category explores restriction measures.

What is financial integration? What are benefits and costs of financial integration? And how can we measure financial integration? For the purpose of answering these questions, this Chapter presents a theoretical framework of financial integration. This Chapter is structured as follows. The second section introduces the definition of financial integration used throughout this study. Next, potential benefits and losses of financial integration are explored. Section 2.4 describes the framework commonly used in literature to assess the degree of financial integration. Finally, conclusions are presented in Section 2.5

2.2 BASIC CONCEPTS OF FINANCIAL INTEGRATION

2.2.1 Financial Integration Defined

The concept of financial integration is difficult to define in any precise form. Particularly, the concept lacks an all-purpose definition and analysis on the subject invariably become embroiled in confusing expositions of the relationship between capital mobility and substitutability among comparable financial assets in terms of yields, maturity and risk in international financial markets.

Arguably, the most theoretically satisfactory definition of financial integration is based on asset substitutability, or the '**law of one price**', whereby equal and free access to information equalities returns on perfectly substitutable assets (Kreinin and Officer 1978). Such asset substitution is dependent on the willingness of asset-holders to exchange financial claims, but the presence of any barriers to trade in financial assets whether they are institutional, subjective or expectational, will ensure imperfect asset substitution. Thus, given economic interdependence, yet national political sovereignty in the world economy, a lack of consistency must exist in distinguishing theoretical and operational definitions of financial integration specified in terms of asset substitutability.[2]

Financial market integration may also be defined in terms of capital mobility. However, the notion of perfect capital mobility need not be consistent with that of perfect asset

[2] See Allen (1976), Allen and Kenen (1980), Kenen (1976), Cordon (1972) and Scitovsky (1969) for more discussions.

substitution.[3] Perfect capital mobility, defined as the instantaneous, full adjustment of asset stocks in response to changes in relative yields among markets, assuming no default risk or future capital controls, implies covered interest parity: the interest rate on domestic assets is equal to that on a similar foreign asset plus the forward premium (or discount) on foreign currency. However, perfect substitutability between domestic and foreign assets is the much stronger assumption that asset holders are indifferent as to the currency composition of their asset portfolios, so long as the expected rates of return on the countries' assets are equalized. Perfect asset substitution thus implies uncovered interest parity: the interest rate on domestic assets is equal to that on similar foreign assets plus the expected rate of appreciation of the foreign currency. Since covered and uncovered parity need not coincide – unless the forward premium equals the expected rate of change in the spot exchange rate – perfect capital mobility and perfect asset substitution need not coincide. Furthermore, to the extent the fact that unexpected exchange rate or national price level changes can occur influences on the willingness of asset holders to exchange financial claims. Therefore, uncovered interest parity, given risk-aversion on the premia to encourage the holding of foreign currency-denominated assets, rules out perfect asset substitutability and renders the law of one price.

These conceptual distinctions imply that, in practice, asset yields on comparable assets need not be equalized in all markets for general asset substitutability to exist. However, they also imply that any intertemporal change in relevant asset yields will induce capital movements in relation to the degree of capital mobility, thereby encouraging further financial integration. International capital mobility is thus required for international asset substitution which, in turn, is required for international financial integration to occur.

2.2.2 Financial Integration and Financial Openness

So far, the literature has often used 'financial integration' and 'financial openness' interchangeably (see De Brouwer 1999). However, the concepts of 'financial openness' and 'financial integration' should be clearly distinguished.

[3] Discussion of the distinction between capital mobility and asset substitutability is found in Dornbusch (1976) and Krugman (1978).

A country pursuing capital account liberalisation is said to be seeking 'financial integration' with international financial markets through 'financial openness' (De Brouwer 1999). That is, 'financial openness' is the means, while 'financial integration' is the goal. Although financial openness is a necessary condition for financial integration, it is not a sufficient condition. Indeed, 'financial openness' is the situation where existing administrative and market-based restrictions on capital movements across borders have been removed. In some countries it also includes the introduction of measures to attract foreign capital and reduce the discrimination against foreign financial institutions operating in domestic markets. When a country implements capital account liberalisation, it should first ensure 'openness', then 'financial integration' will gradually be achieved. Ideally, that country will eventually have a financial market structure[4] and products similar to those of overseas markets. Domestic financial markets effectively become part of the world market, synchronising interest rate movements, saving and investment activities, and the accumulation of physical capital stocks.

Many countries have experienced a lot of problems after liberalising their capital accounts, which have prevented them from achieving the final goal—financial integration. This implies that financial openness does not guarantee immediate financial integration. Since the financial crisis in East Asia, the economic literature has sought other necessary for those countries which were relatively open in terms of their capital accounts. Among researchers, the answers to this question range from asymmetric information problems, such as moral hazard and adverse selection (Eichengreen et al. 1998), to flawed financial fundamentals (Moreno, Pasadilla, and Remolona 1999; Wibulswasdi 1998).

2.3 POTENTIAL GAINS AND LOSSES OF FINANCIAL INTEGRATION

2.3.1 Potential Benefits

Agenor (2003) has reviewed and placed potential gains of financial integration into four major themes. Firstly, financial integration may allow a country to engage in consumption

[4] This includes the forms and interactions of financial institutions, laws and regulations and also market practices and customs (Chinn and Ito 2002).

smoothing. Secondly, financial integration is believed to raise capital flows in domestic investments and enhance the growth in developing countries. Thirdly, financial integration helps the country increase macroeconomic discipline. And finally, financial integration may contribute to improving the efficiency of domestic financial system associated with foreign bank penetration (Agenor 2003).

2.3.1.1 Consumption smoothing

Financial integration may allow a country to smooth its consumption. Particularly, the country may be allowed to borrow in bad times, such as during a recession or a sharp deterioration of trade, and lending in preferable times, such as in an expansion or following a trade improvement). Therefore, capital flows may help domestic households to smooth their consumption path over time, which leads to the increase of welfare. This 'counter-cyclical' role of world capital markets is especially important in the cases of temporary shocks.

2.3.1.2 Domestic investment and growth

Financial integration helps the country access to the international pool of resources which may give a direct effect on domestic investment and growth. Given a low level of income, the capacity to save is constrained in many developing countries. However, net foreign resource inflows can supplement domestic saving and increase levels of physical capital per worker as long as the marginal return from investment is at least equal to the cost of (borrowed) capital. As a result, the rate of economic growth and living standards in the recipient country are, in turn, improved (see Obstfeld, 1999). These potential benefits seem to be considerable for some types of capital inflows, especially foreign direct investments (FDIs).

Besides, MacDougall (1960), Grossman and Helpman (1991), Birebsztein et al (1998) and by Berthelemy and Demurger (2000) agree that FDIs may also have significant indirect long-run benefits. Particularly, as a result of on-the-job training, 'learning by doing' effects and investments in formal education, the managerial and technological know-how is transferred; and the labour force kills are improved. Additionally, spillover effects through linkages to supplier industries may reduce input costs, raise profits and

stimulate domestic investments despite the fact that FDI may tend to reduce profits of local firms due to the increased degree of competition in the product and factor markets (Markusen and Venables, 1999).

2.3.1.3 Enhanced macroeconomic discipline

Arguments supporting financial integration also emphasised that the financial integration process may increase the rewards of "good policies" and the penalties for "bad policies" (see Obstfeld, 1998). Thus, countries are induced to follow more disciplined macroeconomic policies and reduce the policy mistake frequency. In addition, Bartolini and Drazen (1997) state that pursuing the process of financial integration can be considered a "signal" showing that the country is willing (or ready to) adopt sound macroeconomic policies, such as forgoing the use of the inflation tax and reducing budget deficits. From this point of view, an open capital account may also encourage macroeconomic and financial stability, allocate resources more efficiently and increase economic growth rates.

2.3.1.4 Increased banking development and system efficiency

Levine (1996) and Caprio and Honohan (1999) find that financial integration increases the foreign bank penetration, the bank competition and enables the application of more complex banking techniques as well as technologies, which may sequentially lead to enhancing the country's access to international capital, stimulating the development of the domestic bank supervisory and improving the quality and availability of domestic financial services. Financial integration may also reduce costs and abnormal profits related to monopolistic cartelised markets and contribute to the increase in the degree of banking efficiency. Sequentially, efficiency improvement in banking may reduce markup rates, lower investment costs and raise growth rates (Baldwin and Forslid, 2000).

2.3.2 Potential Costs

In addition to the potential benefits discussed above, economists and policymakers with the experience of the past two decades have realised that financial integration may also cause potential costs. According to Agenor (2003), potential costs can be summarised as:

domestic misallocation of capital flows, herding and contagion behaviours, high level of capital flow concentration to a small number of countries and risks of foreign bank penetration.

2.3.2.1 Domestic misallocation of capital flows

As mentioned in section 2.3.1.2, the process toward financial integration may help the country increase its domestic investments. However, Agenor (2003) states that if most of these inflows are allocated to low-quality or speculative investments (e.g. real estate investments), benefits from financial integration may be limited in long-run, which may lower the country's export capacity and enlarge external imbalances over time.

2.3.2.2 Herding and contagion behaviour

The high volatility degree of capital flows can cause financial crises with very significant social and economic costs. According to Agenor (2003) and Chang and Velasco (2000), short-run capital flows seem to be highly sensitive to herding and contagion effects. Herding effects indicate similar expectations at the same time about future prices and returns. As a result, herding effects will move a large amount of capital flows into or out of a certain type of assets at the same time, which leads to considerable volatilities in asset prices.

Fluctuations of capital flows can also be originated from contagion factors. Although there is no consistent definition of contagion, it is widely understood as the transmission shocks from one country to another based on various channels (Eichengreen et al 1996, and Glick and Rose 1998). The 1997 Asian crisis can be used as an illustration of contagion effect. The currencies of neighbouring countries were put in pressure due to the sharp depreciation of the Thai baht that began in July 1997.

2.3.2.3 Capital flow concentration

Financial openness may allow developing countries to attract more investments from abroad. However, Fernandez and Montiel (1996) reported that only a small number of countries with large and middle-income in Latin America and Asia were the recipients of

the huge increase in capital inflows in the early 1990s. In opposite, the share of total private capital flows allocating to low-income countries fell from levels that were already quite low during the 1990s. Therefore, several developing countries with low income still stood outside of international capital resources despite the fact that how open their policies are.

2.3.2.4 Risk of entry by foreign banks

Although the penetration of foreign bank involves a lot of benefits (see section 2.3.1.4), it may also lead to unfavourable impact. De Ralph and Van Lelyveld (2002) stated, "the risks and potential disadvantages of foreign entry are not so much related to the efficiency of the domestic banking system but more to the short-run stability of this system". Particularly, for domestic banks operating less efficiently (e.g. with huge burden), entry of foreign banks may weaken their positions. Domestic banks may fail if they are unable to cope with the higher pressures from foreign competitors, which may result in periods of cautiously financial instability. More severely in the case foreign banks are not loyal to the host countries during a downturn period, they are not only unsupportable, but also tend to "cut and run".

2.4 MEASUREMENT OF FINANCIAL INTEGRATION

Several methods have been applied to estimate the degree of financial integration. They are placed into three groups. *The first group* conducts the measures taking advantages of price/return-based data availability to assess the degree of financial integration. They mainly involve the interest parity conditions, convergence criteria, capital asset pricing models, cointegration, correlation and volatility spillover measures. *The second group* refers to quantity-based measures such as consumption correlations, savings-investment correlations and cross-border activities. Finally, *the third category* explores restriction measures, which can be widely considered regulatory or capital control factors.

2.4.1 Price/Return Based Measures

Price/return-based measures of financial integration test the proposition that rates of return on comparable assets are equal across markets and/or economies. This section

shows six common theoretical models for testing this proposition: namely, interest rate parity conditions, convergence criteria, capital asset pricing models, cointegration, correlation dynamic and volatility spillover tests[5].

2.4.1.1 Interest rate parity conditions

Due to the increase of financial assets traded across countries, returns on identical assets should tend to equalise over time. Therefore, it is natural to evaluate financial integration based on interest parity conditions. The conventional definitions of interest rate parities including covered, uncovered and real interest rate parity are usually used to investigate the state of a country's international financial integration (see De Brouwer 1999). Each definition is now explained in turn:

Covered interest parity (CIP) condition:

The CIP may be formally expressed as follows:

$$i_t = i_t^* + f_{t,t+n} \tag{2.1}$$

where i_t stands for the domestic interest rate at time t, i_t^* stands for the foreign interest rate and $f_{t,t+n}$ stands for the forward margin (discount on the domestic currency) at time t for n periods into the future. The covered interest differential (CID) is the interest differential between identical assets based on local currencies. Therefore, if there is the existence of financial integration, CID should not differ significantly from zero. A negative value of CID signals the presence of transaction costs or capital controls. Although several studies involve the CIP in industrial countries, only few ones explore this method in developing countries. The primary reason is that most of developing countries have not built up a sufficient data base on forward rates or it has not been easy to access this data base.

Frankel (1991) uses monthly observations of the 3-month local money market rate against the equivalent Eurodollar rate in order to examine mean covered interest differentials

[5] For survey of the literature, see Cavoli et al. (2003) and Fratzscher (2001).

(CIDs). The sample includes developed and developing countries covered from 1982 to 1987. East Asian countries in the sample are Japan, Singapore, Hong Kong, and Malaysia. The null of a zero differential is rejected for Japan, Hong Kong and Malaysia. Especially, Malaysia has large and negative mean CID, signaling considerable controls on outflow capital.

Uncovered interest parity (UIP) condition:

The UIP may be represented as follows:

$$i_t = i_t^* + \Delta e_{t,t+n}^e \qquad (2.2)$$

where $\Delta e_{t,t+n}^e$ is the expected exchange rate change at time $t+n$

The CIP and UIP are related to each other by decomposing equation (2.2) as follows:

$$i_t - i_t^* - \Delta e_{t,t+n}^e = \left[i_t - i_t^* - (f_{t,t+n} - e_t)\right] + (f_{t,t+n} - e_{t,t+n}^e) \qquad (2.3)$$

CIP is illustrated in the first bracket on the right hand side and the currency risk premium is in the second term. Forward rates are biased predictors of future exchange rate if the CIP holds but the UIP is rejected. In practice, to overcome the problem of non-observable expected exchange rate changes, researchers may normally use ex-post differentials. Besides, surveys of exchange rate expectations of market agents are also considered.

Given the assumption of Rational Expectations held, Montiel (1994) uses ex-post differentials to examine uncovered interest differentials (UID). His sample covers from 1985 to 1990 and includes 48 developed and developing countries. His results related to East Asian countries show that Indonesia and Malaysia have significantly negative UID, while the Philippines and Thailand have significantly positive UID.

The real interest parity (RIP) condition:

The real interest parity (RIP) condition may be derived by taking the two following equations:

UID equation: $$\Delta e^{e}_{t,t+n} = i_t - i^{*}_t \qquad (2.4)$$

Purchasing power parity (PPP) equation: $\Delta e^{e}_{t,t+n} = \pi^{e}_{t,t+n} - \pi^{e*}_{t,t+n}$ (2.5)

where $\pi^{e}_{t,t+n}$ denotes the domestic inflation rate from time t to time $t+n$, $\pi^{e^*}_{t,t+n}$ denotes the foreign inflation rate from time t to time $t+n$. Combining equations (2.4) and (2.5) with the Fisher equation, $r_t = i_t - \pi^{e}_{t,t+n}$, yields the expression for the RIP: $r_t = r^{*}_t$, where r_t and r^{*}_t indicate domestic and foreign real interest rates, respectively.

It is clear that the CIP, UIP and the Fisher hypothesis have to simultaneously hold for the RIP to hold. Cavoli et al (2003) point out that there is no empirical success of both the PPP and UID over the short- and medium-terms. Therefore, studies of real interest parity usually focus on the long–run interest parity condition dealing with both real and financial linkages (see section 2.4.1.5 for more details).

2.4.1.2 Convergence criteria

The concept of convergence was firstly applied for examining integration in goods markets. Particularly, if the price deviations for identical products tend to return to the long-term equilibrium state over time, the price differentials for these products seem to be stationary over time. If these differentials are stationary and small (or absent), there is the existence of integration in goods markets (Adam et al 2002). A similar concept is used to estimate the degree of financial market integration. Briefly explaining what convergence is with respect to financial integration will be made below.

There have been three main questions of financial integration which are of interests. First, is there the existence of financial integration? Second, If it exists, at which speed does it take place? Third, how does the degree of financial integration change over time? For the purpose of answering the first two questions, it is proposed to test the following equation (Goldberg and Verboven 2001):

$$\Delta i_{ct} = \alpha_c + \beta i_{ct-1} + \sum_{l=1}^{L} \gamma_l \Delta i_{ct-l} + \varepsilon_{ct}\,, \qquad (2.6)$$

where c and t indicate the country and time indices, respectively. Δi is the change in the variable, such as interest rate. L and α_c refer to the period lagged and the country dummies, respectively. The magnitude of β implies the convergence speed. A negative β signals convergence (if $\beta = 0$ there is no convergence). Besides, ε indicates exogenous shocks which make interest rates on identical assets different between the considered countries.

This convergence concept is rather similar to the $\beta - convergence$ concept broadly used in the literature of economic growth (Adam et al, 2002). Particularly, for the growth literature, a negative correlation between the average growth rate of GDP and its initial level signals the existence of convergence. For applications in financial markets, equation (2.6) extends the concept of $\beta - convergence$ to cases where variables, such as interest rates, may not be stationary. Additionally, this method explores the data with respect to both time-series and cross-sectional dimensions.

In order to test the degree of financial integration at each time point, it is proposed to apply the $\alpha - convergence$ concept. This concept states that there is the existence of $\alpha - convergence$ or the increase in the degree of financial integration if the cross-sectional standard deviation of a variable, such as interest rate, is trending downward. And, full integration occurs if this standard deviation converges to zero.

It is noticed that the information content of these two indicators is different from each other. In fact, $\beta - convergence$ does not reveal the same information as $\alpha - convergence$ (see Quah, 1993) because the mean reversion does not mean that the sectional standard deviation is downward over time. Actually, $\beta - convergence$ could even be related to $\alpha - divergence$). Therefore, it is recommended to test for both notions of convergence to evaluate financial integration.

2.4.1.3 Capital asset pricing models (CAPM)

Definition of financial integration in section 2.2.1 indicates that markets are said to be fully integrated if assets with the same risk have equal expected returns regardless the market. Risk indicates exposure to some common factor. A market's covariance with a

common world factor may have little or no ability to explain its expected return if it is segmented from the rest of the world.

Asset pricing studies can be classified in three broad categories: studies of segmented markets, integrated markets and partially segmented markets. An example of an asset pricing study that assumes markets are segmented is one that tests a model like the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Black (1972), using one country's data. Indeed, the entire seminal U.S. asset pricing studies assumes that the United States is a completely segmented market – or that the market proxy represents a broader world market return. While this might have been a reasonable working assumption through the 1970s, in the 1980s the U.S. equity capitalisation dropped below 50% of the world market capitalisation. Indeed, Japan's market capitalisation exceeded that of the United States in 1989.

The second class of asset pricing studies assumes that capital markets in the world are in fact completely integrated. Thus, asset risk can be purely originated from the covariance of the world market portfolio and local returns. This set includes studies of international CAPM (see Grauer et al 1976), world arbitrage pricing theory (see Solnik 1983), world consumption-based model (see Wheatley 1988), world latent factor models (see Bekaert & Hodrick 1992, Campbell & Hamao 1992) and world multi-beta models (see Ferson & Harvey 1993, 1994). Of course, the other extreme is a model where the standard CAPM model is applied to the returns of a single country. In that case, the implicit assumption is that the market is either perfectly segmented from the world market or it represents an adequate proxy to the world market. Neither of these approaches is based on inherently plausible assumptions, and not surprisingly, they have performed unspectacularly in empirical tests.

A more realistic approach by Errunza and Losq (1985) and Errunza et al (1992) derives an international CAPM in which segmentation can be other than either of the extreme cases. The advantage of these models is that the polar segmented/integrated cases are not assumed. The key weakness of this approach, however, is that the degree of segmentation is assumed to remain constant over time. A development by Baekert and Harvey (1995) and De Santis and Imrohoroglu (1997) allows the degree of segmentation to vary over time, smoothly in the case of Bekaert and Harvey, in a regime change by De Santis and

Imrohorglu, and then applied by Phylatkis and Ravazzolo (2002). Generally, these papers show that the degree of integration generally rises over time, but that the degree of integration is closely related to the degree of currency risk and currency instability.

2.4.1.4 Vector autoregressive (VAR) model

In investigating the question of financial integration, another approach is to look at the degree of capital market interrelationships. The technique of vector autoregressive (VAR) is considered one methodology for estimating the dynamic responses stemming from shocks originating from the variables within a system; and for measuring the relative importance of each variable in generating unexpected variations.

The VAR model proposed by Sims (1980) allows us to explore shock transmissions across markets. The method requires the time series analyzed to be stationary. The VAR model may be formally expressed as:

$$R(t) = C + \sum_{k=1}^{p} A(k)R(t-k) + e(t) \qquad (2.7)$$

where $\boldsymbol{R}(t)$ is a n×1 column vector of daily returns on the market indices at time t. p is the number of time lags. $\mathbf{A}(k)$ is a n×n matrix of coefficients such that the i, jth component of $\mathbf{A}(k)$ measures the effect of a change in the jth market on the ith market after k periods. $\boldsymbol{C}$ is a n×1 column vector of constant terms, $\boldsymbol{e}(t)$ is a n×1 column vector of innovations such that $E(e_{it})=0$, $E(e_{it}^2)=\sigma^2$, $E(e_{it},e_{jt})=\sigma_{ij}$ and $E(e_{it},e_{jt-k})=0$.

The VAR model treats all the variables in a system as endogenous. In other words, it estimates the parameters in a dynamic system without imposing any a *priori* restrictions on the presence of variables in an equation. However, since it expresses the dependent variables in terms of only predetermined lagged variables, the VAR model is a reduced form model. The number of lags, i.e., p in equation (2.7), is determined through an analysis of the data. A modified likelihood ratio test is often used for this purpose. The VAR model in equation (2.7) is usually transformed into its moving-average representation as equation 16 in order to exploit the system dynamics:

$$R(t) = \sum_{k=0}^{\infty} B(k)e(t-k) \qquad (2.8)$$

$B(k)$ is a n×n matrix of coefficients. It is noticed that a shock in one market may work through the contemporaneous correlations with innovations in other markets when innovations in market returns are contemporaneously correlated. These correlations is typically transformed by orthogonalising the innovations in the VAR system based on a pre-specified causal ordering.[6] Equation (2.8) may be transformed as follows,

$$R(t) = \sum_{k=0}^{\infty} C(k)u(t-k) \qquad (2.9)$$

where the transformed innovations, $\boldsymbol{u}(t)$, are now uncorrelated contemporaneously at all lags.

The moving-average component of the VAR model may allow us to trace the dynamic responses to shocks in the system. The value of the *i*th market (R_i) changes by $c_{ij,1}$ in the period followed and by $c_{ij,2}, c_{ij,3}$ and so on in continuing future periods if there is a unit shock in the innovation of the *j*th market in period t (u_{jt}). The VAR model may also allow us to estimate the overall influence of an individual market in generating variations on its own returns and other market returns by decomposing forecast error variances. Particularly, we may apply the decomposition of forecast error variances in order to estimate the effects each market in the system has on itself and each other market over different time horizons.

2.4.1.5 Cointegration tests

Granger (1981) has introduced the concept of cointegrated variables, which has considerably contributed to the development of empirical models today with respect to macroeconomic relationships. The idea of cointegration can be related to the concept of

[6] Specifically, the innovations are orthogonalized using a Cholesky decomposition so that the resulting covariance matrix is diagonal. This essentially amounts to assuming that the first market in prespecified ordering has an immediate impact on all other markets in the VAR system. A shock in the second market in the system has an immediate impact on all markets, excluding the first market, and so on. Clearly, the prespecified ordering of markets is important and can alter the dynamics of the VAR system.

long-run equilibrium between time series when one allows for the possibility of nonstationarity in the underlying series. If a linear combination of nonstationary (I(1)) variables is stationary (I(0)), then the variables are said to be cointegrated. The existence of a cointegrating vector implies that the two variables cannot continue to move apart. Cointegration has an intuitive appeal to researchers of integration.

Cointegration tests cover two situations:

- There is at most one cointegrating vector
- There are possibly $0 \leq r < n$ cointegrating vectors.

The first case was originally considered by Engle and Granger (1987) and they developed a simple two-step residual-based testing procedure based on regression techniques. The second case was originally considered by Johansen (1988) who developed a sophisticated sequential procedure for determining the existence of cointegration and for determining the number of cointegrating relationships based on maximum likelihood techniques.

A significant number of papers have applied cointegration techniques to test the degree of international integration in equity markets. Kasa (1992) examines the major equity markets over the period of 1974–1990 and finds a single cointegrating vector indicating low levels of integration, while Chan et al. (1992) examine the Asian markets and find in favour of segmentation, as do Allen and Macdonald (1995). Chan et al. (1997) expand their previous study and find a decrease in integration during the 1980s. Similar results for world markets are found by Arshanapalli and Doukas (1993). Gallagher (1995) finds no evidence of cointegration between Irish and either German or UK equity markets.

All these measures, however, use the Engle–Granger methodology. Studies that have used the more sophisticated Johansen multivariate approach generally find stronger evidence of integration. Thus, Chou et al (1994) for the G7 countries, Hung and Cheung (1995) for the Asian markets, Kearney (1998) for Irish–European markets, Gilmore and McManus (2002) for U.S.–Central European markets, and Ratanapakorn and Sharma (2002) and Manning (2002) for Southeast Asian, European, and U.S. markets, all find evidence of integration. This is not unanimous, however, with findings of Kanas (1988) with respect to the European and US markets.

The Johansen Maximum Likelihood procedure is based on a process of *N* I(1) variables in an *(n*x*1)* vector X as follows:

$$X_t = \alpha + A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + \varepsilon_t \qquad (2.10)$$

Where A is an (n,n) matrix of parameters; ε_t is an independently and identically distributed n-dimensional vector with zero mean and variance matrix $\sum_{\varepsilon}$; p represents the number of time lags; and $t = 1, 2, 3,\ldots, T$. Equation (2.10) can then be re-arranged into the following Vector Error Correction (VECM) form:

$$\Delta X_t = \alpha + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \ldots + \Gamma_p \Delta X_{t-p+1} + \Pi X_{t-p} + \varepsilon_t \qquad (2.11)$$

Where $\Gamma_i = (-A_1 - A_2 - \ldots - A_i), i = 1,\ldots, p-1$ and $\Pi = I_n + \Gamma_{p-1}$

The essence of the Johansen approach is to establish *r*, the rank of the matrix Π. If *r=n*, then the individual series are all stationary; if *r*=0, all are nonstationary and independent; if 0<*r*<*n*, there are *(n-r)* common stochastic trends; and if *(n-r)=1*, markets are fully integrated. The cointegration procedure yields two likelihood ratio test statistics, referred to as the Trace test and the Maximum eigenvalue (λ max) test. The Trace and λ max test statistics are given by:

$$Trace = T \sum_{i=r+1}^{n} \ln(1-\lambda) \qquad (2.12)$$

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

λ is estimated eigenvalue calculated from the matrix Π defined above. Since the asymptotic distributions of the Trace and λ max test statistics follow χ^2 distributions, a simulation procedure is needed to identify proper critical values for each test (see Osterwald-Lenum, 1992).

2.4.1.6 Volatility spillover and correlation dynamics – Multivariate GARCH models

Financial integration may be tested by the level of correlation dynamics and volatility spillover across markets. The hypothesis is that the more interdependent the markets are, the higher the level of financial integration is. Because of the high frequency of price volatilities and also the high degree of persistence in the conditional means, multivariate generalised autoregressive conditional heteroskedasticity (GARCH) models have been preferred for studying the correlations and volatilities in several markets. How is the volatility of an market transmitted to other markets? How much does a shock on a market affect on other markets' volatilities? (see Kearney and Patton (2000) and Karolyi (1995))? Does the correlation between market returns fluctuate over time (see Bollerslev (1990) and Longin and Solnik (1995))? May higher volatilities lead to higher correlations between markets? (see Engle and Sheppard (2001) and Chandra (2005))? Several questions in the same line may be directed and explored by applying multivariate GARCH models (M-GARCH).

The most popular M-GARCH models are the Vech of Kraft and Engle (1982) and Bollerslev, Engle, and Wooldridge (1988), the Constant Conditional Correlations model (CCC) of Bollerslev (1990), the Factor GARCH of Ng, Engle and Rothschild (1992), the BEKK of Engle and Kroner (1995), the General Dynamic Covariance (GDC) model of Kroner and Ng (1998), the Time-Varying Correlation (TVC) model of Tse and Tsui (1998) and the Dynamic Conditional Correlations (DCC) model of Engle (2001). Maximizing a Gaussian likelihood function is commonly used to estimate these models. Due to the available of an excellent survey of M-GARCH models by Bauwens et al (2006), this section only introduces the BEKK model (acronym for Baba, Engle, Kraft and Kroner), a well-known one among the M-GARCH family, proposed by Engle and Kroner (1995).

Consider a vector stochastic process $\{y_t\}$ of dimension $N \times 1$. θ is denoted as a finite vector of parameters:

$$y_t = \mu_t(\theta) + \varepsilon_t \tag{2.14}$$

Where $\mu_t(\theta)$ is the conditional mean vector and

$$\varepsilon_t = H_t^{1/2}(\theta) z_t \tag{2.15}$$

Where $H_t^{1/2}(\theta)$ is a $N \times N$ positive definite matrix. Additionally, it is assumed the $N \times 1$ random vector z_t to have the following first two moments:

$$E(z_t) = 0 \tag{2.16}$$

$$Var(z_t) = I_N \tag{2.17}$$

Where I_N is the identity matrix of order N. In order to explain what $H_t^{1/2}(\theta)$ is (for convenience we will leave out θ when explaining). The conditional variance matrix of y_t is calculated as follows:

$$Var(y_t | I_{t-1}) = Var_{t-1}(y_t) = Var_{t-1}(\varepsilon_t) = H_t^{1/2} Var_{t-1}(z_t)(H_t^{1/2})' = H_t \tag{2.18}$$

Hence $H_t^{1/2}(\theta)$ is any $N \times N$ positive definite matrix such that H_t is the conditional variance matrix of y_t (e.g. $H_t^{1/2}(\theta)$ may be estimated by the Cholesky factorization of H_t. Both H_t and μ_t depend on the unknown parameter vector θ, which can be divided into two parts in most situations, one for μ_t and one for H_t (Bauwens et al 2006).

According to Engle and Kroner (1995), the BEKK(p,q,K) model is defined as:

$$H_t = A_0 + \sum_{k=1}^{K} \sum_{i=1}^{q} A_{ik}^{*\prime} \varepsilon_{t-i} \varepsilon_{t-i}' A_{ik}^{*} + \sum_{k=1}^{K} \sum_{i=1}^{p} B_{ik}^{*\prime} H_{t-i} B_{ik}^{*} \tag{27}$$

Where p and q are the number of time lags; k determines the generality of the process; A_0, A_{ik}^* and B_{ik}^* are $N \times N$ parameter matrices; A_0 is matrix of constants; Elements a_{lm} in matrix A_{ik}^* measure the degree of shock from l market to m market; Elements b_{lm} in matrix B_{ik}^* refers to the persistence in conditional volatility between l and m markets. If A_0 is positive, H_t is positively defined. With $p=q=k=1$, the BEKK in equation (27) may be illustrated as follows:

$$\begin{bmatrix} H_{11} & H_{12} \\ H_{21} & H_{22} \end{bmatrix} = \begin{bmatrix} a_{11}^{0} & a_{12}^{0} \\ a_{21}^{0} & a_{22}^{0} \end{bmatrix} + \begin{bmatrix} a_{11}^{*} & a_{12}^{*} \\ a_{21}^{*} & a_{22}^{*} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^{2} & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^{2} \end{bmatrix} \begin{bmatrix} a_{11}^{*} & a_{12}^{*} \\ a_{21}^{*} & a_{22}^{*} \end{bmatrix} + \\ + \begin{bmatrix} b_{11}^{*} & b_{12}^{*} \\ b_{21}^{*} & b_{22}^{*} \end{bmatrix}' \begin{bmatrix} H_{11,t-1} & H_{12,t-1} \\ H_{21,t-1} & H_{22,t-1} \end{bmatrix} \begin{bmatrix} b_{11}^{*} & b_{12}^{*} \\ b_{21}^{*} & b_{22}^{*} \end{bmatrix} \tag{2.19}$$

2.4.2 Quantity-Based Measures

There are a growing number of studies that have tested financial integration by applying quantity-based measures. This section looks at three popular quantity-based measures of financial integration: namely, savings investment correlations, consumption correlations and cross-border activities.

2.4.2.1 Savings-investment correlations

Feldstein and Horioka (1980), henceforth FH, are pioneers in this line of research. They state that "in a world where there is high capital mobility, a country's savings are effectively part of a world pool that is able to be directed anywhere". The world savings should theoretically be equal to the world investment, deviations of savings from investment, however, signals a degree of capital mobility in a specific country. If financial integration occurs real interest rates are equal across countries, savings and investment are not correlated to each other. If capital mobility is low, real rates are not the same, leading equalised savings and investment ratios within national borders[7]. The FH test of capital mobility is based on the following estimating equation:

$$(I/Y)_i = \alpha + \beta(S/Y)_i + \varepsilon \tag{2.20}$$

I, S and Y stand for country's investment, savings and GDP, respectively.

FH (1980) tests capital mobility for 16 OECD countries from 1960 to 1974. As a result, the β value is approximately equal to 0.9 and insignificantly different from one. This high correlation coefficient implies a low capital mobility in OECD area. Bayoumi (1997) examine capital mobility for 22 OECD countries from 1960 to 1993. Compared to findings of FH (1980), Bayoumi reports a considerable reduction of correlation in this

[7] see Frankel 1991 and Bayoumi 1997

area. Particularly, the β value is 0.64 for the 1980s, which is in line with Obstfeld (1995).

2.4.2.2 Consumption correlations

Another theoretical measure of financial integration is to look at the pattern of consumption within and across economies over time. Particularly, a convergence of consumption between two economies indicates that each country is using capital markets to make a consumption pattern which is different from the pattern implied by available domestic resources, so indicating access or openness to capital flows (Montiel 1994 and de Brouwer 1999).

Montiel (1994) examines the capital mobility in a group of developing countries from 1970 to 1990. Particularly, he observes correlations of consumption growth for individual economies against an average consumption growth for the rest of the sample and against real GDP. He concludes that the economies of Singapore, Thailand, Korea, Malaysia and the Philippines have quite high capital mobility.

De Brouwer (1999) examines the capital mobility for East Asian economies by looking at correlations between consumption and real income. The sample is divided into three sub-periods: 1963-1972, 1973-1982 and 1983-1992. As a result, Korea, Thailand, Malaysia and the Philipppines show high capital mobility in the first and third periods, but low in the second. Japan, Singapore and Hong Kong have intensified capital mobility with an increasing level of correlation over time.

2.4.2.3 Volume-based approaches

This section introduces another approach to measure financial integration. This approach is based on actual capital inflows and outflows among countries. It is also called *de facto* measures distinguished from *de jure* ones which measure legal restrictions on capital account (see the following section 2.4.3).

Heathcote and Perri (2001) find that the sum of US foreign direct investment and portfolio equity had rapidly increased over the period of 1972-1999. At the same time, the

stock of liabilities had also grown quickly. That is, the size of capital flows had developed significantly. Lane and Milesi-Ferretti (2003) and Prasad et al (2003) apply the volume-based approach by using the ratio of foreign assets and liabilities divided by GDP. Lane and Milesi-Ferretti study 18 OECD economies in 1990s. Prasad et al look at developing economies in 1990s. Although they use different samples of countries, they all report a remarkable increase in openness for both developing and developed economies.

2.4.3 Legal Restriction Measures on Capital Accounts

One strand of the literature studies financial integration based on official restrictions on cross-border capital flows. The central theory is the process of financial integration should be related to relaxing capital controls which used to be imposed in the earlier structure. Therefore, we may examine whether an economy is being in a state of more or less integration by investigating whether controls are being relaxed or imposed over time. There are two types of restriction measures: simple restriction measures and intensive restriction measures.

2.4.3.1 Simple restriction measures

A simple restriction measure is usually a binary indicator, under which a country is either counted as open or closed in terms of control on capital flows. Most simple restriction measures applied 0/1 IMF dummies to study the effects of cross-border capital controls. The pre-1996 editions of IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* (*AREAER*) described dummies in six categories: bilateral payments arrangements with members and nonmembers, restrictions on payments for current account transactions, restrictions on payments for capital account transactions, import surcharges, advance import deposits, and surrender or repatriation requirements for export proceeds. Generally, dummy classifications in these editions are quite simple. To overcome this disadvantage, IMF edited a new AREAER with a more complex and specific structure.[8] For each of the categories in the pre-1996 editions, dummies in the "new" *AREAER* were classified into many different sub-categories of transactions. There are, for instance, thirteen sub-categories in capital account transactions.

[8] Note that the new reporting procedures covered only 52 countries in the first year and were subsequently extended to all the member countries.

Several capital control indices are established by using the IMF's AREAER classifications (see Table 2.1). Johnston and Tamirisa (1998) are considered pioneers in this line of research. They establish 1997-indices for 45 countries. Rossi (1999) develops these indices by an extended period covering from 1989 to 1997 for a smaller sample of 15 countries. Brune et al (2001) build indices of 173 countries for the period from 1973 to 1999. Brune et al's indices are really distinctive except that they are not available to the public. Some other simple restriction measures, for example Klein and Olivei (2000), are based on *OECD Code of Liberalization of Capital Movements,* which provides data on the restrictions of international transactions of OECD countries. It reports the binary indicators of 11 categories of international transactions as direct investment, liquidation of direct investment, and admission of securities to capital markets etc.

2.4.3.2 Intensive restriction measures

Since a simple restriction measure provides no information about how strong a country's capital controls are, Quinn (1997) constructs the intensity restriction measure by assigning scores separately to the intensity of controls for capital account receipts and capital account payments. He scores each of these two categories according to the description in IMF AREAER as: 0 indicating that payments are forbidden; 0.5 indicating existence of quantitative or other regulatory restrictions; 1 indicating that transactions are subject to heavy taxes; 1.5 indicating less severe taxes; and 2.0 indicating transactions are free of restrictions or taxes. Ranging between 0 and 4, the intensive restriction indicator is the sum of the scores of these two categories. Using the similar method, Montiel (1996), and Montiel and Reinhart (1999) also construct intensive restriction measures according to IMF AREAER.

Except for the simple restriction measures based on IMF AREAER, other studies on restriction measures only have limited time samples and country samples mainly OECD countries included. It is therefore difficult to study trends in financial integration, especially for developing countries, through the restriction measures.

Table 2.1: Summary of alternative capital control measures

	Name	Information Source	Coverage	Coding	Advantages	Disadvantages
Based on *AREAER* information	IMF dummy	*AREAER*	All IMF member countries, 1967–1995.	0/1 dummy depending on whether country has controls on outflows.	Extensive coverage.	– Accounts only for controls on outflows. – Single dummy is too limited.
	Johnston and Tamirisa (1998)	*AREAER*	45 countries for the year 1996.	Average of all possible 0/1 dummies in the new *AREAER*.	– Discriminates between controls on inflows and outflows. – Most disaggregated among *AREAER* indices.	Coverage restricted to post-1996 period.
	Rossi (1999)	*AREAER*, others nonspecified.	15 countries, 1989–1997.	For 1997, average of 0/1 dummies over all disaggregated categories of transactions. For 1989, three possible values depending on whether 1997 value is high, intermediate, or low. In between, linear interpolation if country had gradual change, or one-time change otherwise.	Discriminates between controls on inflows and outflows.	– 1989 index can take only three values. – 1989 index depends on 1997 index. – Values in between 1989 and 1997 are computed through linear interpolation or one-time change. – Limited coverage.
	Brune and others (2001)	*AREAER*	173 countries, 1973–1999.	Sum of all 0/1 dummies over five disaggregated categories, four of which separate controls on inflows and outflows.	– Extensive coverage. – Discriminates between controls on inflows and outflows.	– Not publicly available. – Only five categories of transactions. – Pervasive lack of information in the *AREAER?*
	Quinn (1997)	*AREAER*	63 countries, 4 years publicly available: 1958, 1973, 1982, and 1988.	For capital account receipts and payments, assigns a value between 0 and 2 in increments of 0.5 depending on severity of the restrictions.	– Takes into account the severity of restrictions. – Discriminates between inflows and outflows.	– Limited public availability. – Limited disaggregation. – Aggregation over different degrees of severity is problematic.
	Miniane (2004)	*AREAER*	34 countries, 1983–2000.	Average of all possible 0/1 dummies over 13 categories of capital account transactions.	– Substantial disaggregation. – Indicates systematically when coding is done by induction rather than through explicit information.	– Limited country coverage. – No distinction between controls on inflows and outflows.

Source: Miniane (2004)

2.5 CONCLUSIONS

The main objective of this chapter is to present definitions, potential benefits and costs and common measures of financial integration, which is considered the theoretical framework for the whole dissertation. The most theoretically satisfactory definition of financial integration is based on asset substitutability, or the '**law of one price**', whereby equal and free access to information equalities returns on perfectly substitutable assets. Such asset substitution is dependent on the willingness of asset-holders to exchange financial claims, but the presence of any barriers to trade in financial assets whether they are institutional, subjective or expectational, will ensure imperfect asset substitution. Thus, given economic interdependence, yet national political sovereignty in the world economy, a lack of consistency must exist in distinguishing theoretical and operational definitions of financial integration specified in terms of asset substitutability. Besides, the concepts of 'financial openness' and 'financial integration' should be clearly distinguished. A country pursuing capital account liberalisation is said to be seeking 'financial integration' with the international financial markets through 'financial openness'. That is, 'financial openness' is the means, while 'financial integration' is the goal.

Financial integration provides important potential benefits. A country may be allowed to borrow from the world capital markets for smoothing its consumption when confronting temporarily bad shocks. Besides, sharing risk globally may result in permanent and large welfare gains and growth. Nevertheless, financial integration may lead to more risk of volatilities. In fact, financial crises in 1990s period have called attention to potential costs caused in economies with fragile financial structures and weak supervisions. In order to take advantage of potential benefits and minimize risks, policy-makers should understand the degree of financial integration in order to foster policy requisites suitable for each period.

There are various methods to measure financial integration. They are placed into three categories. The first category refers to the measures taking advantages of price/return-based data availability to assess the degree of financial integration. These mainly include interest parity conditions, convergence criteria, capital asset pricing models,

cointegration, correlation and volatility spillover measures. The second category employs quantity-based measures such as savings-investment correlations, consumption correlations and cross-border activities. Finally, the third category explores restriction measures, which may be broadly classified as regulatory or capital control factors. However, each method has its own advantages and disadvantages, which will be discussed later in Chapter IV.

This Chapter has provided a theoretical framework of financial integration. Before applying these theories for evaluating the process of financial integration in East Asia in the short-term and long-term, the next Chapter will draw a clear picture of current financial development in the region.

CHAPTER III

FINANCIAL MARKET DEVELOPMENTS IN EAST ASIA

3.1 INTRODUCTION

East Asia has experienced a major shift since 1998 in to order to strengthen national economic and financial systems and markets, and to form cooperative arrangements with the intention of strengthening the region's financial stability and economic growth. The motivation for this is varied (Wang 2004). It is partly a reaction to the economic and social costs of the financial crises of 1997 and 1998. It is partly to ensure that financial markets and systems can meet the increasingly complex needs of East Asian households and firms as their cross-border trade, investment and people movement increases, both in the region and beyond. It is partly to digest the increasing importance of China and India in the East Asian and global economies and to facilitate necessary market and policy adjustment and reform in those two countries, the East Asian region generally, and the rest of the world. And it is partly a recognition that while East Asia may be a leader in world trade with growing influence on the global economic cycle, it is not so in the world of international finance, notwithstanding the region's large foreign exchange reserves. There is a growing sense that the region needs to develop much further in the domain of finance.

The regional initiatives on finance that emerged after the crisis include the continuing development of ASEAN Framework Agreement on Services (since 1995), which also covers financial services, the Manila Framework Group (since November 1997), the ASEAN Surveillance Process (1998), the Chiang Mai Initiative (2000) and the Asian bond initiatives (2003) under the Asian bond market development programme[9]. These developments have laid the foundation for a reasonable level of development cooperation

[9] Association of Southeast Asian Nations, *http://www.aseansec.org/*

in finance in Asia. However, unlike the more advanced progress achieved in some other areas such as trade liberalization, a lot of works remains in order to achieve strong and robust financial cooperation and integration in the region (Park and Wang 2005). Obviously, reaching an agreement on a clear roadmap would by itself pose as a challenge. Other than that, there are still a number of other challenges to cope with.

The purpose of this Chapter is to briefly review the 1997-1998 financial crisis and present the current process of financial development in East Asia. Section 3.2 and 3.3 summary the 1997-1998 Asian crisis and state of financial markets after the crisis, respectively. Next, section 3.4 introduces regional financial cooperation agreements. And then, section 3.5 discusses challenges to regional financial integration. Finally, conclusions are given in section 3.6.

3.2 THE 1997-1998 ASIAN FINANCIAL CRISIS

3.2.1 Chronology of the Asian Financial Crisis

The crisis opened with Thailand's devaluation on July 2, 1997, and deepened with the spread of difficulties to neighbouring countries in Southeast Asia. Although the Thai, Indonesian, Malaysian, and Philippine currencies all depreciated by 24 to 33 percent in the third quarter of 1997, the crisis could still be seen at this time as limited to these countries. This was no longer true starting in October, with the devaluation of the Taiwanese dollar, which led to a speculative attack on Hong Kong (whose economic structure was similar to Taiwan's and which competed with it in many markets), and with the spread of the crisis to South Korea. The first half of 1998 was dominated by the continued deterioration of economic, financial, and political conditions in Indonesia, with strongly negative impact on investor confidence and, hence, on the prospects for the other crisis economies. The final phase was ignited by the worse-than-expected economic performance of Japan, which came to light in the second quarter of 1998, and by Russia's

default in August and the spread of turmoil to still other emerging markets. Table 3.1 offers a chronological record of the crisis.

Table 3.1: The chronology of the Asian crisis

DATE	COUNTRIES	EVENTS
02/07/1997	Thailand	After four months of depending the weakening baht, the Bank of Thailand announced free float of baht.
20/07/1997	The Philippines	IMF grants US $1000 million as emergency grant after Peso falls outside a widened band to defend the basket peg.
24/07/1997	Malaysia	Malaysian Ringgit comes under speculative attack. The famous Mahathir's attack on speculators such as George Soros.
11/08/1997	Thailand	IMF led by Japan's pressure pledges US$16 billion to Thailand as rescue package.
	Indonesia	Indonesia's Rupiah under attack. Bank Indonesia's attempt to contain the troubles proved unsuccessful.
	Asia	Asian stock markets plunge in unison: Manila 9.3%; 4.5% in Jakarta, etc.
04/09/1997	The Philippines	Philippine Peso falls to the lowest level before central bank intervenes to maintain basket peg.
	Malaysia	Malaysia spends US $20 billion to prop the share market.
08/10/1997	Indonesia	Indonesia considers asking IMF for an emergency bailout.
23/10/1997	U.S.A.	New York share market loses 7.2% in value.
27/10/1997	Hong Kong	Hong Kong share market declined by nearly 25% in value.
03/11/1997	Japan	Japan's Sanyo Securities files for bankruptcy.
	Korea	South Korean Won loses 7%, biggest one-day loss.
		South Korea begins talk with IMF for tens of billions in emergency aid.
08/11/1997	Japan	Japan's third financial house to apply for closure: the seventh largest Yamaichi Securities.
20/11/1997	Korea	Korean Stock Market plunges with a loss of 7.2%.
24/11/1997	Japan	Tokyo City Bank, a regional bank, closes.
22/12/1997	Korea	Korean won plunges further.
25/12/1997	Korea	IMF and lender nations move to finance US $10 billion loan to Korea.
17/01/1998	Indonesia	Indonesian president fires the central bank governor.
21/05/1998	Indonesia	Indonesia's President Suharto resigns after a wave of bloody riots.
11/08/1998	World	Stock markets plunge around the world in expectation of interest rate rises in the U.S.A.
01/09/1998	Malaysia	Malaysia announces going back to fixed (RM 3.8 ¼ US $1) from November 1998. All free market currency transactions is abolished.
27/09/1998	Japan	A major leasing company in Japan, Japan Leasing Corp., files for bankruptcy.
02/10/1998	U.S.A.	The Long Term Capital Management reported to have lost US $5 billion.
		The Federal Reserve mounts a rescue by putting together a consortium to rescue the long term Hedge Fund.
17/10/1998	U.S.A.	The Fed announces interest rate cuts, and the share market rebounds. Two more rate cuts follow by November 20, 1998.
12/1998	Asia	Most currencies that had overshot (Baht; Rupiah; Peso: Ringgit; and Won) recovered about half way from their worst declines. Rupiah gained the most from its low of some Rs. 20,000 to Rs. 7600 to US$.

Source: Khalid-Kawai (2003)

3.2.3 Causes of the Crisis

There are many explanations for the Asian financial crisis. However, all of these may be placed into two main themes. The first theme claims that the crisis was caused by poor fundamentals and weak financial structures (Corsetti et al 1998 and Lane et al 1999). The second theme claims that the crisis was the result of a financial panic (Radelet and Sachs 1998a and 1998b). Some researchers combined these two themes of explanations and stated that the relatively fragile fundamentals and weak financial structures of an economy leaded to the increase of loss due to the changes in investor confidence (Corbett and Vines 1998 and Berg 1999). This section summarises main reasons to the 1997 Asian financial crisis.

3.2.3.1 Fundamentals

The proponents of fundamentals view claimed that liberalisation of financial markets in the early 1990s resulted in the 1997 financial crisis[10]. In fact, while the financial liberalisation did stimulate a surge of capital flows into East Asia (see Table 3.2), these economies were basically weak, lack of financial oversight and lagged behind the rapid expansion of financial services. Therefore, they found themselves considerably fragile in the face of international financial shocks.

Table 3.2: ASEAN-5, net capital flows, 1991- 1999 (billions of US dollars)

Net capital flows	1991	1992	1993	1994	1995	1996	1997	1998	1999
Net private capital flow	24.8	29.0	31.8	36.1	60.6	62.9	-22.1	-29.6	-18.1
Net direct investment	6.2	7.3	7.6	8.8	7.5	8.4	10.3	9.7	9.4
Net portfolio invt	3.2	6.4	17.2	9.9	17.4	20.3	12.9	-7.3	4.5
Other net investment	15.4	15.3	7.0	17.4	35.7	34.2	-45.3	-32.0	-32.0
Net official flows	4.4	2.0	0.6	0.3	0.7	-4.6	30.4	20.2	-4.5
Change in reserves	-8.3	-18.1	-20.6	-6.1	-18.3	-5.4	30.5	-52.1	-39.9

Source: IMF, World Economic Outlook (1999), http://www.imf.org/external/ns/cs.aspx?id=29

The surge of capital inflows contributed to a domestic lending boom in East Asia and put banking system in a more risky position (see Table 3.3). Particularly, the capital inflows were mostly intermediated through the banking system. Banks used these capital flows, mainly in the form of short-term unhedged loans, in order to support long-term

[10] See Corsetti et al (1998), Glick (1998) and Berg (1999).

investments. These mismatches of currency and maturity made banks extremely exposed to liquidity risk and market risk (e.g. sensitive to fluctuations in interest rates currency rates). In addition, banks were in a danger of credit risk from domestic firms (Corsetti et al 1998). In fact, several domestic firms used assets with bubbled prices as collateral against bank loans. Lane et al (1999) determined that the banking system in East Asia was easily collapsed due to an adverse financial shock.

Table 3.3: Real bank credit growth (%) by country and year

Period	Indonesia	Malaysia	Philippines	Rep. of Korea	Thailand
1991-94 (average)	10.2	9.7	15.1	9.7	18.7
1995	13.3	26.5	31.8	10.3	15.6
1996	14.0	22.3	38.8	14.4	9.0
1997	17.2	20.2	20.2	14.4	14.7
1998	-25.4	-2.3	-15.5	4.3	-13.4
1999	-56.7	-0.6	-6.3	18.9	-4.8

Source: Asia Recovery Information Center, http://aric.adb.org/

Many researchers (Corsetti et al 1998, Glick 1998, and Berg 1999) considered the increasing deficits of current accounts as signs of risk (see Table 3.4). These Asian economies had pegged their currency rates to the US dollar. The growing deficits were resulted from the dollar appreciation against the European currencies and Japanese yen. Besides, the slowdown of the Japanese economy and China's increasingly comparative advantage also contributed to the sharp decline in export volumes.

Table 3.4: Current account (% of GDP)

Year	Indonesia	Malaysia	Philippines	Rep. of Korea	Thailand
1992	-2.0	-3.7	-1.6	-1.3	-5.5
1993	-1.3	-4.6	-5.5	+0.3	-4.9
1994	-1.6	-7.6	-4.6	-1.0	-5.4
1995	-3.2	-9.8	-4.4	-1.7	-7.9
1996	-3.4	-4.4	-4.8	-4.4	-7.9

Source: ADB, Key Indicators 2003, http://www.adb.org/documents/books/key_indicators/

3.2.3.2 Financial panics

In terms of the financial panic view, Radelet and Sachs (1998a, 1998b) disagreed that the 1997 financial crisis was as a result of poor fundamentals. In fact they said that the Asian economies had been highly strong before the date of crisis. They pointed out that the sudden withdrawal of funds directly led to the crisis. As illustrated in Table 3.5, the huge amounts of short-term debt had been built up over time. Creditors may realise short-term

debt far exceeded international reserves in Asian economies, which created a self-fulfilling panic that generated results much more dangerous than that done by fundamental problems alone.

3.2.3.3 Hybrid Explanations

Was the Asian financial crisis primarily caused by fundamentals imbalances or confidence shocks? So far the answer for this question has been on debate. In order to combine both explanations, other researchers have suggested an alternative approach called hybrid explanation. This approach stated that lack of financial regulations and weak financial structures had made the Asian economies highly exposed to changes in investor confidence. In deed, changes in investor confidence was obviously expressed through the contagion followed the collapse of Thai Baht in July 1997 (Khalid and Kawai 2003). Glick (1998) pointed out that when a crisis had been caused by poor economic fundamentals, it would quickly take the form of a panic due to the fact that investors would re-consider their positions and subsequently withdraw their funds.

Table 3.5: Short-term debt (% international reserves)

Period	Indonesia	Malaysia	Philippines	Korea	Thailand
1992	158.5	21.0	98.5	69.5	69.5
1993	145.6	25.4	85.0	60.2	89.0
1994	147.4	24.2	80.3	123.1	96.4
1995	175.6	30.4	67.9	142.5	119.4
1996	167.6	40.8	67.9	195.4	123.5
1997	188.9	71.5	135.0	263.6	140.7

Source: ADB, Key Indicators 2003, http://www.adb.org/documents/books/key_indicators/

3.3 FINANCIAL MARKETS AFTER THE CRISIS

De Brouwer (2003) stated that a dynamic and resilient financial market needs to own three primary features: diversification, efficiency and robustness. Particularly, the market needs to be highly *diversified* to provide financial services for growing complex and sophisticated economies. Then, these financial services needs to be provided *efficiently* for the purpose of building a competitive and productive economy overall. And the market also needs to be *robust* in the face of shocks in a global economy rapidly changing.

3.3.1 Diversification of Financial Markets

The region's financial sector except Philippines has deepened, with significant growth of assets in banking, equity and bond markets (see Table 3.6) between 1997 and 2005. The total size of the East Asian financial markets assets approximately valued at US$ 9,600 billion (at 2000 prices in U.S. dollars) in 2005 — or equal to 21% of the US financial market and almost half of that of Japan (Ghosh 2006).

Table 3.6: Financial markets in East Asia

Countries	Bank Assets (% of GDP)			Equity Market Capitalisation (% of GDP)			Bonds Outstanding (% of GDP)		
	1997	2004	2005	1997	2004	2005	1997	2004	2005
China	124.4	207.4	191.6	11.2	27.1	20.9	12.9	29.3	28.6
Indonesia	34.3	14.4	68.4	36.4	36.8	39.8	2.1	22.4	27.0
Korea	67.7	118.0	91.9	14.5	51.8	89.6	45.0	75.6	74.9
Malaysia	100.6	170.0	162.5	93.0	154.2	140.6	56.9	90.5	89.7
Philippines	76.5	68.4	61.3	51.4	34.0	39.3	30.5	29.7	35.6
Thailand	79.7	127.4	102.1	15.1	70.6	69.7	7.1	40.7	40.2
Hong Kong	208.2	343.3	443.3	238.0	528.5	591.9	26.4	47.1	46.5
Singapore	122.7	178.0	185.3	111.5	203.7	220.3	24.8	73.6	68.2

Source: IMF-IFS (http://ifs.apdi.net/imf/logon.aspx), BIS (http://www.bis.org/) and ADB Asian Bonds Online (http://asianbondsonline.adb.org/regional/regional.php).

Table 3.7: Equity market capitalisation and domestic bonds outstanding

Economies	Equity markets (US$ billion)		Bond markets (US$ billion)	
	1997	2004	1997	2004
China	101.4	447.7	116.4	483.3
Indonesia	29.1	73.3	4.5	57.7
Korea	41.9	389.5	130.3	568.3
Malaysia	93.2	181.6	57.0	106.6
Philippines	31.2	28.6	18.5	25.0
Thailand	22.8	115.4	10.7	66.5
Hong Kong	413.3	861.5	45.8	76.8
Singapore	106.3	217.6	23.7	78.6
East Asian region (excluding Japan)	839.1	2,315.1	401.2	1,461.2
Japan	2,160.6	3,557.7	4,433.6	8,866.7
United States	10,730.6	16,323.5	12,656.9	19,186.6
United Kingdom	1,996.2	1,194.5	777.7	1,040.8
Germany	825.2	2,865.2	1,739.7	2,225.7

Source: ADB Asian Bonds Online (http://asianbondsonline.adb.org/regional/regional.php) and World Federation of Exchanges (http://www.world-exchanges.org/WFE/home.Asp?nav=ie)

In terms of market capitalization, East Asia's equity market nearly tripled, about US$ 839 billion in 1997 and reaching US$ 2,315 billion in 2004 (see Table 3.7). Although regional stock markets were sizably smaller compared to those of the US, UK and Germany, stock

market capitalisation as a percentage of GDP is actually larger in Singapore, Hong Kong and Malaysia than that in the US, UK and Germany.

As illustrated in Table 3.7, the size of regional bond markets had also significantly grown between 1997 and 2004, about US$ 401 billion in 1997 and amounting to US$ 1,461 billion in 2004. However, much of the growth in bond markets (over 50% of the growth during 1997-2004 in all economies in the region except Hong Kong and Korea) was accounted by government bonds (see Table 3.8). Although in several countries corporate bonds have taken a reasonable proportion of the growth, in most economies they remain quite a small proportion of the overall bond market. The key reason for the small corporate bond markets is the lack of liquidity in secondary markets.

Table 3.8: Types of bond issuers

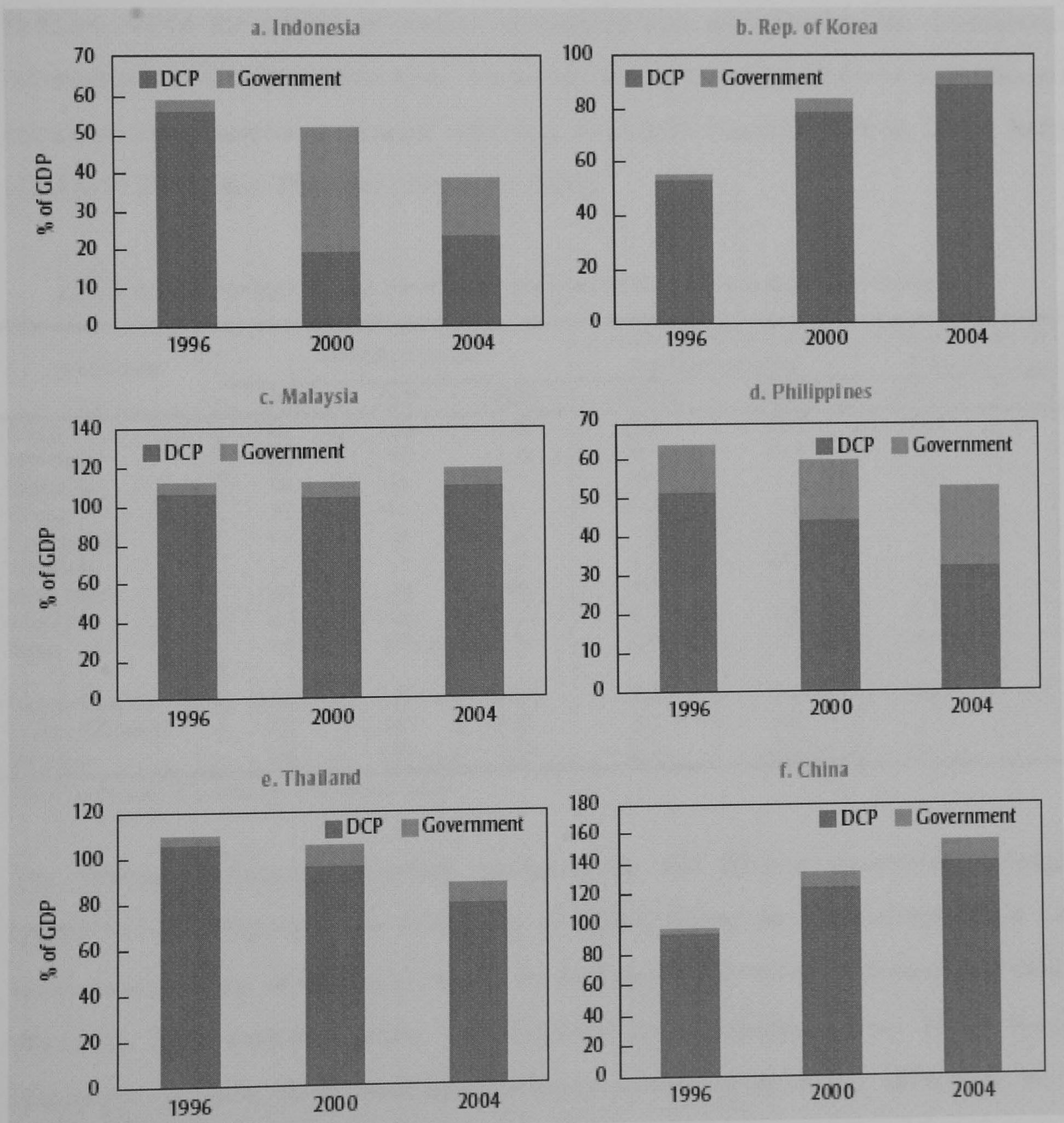
Countries	1997 (% of GDP)			2004 (% of GDP)		
	Government	Corporate	Financial	Government	Corportate	Financial
China	7.1	0.7	4.5	14.9	0.6	9.5
Indonesia	0.0	0.0	0.0	19.8	1.5	1.1
Korea	4.9	10.3	10.0	25.2	23.4	34.9
Malaysia	19.4	20.8	16.8	38.2	38.0	13.9
Philippines	22.3	0.1	0.0	28.4	1.2	0.0
Thailand	0.2	6.0	0.1	22.4	12.3	5.4
Hong Kong	7.5	18.8	0.0	9.7	37.4	0.0
Singapore	13.6	11.2	0.0	41.2	32.4	0.0

Source: ADB (http://www.adb.org/documents/books/key_indicators/),, BIS (http://www.bis.org/), and country sources.

To what extent are the financial sectors in the region serving the needs of consumers and firms through the different financial segments? In banking, the ratio of domestic credit to the private sector (DCP) to GDP has yet to recover to pre-crisis levels in several of the crisis affected countries (see Figure 3.1). Particularly, DCP as a percentage of GDP in the Philippines, Thailand and Indonesia is still considerably below pre-crisis levels. Actually, a greater portion of banks' asset are held in forms other than loans, especially government bonds. Of the domestic credit that banks have extended to private borrowers, a growing share has been distributed to consumers. The World Bank estimated that consumer lending accounted for 53% of total bank lending in Malaysia, 49% in Korea, 30% in Indonesia, 17% in Thailand, 15% in China and 10% in the Philippines in 2004. The bulk of these loans to consumers has been for housing, although other forms of lending,

notably credit card lending, have also grown fast. Lending by banks to the corporate sector has remained insignificant. Partly this reflects low demand, both because corporate investment has remained low and because firms have deleveraged and financed a significant proportion of their capital needs through retained earnings. Firms have also sought alternative sources of external finance as financial markets in the region have broadened.

Figure 3.1: Domestic credit to the private sector (DCP) and government



Source: Ghosh (2006)

3.3.2 Efficiency of Financial Markets

We look at the efficiency of financial markets with respect to *banking sectors*, *equity* and *bond markets*. In their efforts to address problems of operational inefficiencies, risk management, governance and capitalisation, policy makers have implemented considerable changes in the structure of banking sectors. Particularly, they have closed and consolidated banks, normally entailing initial nationalisation followed by re-privatisation. Table 3.9 shows that the number of banks in all East Asian countries except China has declined considerably due to consolidation events. Obviously, the structural changes in banking sectors in East Asian have been in line with that in other industrialised economies such as the United States, the United Kingdom and Germany. Besides, while the extent of foreign ownership and participation has increased, state ownership has decreased over time. However, the pattern varies across countries and the extent of state ownership remains relatively sizable in China (89.7% in 2004), Indonesia (51.3% in 2004) and Thailand (29.3% in 2004).

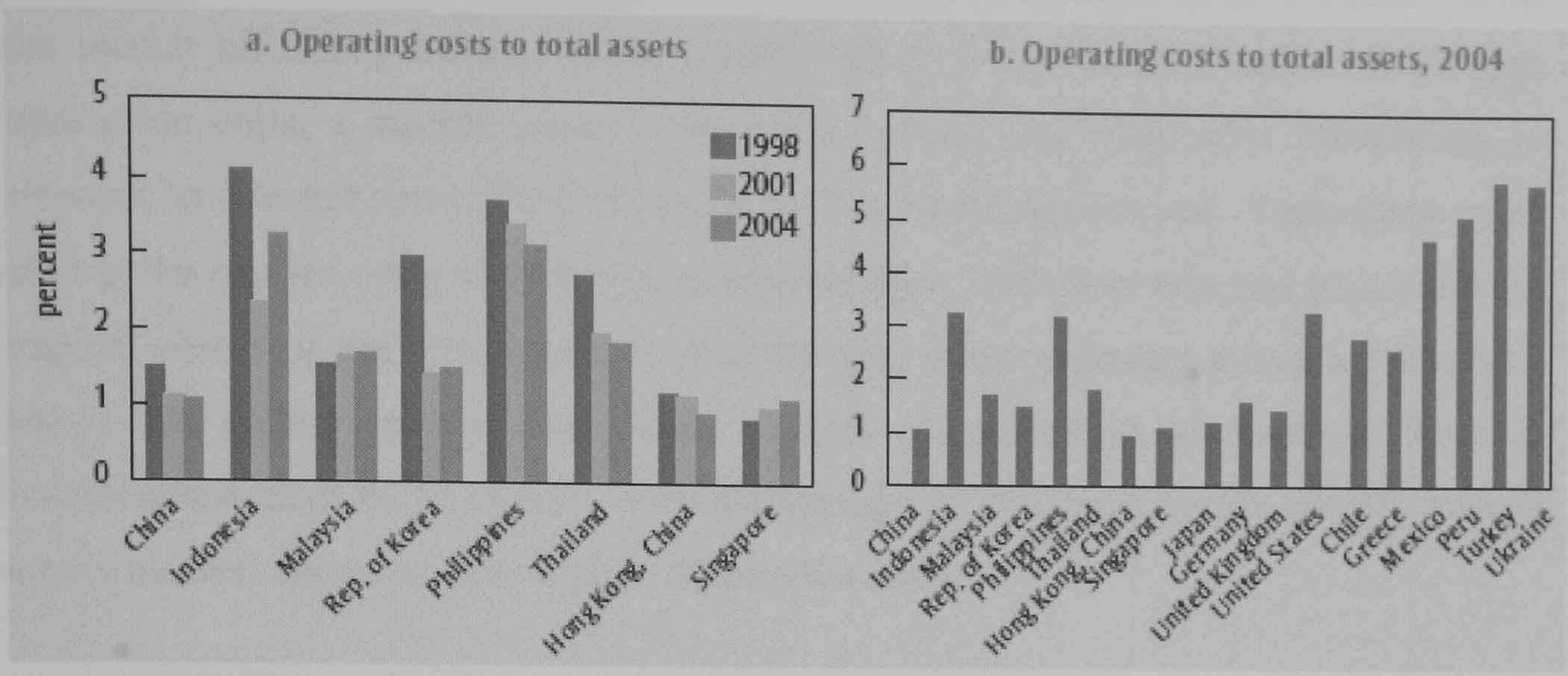
Table 3.9: Changes in the structure and ownership of commercial banks

Economies	Number of banks			Average state ownership in top ten banks (%)		Average foreign ownership in top ten banks (%)	
	1997	2002	2004	1997-99	2004	1997-99	2004
China	86	129	135	96.4	89.7	0.02	3.2
Indonesia	222	142	134	73.8	51.3	0.0	16.7
Malaysia	36	26	25	10.9	3.5	15.9	26.2
Korea	16	11	8	37.2	5.8	12.2	21.3
Philippines	51	24	24	7.8	5.8	11.3	9.0
Thailand	16	13	12	1.3	29.3	8.1	11.7
Hong Kong	361	224	208	0.0	0.3	63.1	66.5
Singapore	152	120	113	0.0	4.0	8.3	15.6
Japan	148	137	129	0.0	1.3	0.2	3.6
United States	9,060	7,798	7,532	0.0	0.0	0.0	3.2
United Kingdom	452	385	380	0.0	0.0	2.9	12.8
Germany	326	273	252	1.7	2.7	3.5	5.8

Source: Country's sources and Bankscope

The structural changes including capitalisation and foreign ownership strengthened appear to have improved the efficiency of banks. Using the ratio of operating costs to assets as a measure of bank efficiency, we find that banks have improved their efficiency since the 1997 financial crisis (see Figure 3.2), especially China, Hong Kong and Singapore. In fact, their banking efficiency seems to be better than that in Japan, Germany, the United Kingdom and the United States in 2004.

Figure 3.2: Measures of banking efficiency



Source: *Ghosh (2006)*

Limited liquidity in the securities markets is a key challenge most of regional countries have had to confront with. An illiquid market appears not to be efficient due to the fact that new information cannot be immediately reflected in transactions. Table 3.10 measures the degree of liquidity in the *equity markets* based on two standard indicators: (1) the turnover ratio calculated by the value of stock trading relative to the market size and (2) the ratio of value traded to GDP. As a result, Malaysia, Indonesia and especially the Philippines show a serious issue of low liquidity in equity markets. In fact, the turnover ratio in the Philippines equity market is as low as 14% or equal to one sixtieth of NASDAQ, the most actively traded equity market in the world.

Table 3.10: Liquidity in equity and bond markets

Economies	Equity markets		Bond markets – Turnover ratio	
	Turnover ratio	Ratio of value traded to GDP	Government	Corporate
China	87.0	45.4	2.2	12.0
Indonesia	44.9	10.7	0.6	0.2
Korea	147.2	94.0	3.3	1.0
Malaysia	33.8	50.8	1.8	0.8
Philippines	14.3	4.2	n.a	n.a
Thailand	110.8	66.7	2.0	0.3
Hong Kong	57.7	269.3	34.7	n.a
Singapore	60.8	76.1	3.2	n.a
Japan	97.1	74.2	5.4	0.9
United States			37.9	n.a
NASDAQ	249.5	165.9		
NYSE	89.8	0.1		
United Kingdom	116.6	173.2	14.2	n.a
Germany	133.8	51.8	10.1	n.a

Source: World Bank FSDI (http://www.fsdi.org/),
World Bank WDI (http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/l)
ADB Asian Bonds Online (http://asianbondsonline.adb.org/regional/regional.php).
Note: n.a = not applicable

The lack of liquidity is affected by low level of information availability and high transaction costs. In fact, the low level of information disclosure directly influences on the market efficiency because prices appear not to reflect fundamentals. Given high transaction costs, a market seems to have less trading and fewer price movements in response to relevant news. Thus, it should be less liquid and efficient. Transaction costs include the explicit costs of trading (e.g. commissions, settlement fees and taxes) and the implicit costs (e.g. the opportunity costs of delaying or not executing a trade). Table 3.11 shows that trading costs in East Asian markets are quite high compared to those in industrialised markets. Especially, with the average of 94.1 basis points, the Philippines equity markets appear to have highest transaction costs.

Table 3.11: Transaction costs in equity markets

Economies	Commissions (basis points	Fees (basis points)	Market impact (basis points)	Total (basis points)
Indonesia	47.7	10.6	9.9	68.2
Korea	29.3	12.4	19.2	60.9
Malaysia	34.2	6.1	15.7	56.0
Philippines	48.5	34.4	11.3	94.2
Thailand	43.7	1.8	11.4	56.9
Hong Kong	22.3	10.7	11.3	44.3
Singapore	25.7	2.0	13.8	41.5
Japan	12.9	0.3	6.3	19.5
United States (NYSE)	18.2	0.3	7.8	26.3
United Kingdom				
Buys	14.2	49.8	7.4	71.4
Sells	13.4	0.8	13.3	27.5
Germany	17.6	0.6	14.1	32.3

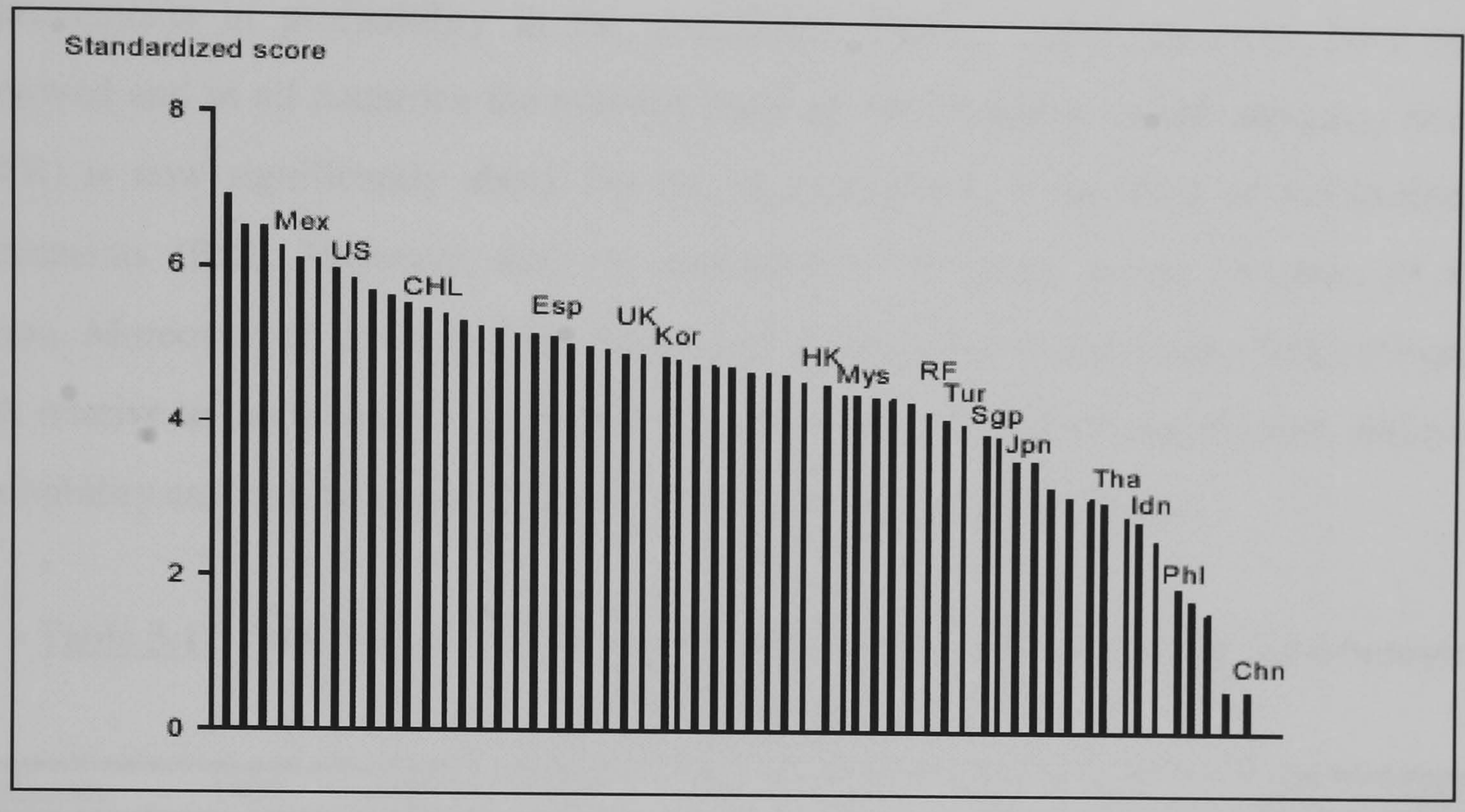
Source: Elkins Mcscherry trading costs 2004, https://www.elkinsmcsherry.com/

In some of the countries in the region a sizable proportion of shares remains inaccessible to cross-border investors. As of end-2004, foreign investors did not have access to around 42% of the stock market in the Philippines, 41% in China and 36% in Thailand[11]. This, combined with the fact that there is also a sizable proportion of shares that are closely held in some economies (around 28% in China, 30% in Indonesia, 40% in the Philippines and 21% in Thailand), means that in some cases only a small percentage of shares is freely available to would-be investors. In turn, this can significantly dampen the liquidity and efficiency of a stock market. Comparisons with countries at similar per capita income levels outside the region suggest that East Asia's equity markets have room to improve

[11] These figures are based on the IFCI (Investable) return index, which includes a subset of the stocks included in the IFCG (Global) index (see International Financial Corporation's Index, *http://www.ifc.org/*).

their efficiency (see Figure 3.3)[12]. Korea, Hong Kong, Singapore and Malaysia have the most efficient markets in the region. In the bottom quartile are Thailand, Indonesia Philippines and China.

Figure 3.3: Composite measure of efficiency of equity markets



Source: World Bank, FSDI Indicators, http://www.fsdi.org/

Lack of liquidity is an even more concerned issue in East Asia's *bond markets* than in its equity markets. As illustrated in Table 3.11, the region's bond markets are much less liquid than those of industrialised countries as a whole. Additionally, liquidity is even more limited in the corporate bond market compared to that in the government bond markets. Gyntelberg et al (2005) pointed out that liquidity in bond markets is limited even in the advanced industrial countries. Even in the United States, liquidity is focused on government bonds and the benchmark corporate bonds. Most of the other bonds are only traded actively in the first few weeks after issuance as part of the allocation process. After that, liquidity is typically low.

[12] The Equity Market Efficiency Indicator is a composite measure that captures transaction costs and the quality of information disclosure. Transaction costs are measured by the proportion of zero return days in a trading year. Since informed traders only trade when the benefits exceed the costs of doing so, a market with higher trading costs (both implicit and explicit) will exhibit more days without trading–hence a zero return. The quality of information disclosure is measured by "stock market synchronicity", which captures the comovement between individual stock returns. A high level of comovement indicates that there is not much firm-specific information (see World Bank FSDI Indicators, *http://www.fsdi.org/*).

3.3.3 Risk of Financial Markets

Banking sectors in the region are sounder on average than they were a few years ago. As for the formerly crisis-affected countries excluding Thailand, the reported nonperforming loan (NPL) ratios are now in single digits (see Table 3.12), reflecting gradual improvements in profitability in the economies. Banks' capital positions have also improved and in all countries the average reported risk-weighted capital adequacy ratios (CAR) is now significantly above the 8% recommended by the Bank of International Settlements (BIS). However, there is considerable difference across countries in the region. Moreover, on average, East Asia's ratio of non-performing loans (NPL) remains high relative to that in other regions such as Latin America or Emerging Europe, while its profitability and risk-weighted capital adequacy ratios are slightly lower.

Table 3.12: NPLs in the commercial banking system of the crisis-affected countries (% of total loans)

Countries	1997	1998	1999	2000	2001	2002	2003	2004	2005
Indonesia	7.2	48.6	32.9	18.8	12.1	7.5	6.8	4.5	7.6
Korea	6.0	7.3	13.6	8.8	3.3	2.4	2.2	2.0	1.3
Malaysia		10.6	11.0	9.7	11.5	10.2	9.0	7.5	5.8
Philippines	4.7	10.4	12.3	15.1	17.3	15.0	14.1	12.7	8.5
Thailand		45.0	41.5	29.7	29.6	34.2	30.6	28.0	24.0

Source: World Bank, East Asia Update (2006)
http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/EXTEAPHALFYEARLYUPDATE/0,,contentMDK:20275253~pagePK:64168427~piPK:64168435~theSitePK:550226,00.html

In general, East Asia's securities markets are relatively stable compared with those of other regions. Among a sample of 124 economies worldwide (East Asia Analytical Unit 2006), Singapore falls in the highest (most stable) quartile, followed by Hong Kong and Malaysia in the second highest quartile. Indonesia, Philippines, and Thailand fall in the bottom quartile, as does Korea.

Regarding the stability of the financial systems, appropriately developed markets and mechanisms for risk sharing and risk transfer, such as securitization and derivatives, can enhance the risk-bearing capacity of an economy, by enabling market participants to manage and transfer risks to those more able and willing to bear them. Using new

financial instruments to transfer risks has been a major innovation all over the world. Global derivatives markets have developed extremely fast. Particularly, over-the-counter derivatives markets have increased by tenfold between 1997 and 2005 to achieve US$ 248,000 billion; exchange-traded derivatives markets have reached US$ 53,000 billion in 2005[13]. Derivatives markets in the East Asia region have accounted for a considerable proportion of 15% of this growth (see Table 3.13), and the stability of financial systems in the region appears to have improved because banks have transferred parts of their traditional credit risks to capital markets. However, while risks can be intermediated and distributed more efficiently, they may simply become less visible as they move into less regulated segments of the financial markets.

Table 3.13: Main over-the-counter and exchange-traded derivatives (US$ billion)

Economies	OTC-FX	OTC-INT	ETD-INT	ETD-EQU
Singapore	91.0	9.0	42.0	3.0
Hong Kong	70.0	11.0	1.0	4.0
Korea	10.0	1.0	13.0	50.0
Other East Asia	8.0	4.0	1.0	8.0
% of the world total	15.0	1.8	2.1	3.7

Source: Ghosh (2006)

Note: OTC = Over-the-counter; FX = Foreign-exchange derivatives; ETD = Exchange-traded derivatives; INT = Interest-rate derivatives; EQU = Equity derivatives

3.4 REGIONAL FINANCIAL COOPERATION AGREEMENTS

A notable development in the aftermath of the Asian financial crisis has been the emergence of keen interest in exploring various forms of monetary and financial cooperation in the region, particularly in East Asia. The main objectives of these initiatives have been to provide mechanisms for crisis prevention and management, policy dialogue and the sharing of resources aimed at maintaining financial stability. Several factors contributed to this new development:[14]

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[13] World Federation of Exchanges, Annual Reports and Statistics 2005, *http://www.world exchanges.org/WFE/home.Asp*

[14] Y. Iwasaki, "Monetary and financial cooperation in East Asia: the way ahead", presentation made at the Boao Forum for Asia Conference, Hainan, China, 2 November 2003.

- First, the unexpected and unprecedented contagion effect of the crisis suggested that financial crises in individual countries should not be a matter of indifference to other countries in the region because such crises may have significant spillover effects;
- Second, since the crisis had its origin in weaknesses in the financial and corporate sectors among several countries, cross-country cooperation on financial sector reform issues is considered beneficial to all;
- Third, there is increasing awareness in the region that policy dialogue at the regional level can usefully complement national-level policy-making and global-level policy dialogue.

The objective of this section is to analyse the existing development cooperation initiatives in finance in the Asia-Pacific region, with a view to developing a monetary and financial framework which reflects the architecture necessary to support the development process in the region. It focuses mainly on selected aspects such as CMI, the Asian bond market and infrastructure development, with special emphasis on how these initiatives could be extended for the benefit of a wider section of developing countries in the region.

3.4.1 Chiang Mai Initiative (CMI)

CMI was developed at Chiang Mai, Thailand, on 6 May 2000 to establish a system of swap arrangements within the ASEAN+3 (Japan, China and Korea) countries. It covers the basic principles and operational procedures for bilateral swap transactions. These are designed to provide liquidity support for member countries that experience short-run balance-of-payments deficits in order to prevent an extreme crisis or systemic failure in those countries and subsequent regional contagion, as occurred in the Asian financial crisis in 1997. Emergency support facilities such as CMI are similar in nature to other regional and international "lender of last resort" facilities (Park and Wang, 2005).

Since the intent of CMI was to be proactive, it is based on a mutually agreed framework for inter-country cooperation within the ASEAN and ASEAN+3 countries that could be used to quickly and effectively render emergency assistance at the required levels when

the need arises. Moreover, a multilateral approach would ensure that any conditionality associated with the financial assistance is consistent across all countries. As illustrated in Table 3.14, bilateral swap arrangements approximately valued at US$ 41.5 billion by the end of 2005. In deed, ASEAN+3 policy makers have considerably supported the liquidity needs within this area.

Table 3.14: Current status of bilateral swap arrangement network (end of 2005)

Bilateral swap arrangement	Currencies	Conclusion dates	Total size
Japan – Rep of Korea	US$/won	04/07/2001	US$ 2.0 billion
Japan – Thailand	US$/baht	30/07/2001	US$ 3.0 billion
Japan – Philippines	US$/peso	27/08/2001	US$ 3.0 billion
Japan – Malaysia	US$/Ringgit	05/10/2001	US$ 1.0 billion
China – Thailand	US$/baht	06/12/2001	US$ 2.0 billion
Japan – China	Yen/Renminbi	28/03/2002	US$ 6.0 billion
Rep of Korea – Thailand	US$/baht	11/06/2002	US$ 2.0 billion
China – Rep of Korea	Renminbi/won	24/06/2002	US$ 4.0 billion
Rep of Korea – Malaysia	US$/Ringgit	26/07/2002	US$ 2.0 billion
Rep of Korea – Philippines	US$/Peso	09/08/2002	US$ 2.0 billion
China – Malaysia	US$/Ringgit	09/10/2002	US$ 1.5 billion
Japan – Indonesia	US$/Rupiah	17/02/2003	US$ 3.0 billion
China – Philippines	Peso/Renminbi	29/08/2003	US$ 1.0 billion
Japan – Singapore	US$/SG$	10/11/2003	US$ 1.0 billion
Rep of Korea – Indonesia	US$/Rupiah	24/12/2003	US$ 2.0 billion
China – Indonesia	US$/Rupiah	30/12/2003	US$ 1.0 billion
Japan – Korea	US$/Won	04/07/2004	US$ 2.0 billion
Japan – Philippines	US$/Peso	27/08/2004	US$ 3.0 billion
Japan – Thailand	US$/Bath	01/2005	US$ 3.0 billion
Japan - Singapore	US$/SGD$	05/2005	US$ 3.0 billion
China - Indonesia	US$/Rupiah	05/2005	US$2.0 billion

Source: ASEAN Secretariat (2006).

3.4.2 Asian Bond Market Development

Since the 1997 Asian crisis, initiatives to develop regional bond markets have been the second area of regional cooperation. At an informal meeting in November 2002, the minister of the Republic of Korea proposed establishing new Asian bond markets under the ASEAN+3 framework. These regional bond markets may allow domestic financial markets to be more diversified, which leads to the increase in risk-bearing capacity of the East Asian economies.

Under the Executives' Meetings of East Asia Pacific Central Banks (EMEAP), two Asian Bond Funds have been launched using a portion of EMEAP's international reserves. The first of these, the Asian Bond Fund 1 (ABF1) established in June 2003, pooled $1 billion of reserves and invested in US dollar-denominated government and quasi-government bonds of eight ASEAN+3 countries. The second (ABF2) with US$2 billion was established in December 2004 and invested in local-currency-denominated sovereign and quasi-sovereign bonds. Its aim is to give both retail and institutional investors access to local bond markets in the region in a transparent and cost effective manner. It has been enlarged through private placements by institutional investors, participating dealers, and market makers[15].

ABF2 should also provide an impetus to broader market development in two ways. First, like ABF1, by being an actual fund it has allowed policymakers to learn from experience and has helped to identify critical impediments to cross-border listing and investing. Second, it is expected to spur the introduction of new instruments for investors: since the construction of the index and the compilation methodology will be published, managers of private funds can use these indexes as benchmark indexes and replicate or customize these for their fixed-income products[16].

3.4.3 ASEAN Surveillance Process

Soon after the Asian crisis the Terms of Understanding on the Establishment of the ASEAN Surveillance Process were agreed in 1998[17]. The objective of the ASEAN Surveillance Process is to strengthen cooperation by:

(a) Exchanging information and discussing economic and financial developments in the region as well as outside it;

(b) Providing an early warning system and a peer review process to enhance the stability of the macroeconomic and financial system in the region;

(c) Highlighting possible policy options and encouraging early unilateral or collective actions to prevent a crisis;

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[15] *<http://www.asianbondsonline.adb.org/regional/>*

[16] *<http://www.emeap.org/press/15apr04.htm>*

[17] *<http://www.aseansec.org/6309.htm>*, 20 November 2003.

(d) Monitoring and discussing global economic and financial developments which could have implications for the region and proposing possible regional and national-level actions.

Periodic meetings and joint declarations of ministers have ensured that the member countries have continuously monitored the development of their financial markets. These meetings also provide a forum for the exchange of ideas on future financial reforms in the region which would increase the efficiency and stability of the financial markets[18]. At the meetings there is recognition that future financial market architecture should be based on greater private sector participation, proper standards for transparency and disclosure, dissemination of necessary information, early warning systems and a well-sequenced approach to capital account liberalization depending on a country's degree of development and macroeconomic stability.

3.4.4 Cooperation in Central Banks

The countries in the region also benefit from cooperation among central banks. The SEANZA Group was established in 1956, initially comprising central banks of British Commonwealth countries in the Asia-Pacific region, with a view to pooling their resources in order to provide intensive and systematic training courses for promising central bank staff[19].

The South East Asian Central Banks Research and Training Centre (SEACEN) was established in 1982; it currently represents central banks, monetary authorities or finance ministries of Indonesia, Malaysia, Myanmar, Nepal, the Philippines, Singapore, Sri Lanka, Thailand, the Republic of Korea, Taiwan Province of China, Mongolia and Brunei Darussalam. Its objectives are to initiate and facilitate cooperation in research and training relating to policy and operational aspects of central banking.[20]

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[18] <http://www.aseansec.org/4927.htm>, 29 October 2003.
[19] D.T. Brash, opening address to the SEANZA Forum of the Banking Supervisors' Conference, Auckland, New Zealand, 11 November 1999, <*http://www.rbnz.govt.nz/speeches/0083380.html*>, 13 January 2004.
[20] <http://www.seacen.org/about/index.aspx>, 10 December 2003.

3.5 BARRIERS TO REGIONAL FINANCIAL COOPERATION AND INTEGRATION

3.5.1 Differences in Economic, Financial and Infrastructural Aspects

The East Asian region is composed of countries with different backgrounds of economics, finance and infrastructure. These differences may become barriers to regional financial cooperation and integration. First, given different states of economic structures and developments, each country may show different behaviours in the face of a common shock to the region. Subsequently, each country may have different acceptant levels of cooperation and integration. Besides, different levels of economic development may challenge these countries in building up cooperative policies of currency and exchange rate. In fact, the ideas of an East Asian central bank or a common currency area seem to be far ahead (Nasution 2003).

Second, the size and depth of individual financial market may affect on the contribution of each country into the process toward regional cooperation and integration (Nasution 2003). The Asian Bond Market Initiative is considered an example. The idea of the Asian Bond Market is to help countries diversify their sources and reduce the instability of their financial markets. While Singapore and Hong Kong are highly developed bond markets, others are still in the beginning stage of development, such as Malaysia, Indonesia or Vietnam. It is obvious that different maturity states of financial markets may affect the capability of individual country to join to the Asian Bond Market Initiative and, subsequently, may influence on the liquidity purpose of the regional bond market.

Finally, Nasution (2003) pointed out that differences in infrastructure developments may prevent East Asian countries from the process toward cooperation and integration in finance. According to Nasution (2003), infrastructures refer to accounting and tax regimes, legal and regulatory arrangements as well as financial institutions and settlement systems. Obviously, the larger imbalances in infrastructure developments, the more difficult regional countries are to be financially cooperated and integrated. Especially, regarding financial integration, it is harder to achieve because the differences in infrastructures may result in the fact that identical assets have different prices across countries.

3.5.2 Constraints of Chiang Mai Initiative (CMI)

With regard to the Bilateral Swap Arrangements (BSA), it is emphasised that the CMI group leaders have not generated a properly monitoring and supervisory mechanism yet (World Bank 2006). In fact, there is a long way for the BSA system to go before it may become an effective tool for protecting East Asian countries from financial crises.

The most serious issue in developing the CMI arrangement is that the country members have not realised the ultimate objectives of the CMI (East Asia Analytical Unit 2006). It appears that they do not know whether they should develop the CMI to become a regional liquidity-supporting system or to be used as the base for building up a regional monetary fund. Actually, given the current state of economic and financial developments, many East Asian countries are not ready to restructure the CMI into the footsteps of the Asian Monetary Fund (AMF).

Another important issue is the role of Japan and China in East Asia. Park (2004) suggests that the CIM development needs leadership that can connect 13 country members together through conciliating their varied interests. Japan and China are expected to be responsible for the roles of leadership. However, they have been unable to achieve consensus on many monitoring and supervisory issues. In fact, Japan would like to create a credible regional system of surveillance in which Japan have the right to exercise influence corresponding to its financial contribution. This may be hard for China to accept. Although China is far ahead before catching up Japan in terms of economic development, China has a super military force in the world. Besides, they have different interests and strategies for regional integration (Wang 2004). It is obvious that the differences in the military and economic status may make the both difficult to cooperate as equal partners. This issue seems to be a big challenge in order to further develop the CMI arrangement.

3.6 CONCLUSIONS

The 1997 financial crisis in East Asia has left lessons of financial structure risks. The crisis mainly occurred because of poor corporate governance and weaknesses in domestic

financial intermediation. In fact, the countries did not prepare an effectively regulatory and supervisory structure to keep pace with the expansion of financial services. Besides, the portfolio with majority of unhedged short-term debt made these countries extremely vulnerable to a sudden loss of confidence.

After the Asian financial crisis, a key development has been the interest in exploring various forms of monetary and financial cooperation in the region. These initiatives aim to share resources, maintain financial stability, manage and prevent potential crises. The regional initiatives on finance include the ASEAN Surveillance Process (1998), the Chiang Mai Initiative (2000) and the Asian bond initiatives (2003) under the Asian bond market development programme. These developments have laid the foundation for encouraging the development of financial market and improving the economic state within individual countries in East Asia. The more developed East Asia would increase the region's contribution in the world economy and keep East Asia in line with the global growth.

Nevertheless, unlike the more advanced progress achieved in some other areas such as trade liberalization there are several challenges ahead in order to build a strong regional cooperation and integration in finance. In fact, these developments would require efforts to enhance technological cooperation, reduce the difference in financial infrastructures in the region and strengthening the Asian currency market. Although, moving toward open market would make financial markets more functional and efficient, this should be supported by appropriate strategies and policies both at the individual countries as well as regional level. Apparently, the establishment of a robust and resilient financial system for the whole region is necessary, but the progress should be conducted orderly and gradually.

In conclusion, this Chapter has reviewed the 1997-1998 financial crisis and presented the current state of financial development and cooperation as well as challenges in East Asia. Next chapter will look at empirical studies of financial integration in East Asia and discuss limitations to these studies.

CHAPTER IV

EMPIRICAL REVIEWS OF FINANCIAL INTEGRATION IN EAST ASIA

4.1 INTRODUCTION

As presented in Chapter III, there has been a substantial reform and growth in the domestic financial systems and liberalisation of the capital accounts in many of East Asian economies since the 1997 financial crisis. Along this line, the process toward financial cooperation and integration has taken place. Both policymakers and investors are interested in financial integration in this region (de Brouwer 1999).

The macro-economic policy depends crucially on the openness of the financial system. Indeed, policymakers in ASEAN economies are interested in identifying the degree of integration of financial markets as part of negotiating and defining an agenda of reform and liberalisation in the region. Investment practitioners are also interested in the degree of financial integration. Financial integration would help them reduce risks by diversifying their portfolios across borders. It is commonly admitted that higher financial integration would improve capital allocation. Firms and investors may access to the most efficient trading, clearing and settlement platforms when trading barriers across countries are completely eliminated.

Several studies have been conducted to explore the degree of financial integration in East Asia. Generally, these studies can be placed into three categories corresponding to their measures of financial integration (see Chapter II): (1) price/return-based studies (e.g. Frankel 1991, Bekaert and Harvey 1995, Hashmi and Liu 2001, Anoruo 2002 and Chandra 2005), (2) quantity-based studies (e.g. Montiel 1994, Isaksson 2001 and Edison and Warnock 2001), and (3) legal restriction studies (e.g. Eichengreen 2001 and Miniane 2004).

The objective of this chapter is to provide a review of empirical studies in financial integration in East Asia. Section 4.2 reviews price/return-based studies. Section 4.3 looks at quantity-based studies. Section 4.4 focuses on legal restriction studies. Section 4.5 discusses limitations to empirical studies. Finally, conclusions are given in section 4.6.

4.2 PRICE/RETURN-BASED STUDIES

4.2.1 Interest Rate Parity Conditions

As introduced in section 2.4.1.1, interest rate parity conditions have been used to estimate the degree of financial integration. Interest rate parities are composed of covered, uncovered and real interest rate parities. This section is going to review empirical studies which have employed conditions of interest rate parities to evaluate the financial integration in East Asia.

4.2.1.1 Covered interest rate parity

There is an extensive empirical literature on parity conditions for most OECD economies and a growing literature for East Asian and Western Pacific economies. Frankel (1991) selects a sample of developed and developing countries in which East Asian countries include Japan, Hong Kong, Singapore and Malaysia. The author uses monthly 3-month market rates covering from 1982 to 1987. As a result, the mean covered interest differentials (CID) of Japan, Hong Kong and Malaysia are significantly different from zero, which implies a low level of international financial integration for these economies. Especially, Malaysia has a large and negative CID, suggesting capital outflows with considerable controls. For Singapore, the the null of zero CID is not rejected, implying a high level of international financial integration.

Chinn and Frankel (1992) introduce two further approaches for evaluating the covered interest parity (CIP). They use the same countries sample as Frankel (1991), covering from 1982 to 1992. The first approach is that they regress the CID on a constant and time

trend and hypothesise that both the constant and the slope coefficient are zero. They find that Malaysia has a large CID while Japan, Singapore and Hong Kong show small CIDs.

The second approach suggested by Chinn and Frankel (1992) is to apply the equation 4.1 to evaluate the CIP:

$$i_t = \alpha + \beta(i_t^* + f_{t,t+n}) + \varepsilon_t \qquad (4.1)$$

where i_t stands for the domestic interest rate at time t, i_t^* stands for the foreign interest rate and $f_{t,t+n}$ stands for the forward margin (discount on the domestic currency) at time t for n periods into the future. The null for the CIP is $\alpha = 0$, $\beta = 1$. The β coefficients for Hong Kong and Singapore, the two regional financial centers, are very close to one, while that for Malaysia is significantly different from unity, implying a high level of segmentation.

De Brouwer uses monthly 3-month assets to examine the degree of financial integration in East Asia. The time series data cover from 1985 to 1994[21]. As a result, Taiwan and Thailand seem to highly deviate from the CIP, implying their capital accounts with strong restrictions. In contrast, Japan, Hong Kong and Singapore appear to come close to the CIP holding, especially Japan.

4.2.1.2 Uncovered interest rate parity

Montiel (1994) uses uncovered interest differentials (UIDs) to estimate the degree of financial integration for 48 industrial and developing economies including some East Asian economies (Singapore, Korea, Thailand, Malaysia, Indonesia and the Philippines). The time series were monthly short-term deposit rates covering from 1985 to 1990. The author reports significantly negative UIDs for Malaysia and Indonesia and significantly positive UIDs for Thailand and the Philippines. Only Singapore and Korea show their UIDs are significantly deviated from zero.

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[21] The sample size varies slightly for each country. In de Brouwer's case, the equation estimated is: $f_{t,t+n} = \alpha + \beta(i_t - i_t^*) + \varepsilon_t$. He finds that the CIDs narrowed in East Asia in the 1980s and 1990s.

4.2.1.3 Real interest rate parity

So far, there have been very few studies examining the financial integration in East Asia region by looking at the real interest parities (RIPs). Brouwer (1999) estimates the real interest differentials for East Asian economies based on monthly short-term money market rates covering from 1975 to 1994. The author finds that while Japan, Taiwan and Malaysia are very close to the RIP, the others show a high level of segmentation from the world market. Generally, the lack of RIPs is resulted from the empirical failure of the UIP and relative PPP.

4.2.2 Capital Asset Pricing Model (CAPM)

Another approach to evaluate the financial integration is to apply capital asset pricing models (CAPM) which have been a growingly popular technique. Studies test whether stocks with the same risk (i.e. exposure to a common world factor) have identical expected returns irrespective of the market. For a highly segmented market in relation to the rest of the world, its expected returns may not be explained by its covariance with the common factor world.

Bekaert and Harvey (1995) test capital market integration using a conditional regime-switching CAPM for emerging markets including Pacific Basin markets, such as Korea, Thailand, Malaysia and Taiwan, covering from 1975 to 1992. Interestingly, their results show that Malaysia, Korea and Taiwan have a substantially high level of capital market integration for the whole period. Besides, the level of market integration in Thailand has been rapidly increased since foreign ownership restrictions were relaxed in 1987[22].

[22] The issue of intergration of Japan, another important Pacific-Basin country, with world markets has also been examined in the literature. For example, Gultekin et al (1989) show using multifactor asset pricing models that the risk in the US and Japanese stock markets was different before the enactment of the Foreign Exchange and Foreign Trade Control Law in December of 1980, which liberalised short-term capital movements, but not after. Similarly, Campbell and Hamao (1992) using the predictability of monthly excess returns on US and Japanese equity portfolios over the US Treasury bill found that in post-liberalisation period, i.e. the 1980s, US variables helped forecast excess Japanese stock returns, which is suggestive of integration of long-term capital markets.

Phylaktis and Ravazzolo (2002) examine real and financial links at both global and regional levels for the US, Japan, Singapore, Hong Kong, Malaysia, Korea, Indonesia and the Philippines over the period 1981 to 1998. They use the Campbell and Shiller's framework[23], expanded by Ammer and Mei (1996). In general, they decompose excess stock return innovations between different economies into news relative to exchange rates, interest rates, dividend growth rates and excess returns. Comovement of dividend news between two countries is taken as a measure real economic integration. Comovement in innovations in future expected stock returns is taken as a measure of financial integration. The period selection depends on the data availability. Monthly observations for Singapore, Thailand, Japan and the US cover from January 1980 to December 1998; for Hong Kong from January 1981 to December 1998; and for Malaysia, Indonesia, Korea, Philippines and Taiwan from January 1990 to December 1998. Phylaktis and Ravazzolo find that economic integration appears to be the premise for financial integration. Especially, the period of 1990s shows a strongly positive relation between regional economic integration and regional financial integration. These authors also report that country specific shocks may be transmitted between Pacific-Basin economies and the two large economies of the US and Japan through their sizable trading with each other. Finally, their studies imply that the US and Japan have different impacts on financial developments of Pacific-Basin countries. While Thailand's equity market, for instance, strongly integrates with the US, those of Taiwan and Korea have substantial relationship with Japan and not any with the US before and after the 1997 financial crisis.

Gerard et al (2003) test equity market integration for the US, Japan, Hong Kong, Korea, Thailand and Malaysia using a conditional international CAPM over the period 1985 to 1998. The return series are monthly dollar denominated observations on national stock index returns. The world market index is collected from the MSCI database. These authors use bi-diagonal multivariate GARCH developed by De Santis and Gerard (1997) to estimate risk exposures and second moments. They notice that this GARCH model generates a substantial better fit of the return process compared to a conventional diagonal model. Surprisingly, they document East Asian economies have little evidence of equity market segmentation during the 1985-1998 period.

[23] See Campbell and Shiller (1988).

Bekaert et al (2005) apply two-factor CAPM for Indonesia, Korea, Malaysia. Taiwan. Thailand and the Philippines. All monthly returns cover from 1986 to 1998. The two-factor CAPM is extended from the traditional CAPM by dividing the world market into the US and a particular region and allows local factors to be priced. They report that both global and regional factors significantly impact local returns. Especially, the degree of regional integration tends to increase over time. They also find an increase in conditional correlations during the Asian crisis.

4.2.3 Vector Autoregressive Models

Vector autoregressive (VAR) models are specially used in analysing high frequency (daily or weekly) market returns and allow us to estimate the transmission of market movements across countries. More details about this model have been mentioned in section 2.3 of this dissertation. In the context of East Asia, the studies by Park and Fatemi (1993), Janakiramanan and Lamba (1998), Cha and Oh (2000), and Hashmi and Liu (2001) are notable. These studies and their results will be respectively summarised below.

Park and Fatemi (1993) investigate the linkages between the emerging Pacific-Basin equity markets and three major developed markets, the US, UK and Japan. The authors assume that innovations in the three equity markets of the U.S., the U.K. and Japan are exogenous. Besides, they examine how these innovations impact the equity markets of the Pacific-Basin. More specifically, they investigate the question of the extent by which the movements in each of the Pacific-Basin equity markets are driven by such innovations; which one is the most influential; how rapidly each of the Pacific-Basin equity markets responds to the innovations in the U.S., the U.K., and Japan. The data are daily rates of return, measured in terms of the local currency unit, on the market indices of Australia, Hong Kong, Japan, Korea, New Zealand, Singapore, Taiwan, Thailand, the U.K., and the U.S. The period covers from January 26, 1983 to June 30, 1990, for all except New Zealand and Thailand, for which the sample period ends in December 31, 1986. To remove the possible effect of the market crash of 1987, the data relevant to the two weeks surrounding the crash are excluded from the observations. Their findings indicate that the daily stock market movements of Pacific-Basin countries are not strongly associated with those of the US, UK and Japan markets:

- First, the Pacific-Basin markets show a weak linkage to the U.S., U.K. and Japanese equity markets – a linkage that is, apparently, weaker than those have documented to exist between the major European markets and these three major markets.
- Further, a considerable amount of variation is observed in the strength of the linkages across the seven Pacific-Basin equity markets: the Australian market exhibits a relatively strong linkage to the U.S. market; Hong Kong and Singapore exhibit a moderate linkage; and New Zealand, Korea, Taiwan, and Thailand exhibit little linkage to any of the three.
- Finally, some of the Pacific-Basin equity markets may not be as informationally efficient as others. For example, the equity markets of New Zealand and Singapore exhibit delays in their dynamic responses to shocks in the markets of the U.S. On the other hand, the Australian and Hong Kong markets appear to be efficient, in that their responses to a shock in the U.S. markets occur immediately and then level off rapidly. For the cases of Korea, Taiwan, and Thailand, the analyses of response patterns fail to provide much insight as reaction to foreign innovations is negligible.

Janakiramanan and Lamba (1998) analyse the dynamic relationship between daily returns on selected Australasian stock markets during 1988–96. Using a VAR model proposed by Sims (1980), they trace the relationships between these markets. They analyse the developed markets (Australia, Hong Kong, Japan, New Zealand, Singapore and the US) and the developing markets (Indonesia, Malaysia and Thailand). For each market, data on daily market indices, measured in local currency terms, are obtained for the period 1988–96. They find that:

- First, the US market influences all other markets, except for the relatively isolated market of Indonesia.
- Second, when the US market is excluded from the VAR system, there are persistent linkages between these markets which, in turn, are traced to the indirect influences of the US market.
- Third, markets with close locations, similar economic systems and/or large numbers of cross-border listings exert considerable impacts over each other.

Cha and Oh (2000) use the VAR method with a control for heteroskedasticity to investigate the relationship between the following: (1) the four Asian emerging equity markets (AEMs): Hong Kong, Korea, Singapore and Taiwan; and (2) the two largest

equity markets in the world: the US and the Japan. Weekly stock returns are computed as the percentage log difference of the closing prices on Fridays. Weekly stock returns are used as opposed to daily ones in order to avoid the problem of no synchronous trading in some thinly trade stocks. This study covers the period from January 4, 1980 to September 18, 1998. To examine the stability of the results, the whole sample period is divided into three sub-periods: January 4, 1980 – Setember 25, 1987 (period 1); November 6, 1987 – June 27, 1997 (period 2); and July 4, 1997 – September 18, 1998 (period 3). Evidence indicates that the degree of association between the developed markets and the AEMs has begun to change after the October Crash of 1987, and that the relationships has significantly intensified since the outbreak of the Asian financial crisis in July 1997:

- Following the October Crash of 1987, the US equity market begins to have a more significant impact on the Hong Kong and Singaporean markets, although influence from the US on the Korean and Taiwanese markets is unchanged.
- Relatively, the Japanese equity market has not had much impact on the four AEMs until the Asian financial crisis.
- The impact of both the developed markets on the AEMs, however, has dramatically increased since the outbreak of the Asian financial crisis. Also, in all four AEMs, the responses of return rates to US and Japanese shocks have become much larger and more persistent since the outbreak of the Asian financial crisis.

On the one hand, the results are consistent with the literature that concludes that the US market is a global factor. On the other hand, the results suggest that an emerging market's sensitivity to shocks from the developed markets is related to its degree of openness. While Singapore and Hong Kong have opened up their stock markets and guaranteed almost free capital flows in and out, Korea and Taiwan have historically put many restrictions on international capital flows and foreign ownership. Therefore, the US influence could be more directly transmitted to Hong Kong and Singapore before the crisis, and US influence on Korea and Taiwan have increased sharply since the crisis.

Hashmi and Liu (2001) explore the linkages of equity markets in the US, Japan, Singapore, Thailand, Malaysia and Philippines based on simple correlations, Granger causality and VAR models. Daily stock returns are denominated in local currencies covering from 1994 to 2000. These authors document the increase in inter-linkages in the South East Asian (SEA) equity markets, especially after the Asian crisis on 1997. They also point out that the US equity market has a considerable impact on the SEA region

while the Japan market does not. The Philippines equity market appears to have little impact on others.

4.2.4 Cointegration Tests

A notable feature of the literature on market integration is the use of tests for cointegration and common stochastic trends. These tests investigate a long term relationship between markets. Particularly, this section reviews studies applying these techniques on credit market as well as equity market integration in East Asia.

4.2.4.1 Credit market integration

There are two weaknesses in applying interest rate parities. First, they do not allow for any capital market imperfections, such as transaction costs. Such costs even when they are small can lead to estimates of α and β taking different values from the expected ones of zero and one. Secondly, the usual regression results assume that individual real rates are stationary, which is not always the case.[24] If the series are non-stationary then the empirical estimates of the parameters α and β will be consistent but their estimated standard errors will not be consistent (see Stock, 1987).

The use of cointegration techniques, developed initially by Granger (1981) to explore the long-run relationship between two series, overcomes these problems. According to cointegration, if two series, such as the real interest rate in two different markets, are non-stationary, but there exists some linear combination of them which is a stationary process, then the two rates are said to be cointegrated with a cointegrating parameter.[25] In the presence of transaction costs and non-synchronous trading, β will be expected to be different from one. In the case where costs are not proportional to interest rates, market efficiency implies that α will be different from zero. Thus, even in the absence of capital controls the joint hypothesis that $\alpha = 0$ and $\beta = 1$ can be rejected because of transaction costs, and which implies that profitable arbitrage opportunities do not exist.

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[24] See Mishkin (1995) for evidence on the non-stationary behaviour of real interest rates.
[25] Such an approach has been applied to European countries by Goodwin and Grennes (1994) with more favourable results to real interest rate parity.

Phylaktis (1999) examines the extent of capital market integration in a group of Pacific Basin countries. Her main concern is to see whether there has been an increase in the degree of capital market integration with world markets, such as the US and Japan, following the deregulation of the region's financial markets. Furthermore, whether the degree of capital market integration with Japan has been greater compared to that of the US, i.e. whether a Yen bloc has been created in the area. She examines these issues by looking at the equalisation of real interest rates using a cointegration methodology which tests for a long-run relationship between interest rates within a band defined by transaction costs, taxes and capital controls. She examines another indicator of integration which relates to the speed of adjustment of real rates to re-establish long-run equilibrium following a shock in one of the rates using innovation accounting analysis. Her final exercise concentrates on exploring the short-run dynamics through multivariate Granger-causality tests. Six Pacific Basin countries are selected for the empirical analysis: Singapore, Malaysia, Hong Kong, Korea, Taiwan and Japan. The sample period varies for each country according to the availability of data. For Singapore the sample period is August 1973 – September 1993; for Malaysia, January 1982 – September 1993; for Taiwan and Korea, February 1972 – September 1993; for Hong Kong, January 1976 – September 1993; and for Japan, January 1974 – September 1993. She uses end of monthly data apart from the case of Korea, where she uses end of quarter. The money market interest rates used are as follows: 90-day Treasury Bill rate for the US; the three month Gensaki rate for Japan;[26] the three month regulated deposit rate for Hong Kong; and the three month interbank rate for Singapore and Malaysia. For Taiwan and Korea, she uses short-term curb rates. The curb market is an unofficial, largely unregulated financial market involving small borrowers and lenders.[27] These rates are used because the domestic financial markets are highly regulated even during the 1980s.[28] The following conclusions are derived from her analysis:

- First, the results from the cointegration exercise (both bivariate and multivariate) provide supportive evidence for real interest rate parity and capital market integration.

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[26] Gensaki transactions consist of the resale or repurchase of bonds at a fixed price after a fixed period. They are short-term capital transactions using bonds as collateral.

[27] The size of the markets remains substantial but has fallen over the years. For example, in the mid 1970s the aggregate size of the curb market in Taiwan was as large as that of all financial institutions put together. In 1986, according to flow-of-funds accounts for private business enterprises, the ratio of curb market to total bank borrowing was 48% (see Fry, 1990). The curb rate in Taiwan is the average loan rate against post-dated checks in Kaoshiung city; and in Korea it is a monthly rate which is provided quarterly.

[28] Taiwan completely liberalised interest rates in 1989, while Korea started to lift regulations on interest rates in 1989 and completed the process in 1993 (East Asia Analytical Unit, 2006).

- Second, the results using the speed of adjustment of real interest rates following a shock as an indicator of capital market integration show that the degree of integration has increased in post-liberalisation period in Singapore and especially in Taiwan. Korea, another country for which data exist for the pre-liberalisation period, seems to be less integrated with the US in the second sub-period.
- Third, an interesting result is the greater capital market integration with Japan than with the US in the second sub-period. It confirms the other indicators which show that Japan's influence is dominating the region. The increased effects of Japan through time could be due not only to the financial liberalisation in the Pacific Basin countries but in Japan itself. Thus, taking into account the interaction of interest rates between the US and Japan in the examination of capital market integration in the Pacific basin countries reveals the increasing financial influence of Japan.
- Finally, the results of the multivariate Granger-causality tests show that both Japanese and US interest rates have been driving the rates in Singapore, Hong Kong, Malaysia and Korea, while only the Japanese interest rate has been driving rates in Taiwan. In Malaysia and Hong Kong, however, there is also reverse causation from both of these countries to Japan. Thus, the results of this exercise point to the fact that some of the countries in the Pacific Basin region have developed close links with Japan and in some of them, such as Taiwan, shocks originating in the US were transmitted via Japan.

Anoruo et al (2002) examine the extent of the inter-market interest rate linkages in the developing Asian economies of Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, S. Korea, and Thailand, and analysed the influence of Japan and the US in this region. This study employs short-term interest rate data (which capture monetary policy) for the period January 1980 through December 1999 and applies a theory-consistent methodology (cointegration and VECM) to investigate the issue. The interest rates used are as follows: the 90-day Treasury Bill rate for the Philippines and the US, the 3-month Gensaki rate for Japan, and 3-month interbank rate for Hong Kong and Singapore, and representative money market rates for the remaining countries. Furthermore, in order to control for the various financial market reforms that are undertaken by the sample countries during this period, and to understand their impact on the interest rate-generating process, the data period is divided into two equal sub-periods: January 1980 through

December 1989, and January 1990 through December 1999. Their findings indicate that interest rates within the Asian region respond well to each other:

- First, the national short-term interest rate nexus is inherently a steady state, long-run phenomenon, in that they are cointegrated.
- Second, for the most recent time period (1990–1999), the results show a substantial increase in interactions among these markets, particularly among the non-Japanese Asian markets.
- Next, Hong Kong and Singapore turn out to be important, but not dominant, players in the Asian region. Hong Kong and Singapore serve to mediate the interest rate linkages between the US and the Asian region. Their important roles are consistent with the fact that the two countries have experienced a relatively steady economy, and a faster pace of deregulation and liberalization of their financial markets than the other newly-industrialised countries (NICs)[29] of Asia.
- Finally, for the more recent decade, they find the US to have displaced Japan's influential role in the Asian region.

Ji and Kim (2005) examine the short run and long run relationships among the real interest rates of several Pacific-Basin countries with a focus on East Asia, paying attention to the impact of the Asian financial crisis. They use monthly 3-month market rates for the US, Japan, Korea, Singapore, and Thailand from 1980 to 2004. To calculate the rate of inflation, the consumer price index is seasonally adjusted with the X-12 ARIMA (autoregressive integrated moving average)[30] method. All nominal interest rates are deflated by inflation in order to generate the real interest rate series. They are concerned with the degree of capital market integration and the nature of short run dynamics. In order to investigate these issues, they adopt Johansen's (1988) cointegration test and impulse response analysis based on the unrestricted VAR model. They also estimate the half-lives of the real interest rates to measure the persistence of real interest rates. For statistical inference on impulse response analysis and half-life estimation, they use the bias-corrected (wild) bootstrap. Their findings are summarised as follows:

- First, the selected group of capital markets in the Pacific-Basin region is highly integrated. The degree of integration has become stronger since the crisis in 1997.

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[29] See *http://en.wikipedia.org/wiki/Newly_industrialized_country*

[30] X-12 ARIMA is the seasonal adjustment method developed by the US Census Bureau, *http://www.census.gov/srd/www/x12a/*

- Second, rich dynamic interactions are observed from the impulse response analysis. Before the crisis, the US rate affected the Singaporean and Thai rates, while Japanese rate affected the Korean rate. After the crisis, the US rate has affected the Korean and Singaporean rates, while the Singaporean rate has affected the Thai rate.
- Finally, the half-life estimation also reveals interesting features in relation to persistence of the real interest rates. Before the crisis, the US and Japanese rates showed the degree of persistence equivalent to a unit root time series, while the others showed strong mean-reversion. After the crisis, however, the US rate has been the only time series that shows the degree of persistence of a unit root time series, while the others including the Japanese rate have been highly mean-reverting. This indicates that the US and Japan were the two dominant capital markets in this region before the crisis, while the US capital market has dominated the region after the crisis.

4.2.4.2 Equity market integration

So far cointegration techniques have been utilised most to estimate the degree of equity market integration in East Asia compared to VAR and GARCH. Notable studies in line are Chung and Liu (1994), Hung and Cheung (1995), McMiken (1997), Masih and Masih (1999), Roca et al (1998), Siklos and Ng (2001), Serrano and Rivero (2001), Roca and Selvanathan (2001), Ng (2002), Manning (2002), Worthington et al (2003), Leong and Felmingham (2003), Click and Plummer (2005) and Ibrahim (2005). These studies and their results will be summarised below.

Chung and Liu (1994) investigate the equity market integration in five East Asian economies, including Japan, Singapore, Hong Kong, Taiwan and South Korea. The US market is considered the world market. These authors use daily national index prices covering from 1985 to 1991 and estimate an error-correction VAR model based on the Johansen multivariate cointegration procedures. As a result, they report a low degree of global and regional market integration. Particularly, they identify two cointegrating vectors, implying that six stock price variables share four common trends. Additionally, the Japan, Singapore, Hong Kong and South Korea markets appear to be segmented from US and Taiwan markets.

Hung and Cheung (1995) use the Johansen multivariate cointegration approach to analyse the interdependence of five major Asian emerging equity markets: Hong Kong, Korea, Malaysia, Singapore and Taiwan. The sample includes weekly observations from January, 1981 to December, 1991. To examine the stability of the results, they apply the tests to two sub-periods: (1) January 1981 to September 1987; and (2) November 1987 to December 1991. Their results indicate there is no evidence that these markets are cointegrated. When the stock prices are measured in US dollars these markets appear to be cointegrated during the second sub-period 1987—1991. This relationship may be attributed to the depreciation of the US dollar during the late 1980s.

McMiken (1997) tests whether the ASEAN stock markets have been collectively efficient during the period 1987-1995. It is argued that if the asset (stock) markets are collectively efficient in the long-run, these asset prices are not cointegrated. That means there is no long-run relationship. On the other hand, the presence of cointegration provides evidence of an interdependent relationship. Capitalisation-weighted monthly price indexes from Indonesia, Malaysia, Philippines (PSE Composite), Singapore (SES All) and Thailand (SET) are used in this study. McMiken examines the weak form efficiency hypothesis of stock prices in each of the five ASEAN stock markets using unit root tests; and then tests the joint efficiency by cointegration tests. The results suggest that with the exception of Indonesia all the markets have been linked with each other. Thus, during the period 1987-95, these markets have not been collectively efficient.

Roca et al (1998) apply Johansen cointegration procedures combined with Granger causality, variance decomposition and impulse response techniques to investigate the long- and short-term price linkages in five ASEAN equity markets including Singapore, Thailand, Malaysia, Indonesia and Philippines. The price series are weekly observations covering from 1988 to 1995 in order to avoid some of the problems associated with daily and monthly data[31]. Roca et al report that there is no evidence of long-term linkages among these stock prices. Nevertheless, all the markets, excluding Indonesia, are strongly linked with each other in the short-term. Especially, Singapore and Thailand play as leaders with linkages to all markets in the region.

[31]Bailey and Stulz (1990) advise that daily data are deemed to contain "too much noise" and are affected by the day-of-the-week effect. Monthly data are also affected by the month-of-the-year effect.

Masih and Masih (1999) apply vector error-correction techniques suggested by Toda and Phillips (1993a) and Toda and Yamamoto (1995) to evaluate the short- and long-run dynamic causal linkages among a set of international stock market indices with a particular focus on emerging Southeast Asian (SEA) markets. The data set is daily stock-price indices over the period 14-February-1992 to 19-June-1997. The SEA countries investigated are Hong Kong, Singapore, Thailand and Malaysia. Masih and Masih (1999) report great impacts from the US on SEA markets in both the short- and long-run. However, Hong Kong takes the leading role in the region. They also state that fluctuations in these SEA markets are mostly influenced by their regional markets rather than by the advanced markets.

Siklos and Ng (2001) examine the number of common stochastic trends among stock prices in the US, Japan, Hong Kong, Korea, Singapore, Taiwan and Thailand. The period of investigation is from January 1976 to August 1995, yielding 238 monthly observations. The results from the cointegration tests strongly suggest that all seven countries share a single common stochastic trend, especially since 1987. VECM models, which allow the examination of short-run dynamics, reveal that the speed of adjustment from a shock to an equilibrium relationship are such that the US stock market in particular seems to be the driving force in Asian-Pacific stock markets. Exchange rate volatility in the VECMs has only a quantitatively small impact on the results when Asian markets, excluding Japan and the US, are considered. While the US and Japan adopt floating exchange rates, most emerging market economies peg their exchange rates. So this result may not be surprising.

Roca and Selvanathan (2001) analyse price linkages between the equity market of Australia and those of Hong Kong, Singapore and Taiwan using cointegration, Granger-causality, variance decomposition and impulse response analyses. Weekly data from the 2nd January 1988 to the 8th December 1995 are collected for Australia, Hong Kong, Singapore, Taiwan and the US. Although this study focuses on Australia and the three little dragons, the US is included as this market is well recognized as an international factor that drives world stock markets (Eun and Shim, 1989). Not including the US would result in spurious results, as found by Espitia and Santamaria (1994). The empirical results of the analysis show that there is no significant short-term and long-term linkage between the equity markets of Australia and that of Hong Kong, Singapore, and Taiwan.

Ng (2002) examines the patterns of linkages between national stock markets in South-East Asia. The data are monthly observations of stock indices from the five ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore and Thailand) over the period December 1987 to December 1997. The author finds that there is no evidence of long-term linkages in regional stock markets. However, analyses of correlations and time-varying parameter model imply that the regional equity markets have been more integrated over time and strongly admitted the leading role of Singapore.

Serrano and Rivero (2001) apply cointegration tests with the possibility of structural shifts in order to investigate the likelihood of long-term relationship between the stock markets in Asia (Japan, Hong Kong, Korea, Singapore and Taiwan). These authors use daily data over the period 1977 to 1999. They document that the results from conventional cointegration tests do not support any long-tem linkage between the stock markets. However, if allowing structural shifts in cointegration tests, they find strong linkages between Japan and Taiwan since October 1987 and between Japan and Korea since April 1987. They also find the linkage between Japan and Singapore during the 1977-1992 period.

Manning (2002) examines the common trends and convergence in South-East Asian equity markets. This study follows Serletis and King (1997) and applies both the Johansen Maximum Likelihood approach and the Haldane and Hall Kalman Filter technique to consider the co-movement of equity markets in South East Asia, also taking the United States to be the external market. The two samples analyzed comprise weekly and quarterly information on equity indices and US dollar series for the US, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand over the period January 1988 to February 1999. As the result, the Johansen approach says little about the dynamics of convergence although it clearly signals the interdependence of these markets. In contrast, the Haldane and Hall Kalman Filter technique identifies two periods of convergence of the Asian markets, namely 1988–1990 and 1992–mid-1997; divergence occurring both in 1990–1992 and during the recent Asian crisis. It would also appear that a sub-sample of the Asian markets, which excludes Japan, Korea and Taiwan, had achieved a common relationship with the (external) US market by mid-1997. According to the Haldane and Hall measure of convergence, these markets had converged over the period mid-1992 to mid-1997. However, this process was abruptly reversed by

the onset of crisis, even though many Asian financial markets were rocked by the crisis almost contemporaneously.

Worthington et al (2003) use multivariate cointegration and level VAR tests to examine price inter-linkages in East Asian markets. The country sample includes Japan Hong Kong, Singapore, Korea, Thailand, Taiwan, Malaysia, Indonesia and the Philippines. All data are weekly national index prices covering from January 1988 to February 2000. These authors report stationary and considerable causal linkages in the region. Besides, they suggest that there is existence of opportunities to diversify their portfolios among East Asian equity markets due to the lower causal linkages between the developed and developing markets in the region.

Leong and Felmingham (2003) test the interdependence of five East Asian stock price indices using daily data from July 8, 1990 to July 6, 2000. A simple correlation analysis of the co-movement of the Singapore Strait Times, Korea Composite, Japanese Nikkei, Taiwan weighted and Hang Seng indices reveals that correlation has strengthened since the Asian crisis. Further half of the bivariate pairings of these indices indicate non-breaking bivariate cointegration, while four are cointegrated subject to a structural break. These results are supported by both multivariate cointegration and ECM. Granger causality is applied when cointegration was not evident. The degree of integration among these five stock price indices has increased and the opportunity for risk diversification has lessened over the 1990s.

Click and Plummer (2005) consider whether the ASEAN-5 markets (Indonesia, Malaysia, the Philippines, Singapore and Thailand) are integrated or segmented using the time series technique of cointegration to extract long-run relations. The data consist of daily stock index quotes in local currencies over the four-and-a-half year period from July 1, 1998 through December 31, 2002. This study also considers weekly stock index data by taking the Friday (or other end of week) observations over the same period. Click and Plummer report that there is a long way to go before achieving a full integration in the region. Particularly, they identify only one cointegrating vector, implying five variables of stock prices shared four common trends. The results also confirm that investors would still benefit from diversifying their portfolios across the five markets.

Ibrahim (2005) evaluates the international linkage of Indonesian stock market during pre-crisis and post-crisis periods using time series techniques of cointegration and vector autoregression (VAR). The data are monthly spanning from January 1988 to December 2003. With the interest in looking at long- run relations and dynamic interactions of the Indonesian market and other regional and global markets pre-and post-crisis, they divide the sample into two sub- samples, namely, pre- crisis sample (January 1988 – June 1997) and post-crisis sample (July 1997 – December 2003). As a result, this study find evidence for lack of cointegration among the Indonesian market, other ASEAN markets (Malaysia, the Philippines, Singapore and Thailand) and two advanced markets (the US and Japan) during both pre-crisis and post-crisis periods. With regard to short run dynamics, there is evidence for substantial interactions among the ASEAN markets. However, it seems that the Indonesian market has become more segmented from other ASEAN markets after the 1997 crisis. Additionally, while most ASEAN markets have responded quickly to shocks in the US regardless of the sample period and seem to be less influenced by the Japanese market post crisis, the Indonesian market have become more responsive to the developed markets of the US and Japan after the 1997 crisis.

4.2.5 Volatility Spillover and Correlation Dynamics - GARCH

4.2.5.1 Volatility spillover

Liu and Pan (1997) use a ARMA(1,1)-GARCH(1,1)-in-mean model in order to investigate the mean return and volatility spillover impact from the US and Japan to four Asian stock markets, Hong Kong, Singapore, Taiwan, and Thailand. All daily data covered from 3 January 1984 to 30 December 1991. These authors document three main results. First, the return and volatility effects to the Asian markets are transmitted more intensively from the US market compared to those from the Japan market. Second, the spillover impact has changed and considerably increased since the stock market crash in October 1987. And, finally, the fact returns and volatilities are transmitted internationally is mainly due to the market contagion effect.

In order to examine volatility spillover effects from the US and Japan to equity markets in Pacific-Basin, Ng (2000) applies a general asymmetric dynamic covariance (ADC) model originally developed by Kroner and Ng (1995). All weekly data are denominated in the

US dollar and cover from January 1986 to December 1996. The country sample includes Singapore, Hong Kong, Korea, Thailand, Malaysia and Taiwan. The author documents the importance of regional and world factors for market volatilities in Pacific-Basin despite the fact that they only capture a small proportion of these volatilities. approximately less than 10% on average. Regional and world market factors involve liberalisation occurrences (such as the introduction of country funds and changes in foreign investment restrictions), fluctuations in currency returns, number of Depository Receipts listings, sizes of trade, and closed-end country fund premium

In et al (2001) analyse the dynamic interdependence of selected major Asian stock markets during the Asian crisis period (1997-1998). This study investigates dynamic first and second moment interactions among the Asian stock markets of Hong Kong, Korea, and Thailand using the multivariate VAR-EGARCH model. This model allows examining dynamic interdependence among the Asian stock markets and accounts for potential asymmetries that may exist in the volatility transmission mechanism. The data set is from February 3, 1997 to June 30, 1998. If a market is closed, the price index of the market is the same value as the day before the market closed. The empirical findings can be summarized as:

- First, the multivariate VAR-EGARCH model captures market interactions, i.e., lead-lag relationships and volatility interactions, among the three Asian stock markets. In terms of lead-lag relationships, it is found that Korea exerts a weak influence over the other markets. The multidirectional nature of these relationships suggests that the Korean market plays as a lesser role as an information producer.
- Second, during the Asian crisis period 1997±1998, there were existence of reciprocal volatility transmissions between Hong Kong and Korea, and unidirectional volatility transmissions from Korea to Thailand. In short, Hong Kong plays an important role in the transmission of volatility to other Asian markets. These empirical findings suggest that the markets were more interdependent during the Asian crisis period, but at the same time, more integrated in the sense that they each reacted not only to local news, but also to news originating in the other markets, especially when the news were adverse.
- Finally, with regard to correlations between the markets, Thailand demonstrated a greater linkage with Hong Kong and Korea during the crisis period.

Suk (2003) uses Parsimonious Moving Average–EGARCH(1,1) models in order to examine the information leadership of the US and Japan in the developed Asia-Pacific equity markets. Particularly, the author tries to explore how much news announcements from the US and Japan affects equity markets in Australia, Singapore and Hong Kong. The news announcements involve inflation policies and economic activities. Daily index returns (open, high, low and close) are collected from Commodities Systems, covering from 2 January 1991 to 31 May 1999. This study reports that news announced from both the US and Japan significantly influences the first and second moments of returns in the developed Asia-Pacific equity markets. It is also evident that the way these markets responds to bad news is different from the way they did to overall news including both bad and good news.

4.2.5.2 Correlation dynamics

Chandra (2005) examines the correlation structure amongst selected Asia-Pacific equity markets using the Constant Correlation multivariate GARCH (CC-MGARCH) model, the Dynamic Conditional Correlation multivariate GARCH (DCC-MGARCH) model and an Exponentially-Weighted Moving Average (EWMA) correlation measure. The markets of Australia, Hong Kong, Japan and Singapore are analyzed from 1990 to 2001 and dynamic nature of the correlation is captured and explained. He finds that global as well as regional factors have contributed to the correlation spikes. Extreme volatility does not necessarily result in extreme correlations between some markets and there is higher comovement between markets since the Asian financial crisis. He also finds that despite common periods of high volatility, there is still economic justification for diversification within this region.

4.2.6 Other Econometric Techniques

Apart from studies with popular measures of financial integration reviewed above, there are some others with different methods to test financial integration in East Asian markes. So et al (1997) focus on seven South East Asian markets, namely Hong Kong, Malaysia, Philippines, Singapore, South Korea, Thailand and Taiwan. The persistence of the impact of shocks is addressed by the Autoregressive Random Variance (ARV) model proposed by Taylor (1982). Overall volatility is decomposed into two components which are

baseline volatility and residual volatility. The data used are daily price indices in the seven Asian stock markets from January 1980 to December 1991. The results indicate that instantaneous causality of volatility among Hong Kong, Malaysia, Philippines. Singapore, Thailand and Taiwan is evident. South Korea seems to be an independent market in which the market volatility is not contemporaneously correlated with other stock exchanges. On the other hand, Hong Kong, Taiwan, Singapore and Malaysia act as one enterprise while Philippines and Thailand form the other. There are spillover effects from Hong Kong to Taiwan but not vice versa. The results also reflect the tight relationship between the volatility in the Malaysia and the Singapore stock markets which are the only markets showing volatility feedback.

Johnson and Soenon (2002) investigate the integration between equity markets in Asia and Japan. They use Geweke measures of feedback based on log likelihood ratio statistics, which provide a cardinal measure of the degree of comovement. The data include daily stock index returns for thirteen national equity markets, Australia, New Zealand, Japan, China, Hong Kong, India, Indonesia, Korea, Malaysia, Philippines, Singapre, Taiwan and Thailand, over the period 1988 to 1998. The findings indicate that there is a considerably high degree of stock market integration between Japan and the Asian markets including Australia, New Zealand, China, Hong Kong, Singapore and Malaysia. The fact the Asian economies have increased their share of exports to Japan and received more direct investments from Japan produces positive effects on stock market co-movements.

4.3 QUANTITY-BASED STUDIES

4.3.1 Saving-Investment Correlations

There have been very few studies applying saving-investment (S-I) correlations to evaluate the degree of financial integration. Montiel (1994) examined the state of financial integration for a large sample of developing economies, covering from 1970 to 1990. The author used FH-type tests (see section 2.4.2.1) to estimate the saving-

investment correlations in levels, first differences and an error correction version. As a result, he documented that the order of capital mobility from the highest to the lowest is: Singapore, Malaysia, Korea, Indonesia, Thailand and the Philippines. The state of perfect capital mobility appeared to exist in the case of Singapore with its slope coefficient (ß) close to zero.

Le (2000) uses annual data to estimate equation (29) (see section 2.4.2.1) for a large sample of fifteen Asian countries, covering from 1976 to 1996. Generally, the capital mobility for these markets is rather low. In fact, the slope coefficient was 0.73 on average. The coefficients for China and Indonesia are 0.9 and 1, respectively. More surprisingly, while the coefficients for Singapore and Hong Kong are 0.9 and 0.8, respectively, indicating low degrees of capital mobility, the coefficients for Korea and Malaysia are very low, suggesting high levels of capital mobility.

Isaksson (2001) applies FH approach for a large sample of ninety developing countries. All monthly data on savings and investment rates are from 1975 to 1995. The author estimates the degree of financial integration based on two steps. First, he calculates simple correlations between savings and investment rates. Second, he conducts a variation of the conventional FH regressions. As a result, he reports high savings-investment correlations and the state of low capital mobility in the East Asian economies.

4.3.2 Consumption Correlations

Montiel (1994) investigates the financial integration in a group of developing countries, covering from 1970 to 1990. In particular, the author computes correlations of consumption growth for individual economies against an average consumption growth for the rest of the sample and against real GDP. In conclusion, He reports that the economies of Singapore, Thailand, Korea, Malaysia and the Philippines have quite high capital mobility.

De Brouwer (1999) studies the capital mobility for developed and developing economies in East Asia by looking at correlations between consumption and real income from 1963

to 1992. The sample is divided into three sub-periods: 1963-1972, 1973-1982 and 1983-1992. His analysis shows that the developing economies including Korea, Thailand, Malaysia and the Philippines have high capital mobility in the first and third periods, but low in the second. The developed economies, such as Japan, Singapore and Hong Kong, have intensified capital mobility with an increasing level of correlation over time.

4.3.3 Volume-based Approaches

Using monthly data on market capitalisation from 1988 to 2000, Edison and Warnock (2001) estimate the level of capital controls for a large group of developing economies. Particularly, their measure is as follows:

$$I_{Edison-Warnock} = 1 - \frac{IFCI}{IFCG}$$

$I_{Edison-Warnock}$ refers to Edison-Warnock measure of capital controls. IFCI refers to the Investable Index capturing the proportion of the market which investors may access to. IFCG refers to the global index showing the whole market capitalisation. Both of these indices are provided by S&P/IFC[32]. Edison and Warnock's report on Asian economies shows that the initial degrees of capital controls, with the exception of Malaysia and the Philippines, are quite high, but sizably lowered over the 1990s. For Malaysia, the degree of controls is much higher after the Asian crisis. For the Philippines, it fairly keeps constant over time.

4.4 LEGAL RESTRICTION STUDIES

More technical details of these measures have already discussed in the section 2.4.3 of this dissertation. Therefore, this section only summarises main results from recent empirical stuides on East Asian markets. Particularly, these results are derived from IMF single dummy and Miniane (2004) indices.

[32] S&P/IFC refers to Standard & Poor's/International Financial Corporation.

4.4.1 IMF Single Dummy Indices

The 0/1 IMF dummies depends on whether country has controls on outflows. Table 4.1 shows results referring to East Asian economies. However, this measure does not express the different degrees of capital controls across markets. Generally, Korea and Philippines had heavily applied controls on their capital accounts till 1995 while Hong Kong, Singapore and Malaysia had had very few capital restrictions during the period under consideration.

4.4.2 Miniane (2004) Indices

Miniane (2004) investigated capital restrictions of 34 countries covering the period 1983 to 2000. East Asian markets in investigation include Hong Kong, Japan, Korea, Malaysia, Philippines and Singapore. According to Miniane (2004), capital account transactions are divided into 14 sub-categories: "1) capital market securities, 2) money market instruments, 3) collective investment securities, 4) derivatives and other instruments, 5) commercial credits, 6) financial credits, 7) guarantees, sureties and financial backup facilities, 8) direct investment, 9) repatriation of profits or liquidation of direct investment, 10) real estate transactions, 11) personal capital movements, 12) provisions specific to commercial banks and other credit institutions, 13) provisions specific to institutional investors and 14) multiple exchange rate arrangements".

Miniane attributes a value of 1 whenever a control exists, regardless of whether it is enforced. These are fully de jure measures. An average over the dummies for East Asian economies each year is presented in Table 4.2. It is evident that there is a trend of less control on capital in the region except for Hong Kong and Singapore as time goes by. Generally, Hong Kong and Singapore are the most liberalised countries in this region, even compared to Japan during the 1980 and 1990s. The 1997 Asian crisis forced these two to tighten their capital control policies in the last years of the decade. Moreover, year 1997 is also the time China took over Hong Kong from England, which significantly contributes to the increase of capital controls in here. Among these Asian markets, Japan

is the country with the fastest speed of liberalisation. Indeed, the degree of capital control was 0.692 in 1983, decreased to 0.154 and then kept stable.

4.5 LIMITATIONS OF EMPIRICAL STUDIES

Based on the review of the literature in the previous sections, we discuss limitations on empircial studies and ongoing reseach questions. We start out by assessing the problems related to measuring financial integration in East Asia markets so far. Next, we assess empirical results, which are poor and seem not to be completely consistent. Finally, we raise research questions regarding to the process of financial integration in East Asia.

4.5.1 Data Availability to Studies

The availability of data is essential in evaluating the ongoing process of financial market integration. Data available need to be reliable and timely. As for price/return-based measures, data are not available in all Asian markets, especially less developing and developing markets. For advanced markets as Japan, Singapore and Hong Kong, daily data may be access to but data with higher frequencies, such as hourly frequency, are extremly restricted. In fact, high frequency data are very important in assessing the degree of financial integration, especially in capturing regimes of volatility and shock transmission across borders.

As for quantity and restriction-based measures, microeconomic data would be superiorly needed compared to macroeconomic data because the information generated from these data are more relevant to predictions most of which is at the microeconomic level. Nevertheless, data at both firm and household levels are not available in Asian markets. Or, if available they do not cover a sufficiently long period of time. The availability of data is a more serious issue in examining the impact of legal restrictions on financial markets. So far, comparisons between legal systems have mostly been qualitative, rather than quantitative. Thus, the availability of data should be the first concern in investigating the degree of financial integration in East Asia.

Table 4.1: IMF single dummy indices

Country	Hong Kong	Japan	Korea	Malaysia	Philippines	Singapore	Australia	US
1983	0	0	1	0	1	0	1	0
1984	0	0	1	0	1	0	0	0
1985	0	0	1	0	1	0	0	0
1986	0	0	1	0	1	0	0	0
1987	0	0	1	0	1	0	0	0
1988	0	0	1	0	1	0	0	0
1989	0	0	1	0	1	0	0	0
1990	0	0	1	0	1	0	0	0
1991	0	0	1	0	1	0	0	0
1992	0	0	1	0	1	0	0	0
1993	0	0	1	0	1	0	0	0
1994	0	0	1	0	1	0	0	0
1995	0	1	1	0	1	0	0	0
Average	0	0.077	1	0	1	0	0.077	0
1983-88	0	0	1	0	1	0	0.167	0
1989-95	0	0.143	1	0	1	0	0	0

Source: Adapted from Miniane (2004)
0: no existence of capital controls
1: existence of capital controls

Table 4.2: Miniane (2004) indices – dummy average

Country	Hong Kong	Japan	Korea	Malaysia	Philippines	Singapore	Australia	US
1983	0.077	0.692	0.846	0.846	0.923	0.231	0.500	0.4615
1984	0.077	0.538	0.846	0.846	0.923	0.231	0.500	0.3077
1985	0.077	0.538	0.846	0.846	0.923	0.231	0.500	0.3077
1986	0.077	0.538	0.846	0.846	0.923	0.231	0.500	0.3077
1987	0.077	0.538	0.846	0.846	0.923	0.231	0.500	0.3077
1988	0.077	0.462	0.846	0.846	0.923	0.231	0.500	0.3077
1989	0.077	0.462	0.846	0.846	0.923	0.231	0.500	0.2308
1990	0.077	0.462	0.846	0.846	0.923	0.231	0.500	0.2308
1991	0.077	0.462	0.846	0.846	0.923	0.231	0.500	0.2308
1992	0.077	0.462	0.846	0.846	0.846	0.231	0.500	0.2308
1993	0.077	0.462	0.846	0.846	0.846	0.231	0.500	0.2308
1994	0.077	0.462	0.846	0.846	0.846	0.231	0.500	0.2308
1995	0.077	0.462	0.846	0.846	0.846	0.231	0.500	0.2308
1996	0.077	0.385	0.846	0.846	0.917	0.231	0.500	0.2308
1997	0.077	0.385	0.846	0.846	0.846	0.308	0.500	0.2308
1998	0.231	0.231	0.769	0.846	0.846	0.385	0.462	0.2308
1999	0.231	0.154	0.769	0.846	0.846	0.385	0.462	0.2308
2000	0.231	0.154	0.769	0.846	0.846	0.462	0.462	0.2308
Average	0.103	0.436	0.833	0.846	0.889	0.265	0.494	0.2600
1983-91	0.077	0.521	0.846	0.846	0.923	0.231	0.500	0.2991
1992-00	0.128	0.350	0.821	0.846	0.854	0.299	0.487	0.2308

Source: Adapted from Miniane (2004)

4.5.2 Investigation Approaches

Although quantity and restriction-based measures have the same main advantage which is that they can be easily benchmarked, they both carry several weaknesses. For example, correlation-based studies use risk-sharing as an indicator of financial integration. Particularly, the full risk-sharing exists when the correlation between consumption and income growth is equal to zero. However, this full risk-sharing is not always an indicator of full integration in financial markets. It is reminded that risk-sharing may generally be obtained through different channels, such as public financial policies or transfer among household members. Similarly, restrictions-based indicators may not conclude the status of market integration or segmentation. Rather, they address reasons financial markets may be segmented. If similar financial assets in different countries have persistently different returns, institutional features may help us understand whether the different tax policy is the reason for segmentation.

Price/return-based approaches are more favourable compared to quantity/restriction-based measures. Clearly, data on equity prices and returns are available at higher frequencies and more reliable than data on financial flows and institutional characteristics. Nevertheless, sophisticated procedures are required to estimate price/return-based indicators. In terms of interest rate parity conditions, in order to examine whether the covered interest rate parity (CIP) holds, there needs to be a liquid forward exchange market in the currency pair under consideration, which is clearly impossible for developing countries in East Asia at present. As for the uncovered interest rate parity (UIP), the test is really a joint test for the CIP and the currency risk premium. The failure of UIP to hold could be due to at least one of the following three reasons: 1) the failure of CIP to hold, 2) the existence of high and fluctuated currency risk premium and 3) inappropriate rational expectations of returns. For the real interest rate parity (RIP) to hold, both the purchasing power parity (PPP) and the UIP have to hold simultaneously, which is in fact prohibitive. The RIP appears to hold in the long-run and to be considered an indicator of the marginal cost of capital. It is noted that when interest rates are non-stationary, estimates of interest rate parities may be inappropriate to measure credit market integration.

The CAPM has become a growingly popular approach in order to investigate the equity market integration. Bekaert and Harvey (1995) and Gerard et al (2003) used conditional CAPM, the most advanced CAPM, to test the financial integration in Asian markets. However, Fama and French (2004) state that CAPM has never been an empirical success. They show difficulties in implementing valid tests of the model. Particularly, according to the CAPM, the risk of a stock should be estimated in a relation to a market portfolio that includes not only tradable financial assets, but also others such as human capital, real estates and consumer durables. Even if the view of the CAPM is narrowed down to tradable financial assets, is it appropriate to consider the US stocks the market portfolio, or should other financial assets (e.g. bonds) in the world be included in the market portfolio? Fama and French argue that the failure in empirical tests confirms the invalidity in most applications of the CAPM.

Recently researchers have applied sophisticated correlation tests, such as Johansen's cointegration, to examine the financial integration in East Asia. However, these approaches bear disadvantages. For example, cointegration techniques generate instable results in accordance with the change of the number of lag-length selection. Besides, the appearance of a cointegrating vector between two financial markets does not explain the process of convergence to zero differentials. Devine (2001) states that we may not find any cointegrated relationship even though there seems to be a tendency to converge. Indeed, the process of convergence from a state of non-zero differentials to a state of zero differentials may imply the failure of cointegration tests. Kim et al (2005) stress that the long-run stable equilibrium relationships conjectured by these techniques are not suitable for modeling the dynamic process of stock market integration as it is incomplete and continues to exhibit strong variations over time. Furthermore, only the existence of an equilibrating process and not the driving forces behind the long-run equilibrium are investigated in standard cointegration analyses.

Multivariate autoregressive conditional heteroskedasticity (GARCH) models allow to estimate dynamic volatilities and correlations across financial markets. However, so far there are few applications of these techniques in East Asian studies (Liu and Pan (1997), Ng (2000), Suk (2003) and Chandra (2005)). There are many different types of GARCH models, thus selecting the one which best-explains specific country data is very important. Generally, studies of Asian markets carry a common a drawback: they have

not considered the asymmetric affects of innovations on conditional volatilities, covariances and correlations. Kroner and Ng (1998) and Cappiello et al (2004) agree that positive and negative information have significant impact on the behaviour of market returns.[33]

4.5.3 Informational Content to Studies

In spite of many studies of financial integration in East Asia markets so far, there has not been a clear picture of the ongoing process of financial integration in this region. Empirical findings are limited and not conclusive, especially concerning small financial markets. First, there is no clear answer for the question whether global or regional financial integration is happening in East Asian markets. So far, most of empirical studies have documented the high degree of both regional and global integration in advanced equity markets, such as Japan, Hong Kong and Singapore. Nevertheless, with respect to other smaller equity markets, such as Thailand, Malaysia, Indonesia and the Philippines, the evidence of integration is still being debated.

Second, empirical studies are unable to conclude who the dominant player is regarding to behaviors of East Asian financial markets. Indeed, Masih and Masih (1999) confirmed the leading role of Hong Kong, but Roca et al (1998) found that Singapore and Thailand had most linkages with other markets while Malaysia was the most influential market. Different findings from Ji and Kim (2005) indicated that the US and Japan were the two dominant capital markets in this region before the crisis, while the US capital market dominates the region after the crisis. Wang (2004) expected China will provide leadership in forging regional consensus, but the existing literature put aside the role of China market in this region. Similarly, there are few studies exploring impact of Australia on Asian markets, while De Brouwer (2003) considered Australia as one of three future pillars of finance in East Asia: Australia, Hong Kong and Singapore (not Japan).

Next, the updated status of financial integration in East Asia has not fully investigated. While most of studies look at financial integration in the 1900s period or before, East

[33] See Braun, Nelson, and Sunier (1995), Koutmos and Booth (1995), Koutmos (1996), Booth et al (1997), Scruggs (1998), and Christiansen (2000) for more details.

Asian economies have achieved considerable developments in their domestic financial systems after the Asian crisis, especially since 2001 (see Chapter III). Another noticeable development has been the growing attention to regional cooperation since the Asian crisis. For instance, the Chiang Mai Initiative (CMI) was established in May 2000 in order to prevent currency crises in the region (Park and Wang, 2005). Or, a regional bond market has been developed to increase the risk-bearing capacity of the region through more diversified financial systems. Particularly, two Asian Bond Funds have been launched using a portion of EMEAP's international reserves[34].

Finally, while integration at the country level has been extensively studied, the analysis of financial integration processes at the industry level has not received much attention. The theoretical definition of financial integration is based on "the law of one price". That is, identical tradable assets should expect to receive the same level of return. Hence, in order to evaluate the process of financial integration, we need to analyse the integration in not only country-level, but industry-level as well. Investigating market integration at the industry-level is important because of the increase in economic integration, industrial reorganisation and blurring of national boundaries. Indeed, it is possible that even if a country is integrated with the world capital market, some of its industries may not be integrated due to, for example, industry-specific foreign ownership restrictions, absence or low volume of exports. On the other hand, a country that is segmented from the world market may have some industries that are not segmented to the same degree.[35] Therefore, identifying whether there is considerable industry integration is central for a comprehensive analysis of financial market integration. Carrieri et al (2004) suggested that a country is segmented from (integrated with) the world financial markets only if most of its industries are segmented (integrated).

4.6 CONCLUSIONS

This chapter has provided a critical review of the literature on financial integration in East Asia. The review of empirical studies has been constructed according to categorising methodologies applied. There are several methodologies used for investigating the degree of financial integration, but, in general, they may be placed into three main

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[34] *<http://www.asianbondsonline.adb.org/regional/>*

[35] See De Santis and Gerard (1997), Carrieri et al (2002), Karolyi (2002) and Carrieri et al (2004).

categories: price/return-based studies, quantity-based studies and legal restriction studies. Due to difficulties in obtaining reliable and sufficient data, the quantity and quality of quantity-based and legal restriction studies are limited. So far, the price/return-based approaches have been the most favourable ones for examining the financial integration in East Asia. Among them, while interest rate parity conditions are difficult to hold and tend to be more theoretical, VAR models and cointegration tests are more applicable and become growingly popular approaches. With respect to GARCH models and their increasing developments, they promise to provide great tests for volatility spillovers, shock transmission regimes and time-varying conditional correlations across borders, despite their few applications in East Asia so far.

Despite several studies of financial integration in East Asia, it is still not clear of the ongoing process of financial integration in East Asia, especially in small financial markets. Particularly, there is no confirmed answer for the question whether the East Asian financial markets are integrated with the world or within the region. Empirical studies are still debated on who the dominant player is in East Asia. Limited and inconclusive findings may partly be resulted from limitations in data availability and methodology application. The data issue is serious in East Asia at present, especially in emerging markets. It may restrict researchers from achieving a deep understanding of financial integration process and drivers of this process. Besides, the data issue may also prevent researchers from applying advanced econometrics techniques in examining the degree of financial integration, such as models requiring high frequencies of data. In addition to the cause of data availability, limitations on methodology may be originated from the likelihood of models, such as models are not completely suitable for estimating the degree of financial integration.

What is happening with the ongoing process of financial integration in East Asia? Which methodologies should be applied? Next chapter will present a framework of methodologies applied in this dissertation to examine the degree of financial integration in East Asia.

CHAPTER V

RESEARCH METHODOLOGIES AND DATA PROCESSES

5.1 INTRODUCTION

Chapter II drew a theoretical framework of measuring financial integration; and then Chapter IV reviewed various approaches applied to investigate the process of financial integration in East Asian markets and also pointed out gaps in the existing literature. This Chapter is going to focus on the data samples and methodologies conducted to answer reseach questions of this dissertation. Generally, there are two main concerns: the degree of financial integration of East Asian markets, both global and regional levels; and the state of inter-market linkages. Due to the availability and the reliability of data, this dissertation only looks at the integration of two main financial markets: money markets and equity markets.

The focus of this dissertation is to examine the five East Asian markets: Singapore, Thailand, Malaysia, Philippines and Indonesia (called ASEAN-5 area or ASEAN area). For credit market investigation, the US and Japan are considered the world market and regional market, respectively. Regarding equity market integration, while the US is considered the world market, the returns on regional market are based on the weighted average of ASEAN countries (see section 5.2.3). This thesis also examines dynamic linkages across financial markets (credit markets and equity markets) of the US, Japan and ASEAN-5. Monthly data on credit markets are three-month money market rates covering from January 1983 to August 2006. Weekly and daily data on equity markets are national index returns covering from January 1991 to December 2006 (see section 5.3.3).

Because data are money market rates and stock market returns, price/returns-based measures will be applied. Particularly, with respect to the credit markets, cointegration

tests will be applied to estimate the degree of global and regional integration (see section 5.2.1); and unrestricted VAR, generalised impulse response function (G-IRF) forecasts will be applied to examine inter-market linkages (see section 5.2.2). For the equity markets, capital asset pricing models (CAPM) and asymmetric dynamic conditional correlation (ADCC) models will be used to evaluate the state of integration and dynamic linkages, respectively (see sections 5.3.1 and 5.3.2). However, as discussed in Chapter IV, each approach has its own weaknesses, thus robustness and specification tests should be accompanied in order to achieve informative findings.

The purpose of this chapter is to present a framework of data and methodologies applied to test the state of financial integration and linkages in the ASEAN-5 markets. Particularly, section 5.2 explains the methodologies and data processes used to evaluate credit market integration and linkages. Section 5.3 explains the methodologies and data processes used to evaluate equity market integration and linkages. And, finally, conclusions are reported in section 5.4.

5.2 CREDIT MARKET

5.2.1 Long-term Integration: Unit Root and Cointegration Tests

5.2.1.1 Methodology selection

In order to interpret credit market integration, the most conventional and theoretical approaches are to test the conditions of interest rate parities, CIP, UIP and RIP (see sub-section 2.4.1.1). However, one of the key factors which affect the selection of methodologies is data availability. In fact, as discussed in section 4.5.2, data are unavailable or insufficient to test the CIP and UIP conditions in ASEAN-5 at present. Only monthly real interest rate data are available to test the RIP condition.

However, there are two main reasons not to expect equal real interest rates, even in a well-integrated and efficient international credit market: (1) the existence of non-traded

goods; and (2) the existence of transaction costs. Because prices of non-traded goods expressed in a common currency will not be equalized, nominal interest rates deflated by price indices that include non-traded goods may not be equalized (Kimbrough, 1987). In the presence of transactions costs, real interest rates in an efficient and integrated market will differ by an amount that will not exceed transactions costs. Within a band determined by these costs, national real interest rates will fluctuate independently of one another in response to localised changes in domestic supply and demand conditions. Arbitrage within the transactions cost band is not profitable.

Cointegration tests (see sub-section 4.2.4.1) provide an especially suitable framework for evaluating long-run real interest parity relationships. Real interest rates have exhibited considerable volatility and persistence in the last decade, suggesting the potential for non-stationarity in long-run real interest rate series. As noted above, real interest rates in individual countries may wander within the band created by transactions costs, independent of rates in other countries. This localised movement could occur in response to domestic financial conditions. However, a long-run, efficient arbitrage equilibrium in international financial markets should ensure that the individual rates do not wander arbitrarily far apart. Thus, an implication of interest parity and efficiently integrated markets is that non-stationary real interest rates from two or more different countries should be cointegrated.

For the purpose of this dissertation, investigation of credit market integration will be conducted through Johansen cointegration tests. Before these cointegration tests are applied, the Augmented Dickey-Fuller (1981) unit root tests have to be employed in order to examine the stationarity characteristics of real interest rates. It is reminded that there have been very few studies using these cointegration techniques with data updated since 2000 for the ASEAN markets (see section 4.2.4.1). Only Ji and Kim (2005) examine the short run and long run relationships among the real interest rates of several Pacific-Basin countries, covering from 1980 to 2004. However, there are only two ASEAN markets (Singapore and Thailand) included in their study. Therefore, the fact this dissertation applies Johansen cointegration tests combined with a new set of data covering from 1983

to 2006 should be expected to considerably contribute to the existing literature of credit market integration in the ASEAN-5 markets.

5.2.1.2 Augmented Dickey-Fuller (1981) Unit Root Tests

The Augmented Dickey-Fuller (ADF) tests for an autoregressive unit root are based on the following ordinary least squares regression equations:

Model A: $$\Delta y_t = \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad (5.1)$$

Model B: $$\Delta y_t = a_0 + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad (5.2)$$

Model C: $$\Delta y_t = a_0 + a_2 t + \gamma y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \quad (5.3)$$

y_t refers to the real interest rate variable. The difference between the three regressions concerns the presence of the deterministic elements. Model A is a pure random walk model, model B adds an intercept or *drift* term, and model C includes both a drift and linear time trend. The null hypothesis for ADF test is: $H_0 : \gamma = 0$. Among these three ADF models (A, B and C), which one should be used for the unit root test? This dissertation applies the selection rule of Doldado, Jenkinson, and Sosvilla-Rivero (DJS) (1990). Specifically, DJS (1990) tests for the significance of the trend coefficient in model C first (equation 5.3), followed by testing for the significance of the drift coefficient in model B (equation 5.2). If the null hypothesis is accepted in both cases, model C (equation 5.1) is selected.

Another important issue regarding the implementation of the ADF tests is the selection of the number of lagged first-difference terms Δy_{t-k} needed to induce an approximate white noise error structure in the estimated ADF test regression equations. As pointed out by Campbell and Perron (1991), Dickey-Fuller tests are sensitive to the choice of *k*, the number of lags in the estimated equation. First, too few lags may adversely affect the size of the test. In other words, selecting too few lags may cause one to over-reject a true null of a unit root at any chosen significance level. Second, the introduction of too many lags

may reduce the power of test because more parameters are estimated, which reduces number of effective observations, given the need for additional initial conditions. That is. there is a high probability of falsely rejecting a true null of a unit root against a false stationary alternative when more lags are used. This dissertation follows the Modified Akaike's information criterion (MAIC) suggested by Ng and Perron (2001) to determine the optimal number of lag lengths.

5.2.1.3 Johansen cointegration tests

Soren Johansen firmly roots cointegration and error correction models in a vector autoregression framework. Unlike other cointegration techniques, the Johansen methodology offers a unique way to find the number of cointegrating relationships and estimating these relationships. Thus, the Johansen cointegration test is more appropriate for a multivariate system. This section outlines the work of Johansen (1988, 1991 and 1994).

5.2.1.3.1 The cointegrated vector autoregressive (VAR)

Consider the levels VAR(p) model for the (n × 1) vector Y_t

$$Y_t = \Phi D_t + \Pi_1 Y_{t-1} + \ldots + \Pi_p Y_{t-p} + \varepsilon_t \qquad (5.4)$$

where D_t contains deterministic terms (constant, trend, seasonal dummies etc.). Y_t refers to the variables of real interest rates at time t. ε_t indicates the error term at time t. And, p is the number of time lags. Suppose Y_t is I(1) and possibly cointegrated, then the VAR representation (equation 5.4) is not the most suitable representation for analysis because the cointegrating relations are not explicitly apparent. The cointegrating relations become apparent if the levels VAR (equation 5.4) is transformed to the *vector error correction model* (VECM)

$$\Delta Y_t = \Phi D_t + \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \qquad (5.5)$$

where $\Pi = \Pi_1 + ... + \Pi_p - I_n$ and $\Gamma_k = -\sum_{j=k+1}^{p} \Pi_j$, k = 1, . . . , p – 1. The matrix Π is called the *long-run impact matrix* and Γ_k are the *short-run impact matrices*.

In the VECM (equation 5.5), ΔY_t and its lags are I(0). The term ΠY_{t-1} is the only one which includes potential I(1) variables and for ΔY_t to be I(0) it must be the case that ΠY_{t-1} is also I(0). Therefore, ΠY_{t-1} must contain the cointegrating relations if they exist. If the VAR(p) process has unit roots then it is clear that Π is a singular matrix. If Π is singular then it has reduced rank; that is rank(Π) = r < n. There are two cases to consider:

1. rank(Π) = 0. This implies that $\Pi = 0$ and Y_t is I(1) and not cointegrated. The VECM (equation 5.5) reduces to a VAR(p-1) in first differences

$$\Delta Y_t = \Phi D_t + \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \qquad (5.6)$$

2. 0 < rank(Π) = r < n. This implies that Y_t is I(1) with r linearly independent cointegrating vectors and (n-r) common stochastic trends (unit roots). Since Π has rank r it can be written as the product

$$\underset{n\times n}{\Pi} = \underset{n\times r}{\alpha}\ \underset{r\times n}{\beta'}$$

where α and β are (n × r) matrices with rank(α) = rank(β) = r. The rows of β' form a basis for the r cointegrating vectors and the elements of α distribute the impact of the cointegrating vectors to the evolution of ΔY_t. The VECM (equation 5.5) becomes

$$\Delta Y_t = \Phi D_t + \alpha\beta' Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \qquad (5.7)$$

where $\beta' Y_{t-1}$ □ I(0) since β' is a matrix of cointegrating vectors.

It is important to recognize that the factorization $\Pi = \alpha\beta'$ is not unique since for any r × r nonsingular matrix H we have

$$\alpha\beta' = \alpha HH^{-1}\beta' = (\alpha H)(\beta H^{-1\prime})' = \alpha^{*}\beta^{*} \qquad (5.8)$$

Hence the factorization $\Pi = \alpha\beta'$ only identifies the space spanned by the cointegrating relations. To obtain unique values of α and β requires further restrictions on the model.

5.2.1.3.2 Specification of deterministic terms

Following Johansen (1994), the deterministic terms in equation 5.7 are restricted to the form

$$\Phi D_t = \mu_t = \mu_0 + \mu_1 t \qquad (5.9)$$

If the deterministic terms are unrestricted then the time series in Y_t may exhibit quadratic trends and there may be a linear trend term in the cointegrating relationships. Restricted versions of the trend parameters μ_0 and μ_1 limit the trending nature of the series in Y_t. The trend behavior of Y_t can be classified into five cases:

1. *Model* $H_0(r)$: $\mu_t = 0$ (no constant). The restricted VECM is

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1}\Delta Y_{t-p+1} + \varepsilon_t \qquad (5.10)$$

All the series in Yt are I(1) without drift and the cointegrating relations $\beta' Y_t$ have mean zero.

2. *Model* $H_1^{*}(r)$: $\mu_t = \mu_0 = \alpha\rho_0$ (restricted constant). The restricted VECM is

$$\Delta Y_t = \alpha(\beta' Y_{t-1} + \rho_0) + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1}\Delta Y_{t-p+1} + \varepsilon_t \qquad (5.11)$$

The series in Y_t are I(1) without drift and the cointegrating relations $\beta' Y_t$ have non-zero means ρ_0.

3. *Model* $H_1(r)$: $\mu_t = \mu_0$ (unrestricted constant). The restricted VECM is

$$\Delta Y_t = \mu_0 + \alpha\beta' Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \qquad (5.12)$$

The series in Y_t are I(1) with drift vector μ_0 and the cointegrating relations $\beta' Y_t$ may have a non-zero mean.

4. *Model* $H_2^*(r)$: $\mu_t = \mu_0 + \alpha\rho_1 t$ (restricted trend). The restricted VECM is

$$\Delta Y_t = \mu_0 + \alpha(\beta' Y_{t-1} + \rho_1 t) + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \quad (5.13)$$

The series in Y_t are I(1) with drift vector μ_0 and the cointegrating relations $\beta' Y_t$ have a linear trend term $\rho_1 t$.

5. *Model* $H_2(r)$: $\mu_t = \mu_0 + \mu_1 t$ (unrestricted constant and trend). The unrestricted VECM is

$$\Delta Y_t = \mu_0 + \mu_1 t + \alpha\beta' Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \varepsilon_t \qquad (5.14)$$

The series in Y_t are I(1) with a linear trend (quadratic trend in levels) and the cointegrating relations $\beta' Y_t$ have a linear trend.

5.2.1.3.3 Likelihood ratio tests for the number of cointegrating vectors

Since the rank of the long-run impact matrix Π gives the number of cointegrating relationships in Y_t, Johansen formulates likelihood ratio (LR) statistics for the number of cointegrating relationships as LR statistics for determining the rank of Π. These tests are based on the estimated eigenvalues $\hat{\lambda}_1 > \hat{\lambda}_2 > \ldots > \hat{\lambda}_n$ of the matrix Π. These eigenvalues also happen to equal the squared *canonical correlations* between ΔY_t and Y_{t-1} corrected for lagged ΔY_t and D_t and so lie between 0 and 1. Recall, the rank of Π is equal to the number of non-zero eigenvalues of Π.

Johansen's LR statistic tests the nested hypotheses:

$$H_0(r_0): r = r_0 \text{ vs. } H_1(r_0): r > r_0 \tag{5.15}$$

The LR statistic, called the ***trace statistic***, is given by:

$$LR_{trace}(r_0) = -T \sum_{i=r_0+1}^{n} \ln(1-\hat{\lambda}_i) \tag{5.16}$$

If rank(Π) = r_0 then $\hat{\lambda}_{ro+1},...,\hat{\lambda}_n$ should all be close to zero and $LR_{trace}(r_0)$ should be small. In contrast, if rank(Π) > r_0 then some of $\hat{\lambda}_{ro+1},...,\hat{\lambda}_n$ will be nonzero (but less than 1) and $LR_{trace}(r_0)$ should be large. The asymptotic null distribution of $LR_{trace}(r_0)$ is not chi-square but instead is a multivariate version of the Dickey-Fuller unit root distribution which depends on the dimension (n- r_0) and the specification of the deterministic terms. Critical values for this distribution are tabulated in Osterwald-Lenum (1992) for the five trend cases discussed in the previous section for (n- r_0) = 1, . . . , 10.

Johansen proposes a sequential testing procedure that consistently determines the number of cointegrating vectors. First $H_0(r_0 = 0)$ against $H_1(r_0 > 0)$ is tested. If this null is not rejected then it is concluded that there are no cointegrating vectors among the n variables in Y_t. If $H_0(r_0 = 0)$ is rejected then it is concluded that there is at least one cointegrating vector and proceed to test $H_0(r_0 = 1)$ against $H_1(r_0 > 1)$. If this null is not rejected then it is concluded that there is only one cointegrating vector. If the null is rejected then it is concluded that there is at least two cointegrating vectors. The sequential procedure is continued until the null is not rejected.

Johansen also derives another LR statistic, called the ***maximum eigenvalue statistic***, for the hypotheses:

$$H_0(r_0): r = r_0 \text{ vs. } H_1(r_0): r = r_0 + 1$$

This maximum eigenvalue statistic is given by:

$$LR_{\max}(r_0) = -T \ln(1-\hat{\lambda}_{r_0+1}) \tag{5.17}$$

As with the trace statistic, the asymptotic null distribution of $LR_{\max}(r_0)$ is not chi-square but instead is a complicated function of Brownian motion, which depends on the dimension (n- r_0) and the specification of the deterministic terms. Critical values for this distribution are tabulated in Osterwald-Lenum (1992) for the five trend cases discussed in the previous sub-section for (n- r_0) = 1, . . . , 10.

However, Cheung and Lai (1993) report that using these trace and maximum eigenvalue statistics would lead to the over-rejection of the null hypothesis of no cointegration. These authors advise to use the "finite sample correction" introduced by Reinsel and Ahn (1988) in which the Johansen test statistics are adjusted by a factor $(T - np)/T$. Particularly, the adjusted trace and maximum eigenvalue statistics are caculated as follows:

$$Adjusted_{trace}(r_0) = -(T - np)\sum_{i=r_0+1}^{n}\ln(1-\hat{\lambda}_i) \qquad (5.18)$$

$$Adjusted\lambda_{\max}(r_0) = -(T - np)\ln(1-\hat{\lambda}_{r_0+1}) \qquad (5.19)$$

5.2.1.4 Estimation procedures

This sub-section presents the procedures conducted to examine the state of credit market integration in ASEAN. These procedures are summarised as follows:

- Step 1: for each time period, applying seven ADF unit root tests to explore stationarity characteristics in variables of real interest rates in the US, Japan and ASEAN-5 markets.
- Step 2: applying one Johansen multivariate cointegration test for seven markets including the US (considered the world market), Japan (considered the regional market) and ASEAN-5 markets. The purpose of this test is to estimate the degree of credit market integration among the world market, the regional market and ASEAN markets.
- Step 3: applying one Johansen multivariate cointegration test for six markets including the US (considered the world market) and ASEAN-5 markets. The

purpose of this test is to estimate the extent to which ASEAN markets are integrated with the world.

- Step 4: applying one Johansen multivariate cointegration test for six markets including Japan (considered the regional market) and the ASEAN-5 markets. The purpose of this test is to estimate the extent to which ASEAN markets are integrated within the region.
- Step 5: applying one Johansen multivariate cointegration test for the five ASEAN markets. The purpose of this test is to estimate the extent to which these ASEAN markets are integrated together.
- Step 6: for each time period, applying five Johansen bivariate cointegration tests to examine the cointegration between the US and the five ASEAN markets. If the US and an ASEAN market are cointegrated, there is a long-term integration between this ASEAN credit market and the world credit market. We further test whether this cointegrating vector is equal to [1,-1]. If so, there is the existence of real interest rate parity between this ASEAN market and the world market.
- Step 7: for each time period, applying five Johansen bivariate cointegration tests to examine the cointegration between Japan and ASEAN. Similar to Step 6, if Japan and an ASEAN market are cointegrated, there is a long-term integration between this ASEAN credit market and the regional credit market. We further test whether this cointegrating vector is equal to [1,-1]. If so, there is the existence of real interest rate parity between this ASEAN market and the regional market.
- Step 8: for each time period, applying ten Johansen bivariate cointegration tests to examine the cointegration between the five ASEAN markets. If a pair of markets is cointegrated, there is a long-term integration between these two credit markets. Similar to Steps 6 and 7, we further test whether this cointegrating vector is equal to [1,-1]. If so, there is the existence of real interest rate parity between these two ASEAN markets.

It is noted that multivariate cointegration tests are only applied for the whole data sample covering from January 1983 to August 2006. With respect to sub-periods of time, multivariate cointegration tests are not employed due to the insufficiency of observations. Besides, de Brouwer (1999) stresses that results from the whole sample investigation are more relevant than those from sub-periods because cointegration tests focus on investigating the long-term relationship between variables.

5.2.2 Causality Effects and Short-run Dynamics

5.2.2.1 Methodology selection

In order to examine causality effects between variables, most of studies have employed restricted-VAR (vector error correction model derived from cointegration test) and unrestricted-VAR (Granger (1969) causality test). The restricted-VAR would produce more appropriate results than the unrestricted-VAR would do when variables in the system are strongly cointegrated together. Otherwise, the unrestricted-VAR should be selected (Nieh and Yau, 2004). The results of multivariate cointegration tests (see Chapter VI) indicate a weak level of cointegration in a system of seven real interest rate variables. Therefore, in line with Nieh and Yau (2004), this dissertation will apply the unrestricted-VAR, specifically Granger causality test, to investigate causality effects among seven credit markets, the US, Japan and ASEAN-5.

In order to overcome challenges in interpreting the estimated coefficients of a VAR model, a large number of studies have recently used the impulse response functions (IRF). An IRF traces the response of one of the innovations on current and future values of the endogenous variables to a one standard deviation shock. This shock to a variable directly affects itself, and is also transmitted to all of the endogenous variables through the dynamic structure of the VAR.

Sims (1980) states that dynamic analysis of VAR models is routinely employed through the orthogonalised impulse responses, where the Cholesky decomposition is used to orthogonalise a shock to the VAR model before impulse responses or variance decompositions are calculated. Nevertheless, this method has to depend on the ordering of the variables in the VAR[36]. Cooley and LeRoy (1985) comment that this orthogonalised IRF generally seem to be not quite informative. King et al. (1991) and Zhou (1995) report that due to more than one common trend in a model, different ordering of variables may considerably impact the results of IRF. Pesaran and Shin (1998) develop the generalised IRF (G-IRF), in order to overcome the weakness of orthogonalised IRF.

[36] see Lutkepohl (1991)

Particularly, the results of these models are consistent to any ordering of the variables. Dekker et al. (2001) compared traditional VAR with G-VAR in estimating linkages of the Asia-Pacific equity markets. It was found that the generalized approach significantly gives more realistic results, particularly for those markets with closest geographical and economic links.

For the purpose of this dissertation, we will follow the generalised impulse response functions (G-IRF) forecasts proposed by Pesaran and Shin (1998). It is noted that GARCH models may not be used in this case due to the insufficiency of observations. Moreover, the GARCH models are most appropriate to data with high frequencies, such as daily or hourly stock returns.

5.2.2.2 Granger (1969) causality test

The Granger causality test is expressed as follows:

$$\Delta X_{i,t} = \alpha_i + \sum_{p=1}^{m} \beta_{i,p} \Delta X_{i,t-p} + \sum_{q=1}^{n} \sum_{j=1}^{k} \gamma_{j,q} \Delta X_{j,t-q} + \varepsilon_{i,t} \qquad (5.20)$$

Δ is the difference operator. $X_{i,t}$ indicates the real interest rate in market i at time t. j also indicates a credit market but different from i. k is the number of credit markets and equal to six in this dissertation. p and q are lag lengths decided by the Akaike's information criterion (AIC)[37]. α_i and $\varepsilon_{i,t}$ are constant and error terms at time t.

5.2.2.3 Generalised impulse response functions

Consider the augmented vector autoregressive model,

$$x_t = \sum_{i=1}^{p} \Phi_i x_{t-i} + \Psi w_t + \varepsilon_t, \quad t = 1,2,\ldots,T \qquad (5.21)$$

[37] See Akaike (1969)

where $x_t = (x_{1t}, x_{2t}, ...x_{mt})'$ is an $m \times 1$ vector of jointly determined dependent variables, w_t is an $q \times 1$ vector of deterministic and/or exogenous variables, and $\{\Phi_i, i = 1,2,...p\}$ and Ψ are $m \times m$ and $m \times q$ coefficient matrices. Pesaran and Shin (1998) make the following standard assumptions:

Assumption 1: $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = \sum$ *for all* t *,where* $\sum = \{\sigma_{ij}, i, j = 1,2,...m\}$ *is an* $m \times m$ *positive definite matrix,* $E(\varepsilon_t \varepsilon_{t'}') = 0$ *for all* $t = t'$ *and* $E(\varepsilon_t \mid w_t) = 0$

Assumption 2: *All the roots of* $| I_m - \sum_{i=1}^{p} \Phi_i z^i$ *fall outside the unit circle.*

Assumption 3: $x_{t-1}, x_{t-2}, ...x_{t-p}$, w_t, $t = 1,2,...T$, *are not perfectly collinear.*

Under Assumption 2, x_t would be covariance-stationary, and (5.21) can be rewritten as the infinite moving average representation,

$$x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} + \sum_{i=0}^{\infty} G_i w_{t-i} , \quad t = 1,2,...,T \qquad (5.22)$$

where the $m \times m$ coefficient matrix A_i can be obtained using the following recursive relations:

$$A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + ... + \Phi_p A_{i-p} , \quad i = 1,2,... \qquad (5.23)$$

with $A_0 = I_m$ and $A_i = 0$ for $i < 0$, and $G_i = A_i \Psi$

An impulse response is best described as an outcome of an experiment in which the time profile of the effect of a hypothetical $m \times 1$ vector of shocks of size $\delta = (\delta_1, ...\delta_m)'$, say, hitting the economy at time t is compared with a base-line profile at time $t+n$. Three main issues are arisen: (1) the type of shock hitting the economy at time t, (2) the state of the economy at time $t-1$ before being shocked and (3) the type of shock hitting the economy from $t+1$ to $t+n$.

Denoting the known history of the economy up to time $t-1$ by the non-decreasing information set Ω_{t-1}, the generalised impulse response function of x_t at horizon n *is* defined by:

$$GI_x(n,\delta,\Omega_{t-1}) = E(x_{t+n} \mid \varepsilon_t = \delta, \Omega_{t-1}) - E(x_{t+n} \mid \Omega_{t-1}) \qquad (5.24)$$

Using (5.24) in (5.22), we have $GI_x(n,\delta,\Omega_{t-1}) = A_n\delta$, which is independent of Ω_{t-1}, but depends on the composition of shocks defined by δ.

Obviously, the correct selection of hypothesised vector of shocks, δ, is essential to the characteristics of the impulse response function. Sims (1980) suggests to overcome the problem surrounding the selection of δ by using the Cholesky decomposition of $\sum$:

$$PP' = \sum \qquad (5.25)$$

where P is an $m \times m$ lower triangular matrix. Then, (5.22) can be rewritten as:

$$x_t \sum_{i=0}^{\infty}(A_iP)(P^{-1}\varepsilon_{t-i}) + \sum_{i=0}^{\infty}G_iw_{t-i} = \sum_{i=0}^{\infty}(A_iP)\xi_{t-i} + \sum_{i=0}^{\infty}G_iw_{t-i}, \quad t = 1,2,...T \qquad (5.26)$$

such that $\xi_t = P^{-1}\varepsilon_t$ are orthogonalised; namely, $E(\xi_t\xi_t') = I_m$. Hence, the $m \times 1$ vector of the orthogonalised impulse response function of a unit shock to the *j*th equation on x_{t+n} is given by:

$$\psi_j^0(n) = A_nPe_j, \quad n = 0,1,2... \qquad (5.27)$$

where e_j is an $m \times 1$ selection vector with unity as its *j*th element and zeros elsewhere.

Alternatively, instead of shocking all the elements of ε_t, we may decide to shock only one element, say its *j*th element, and integrate out the effects of other shocks using an assumed or the historically observed distribution of the errors. Then, we obtain:

$$GI_x(n,\delta_j,\Omega_{t-1} = E(x_{t+n} \mid \varepsilon_{jt} = \delta_j,\Omega_{t-1}) - E(x_{t+n} \mid \Omega_{t-1}) \qquad (5.28)$$

Assuming that ε_t has a multivariate normal distribution, it is now seen that

$$E(\varepsilon_t \varepsilon_{jt} = \delta_j) = (\sigma_{1j},\sigma_{2j},...,\sigma_{mj})'\sigma_{jj}^{-1}\delta_j = \sum e_j \sigma_{jj}^{-1}\delta_j \qquad (5.29)$$

Thus, the $m \times 1$ vector of the (unscaled) generalised impulse response of the effect of a shock in the *j*th equation at time *t* on x_{t+n} is given by:

$$(\frac{A_n \sum e_j}{\sqrt{\sigma_{jj}}})(\frac{\delta_j}{\sqrt{\sigma_{jj}}}), \quad n = 0,1,2,... \qquad (5.30)$$

By setting $\delta_j = \sqrt{\sigma_{jj}}$, we may estimate the scaled generalised impulse response function by:

$$\psi_j^g(n) = \sigma_{jj}^{-1/2} A_n \sum e_j, \quad n = 0,1,2... \qquad (5.31)$$

Based on the estimate of generalised impulse response functions, we may calculate the generalised variance decompositions, $\theta_{ij}^g(n)$, as follows:

$$\theta_{ij}^g(n) = \frac{\sigma_{ij}^{-1}\sum_{l=0}^{n}(e_i' A_l \sum e_j)^2}{\sum_{l=0}^{n} e_i' A_l \sum A_l' e_i} \quad i,j = 1,...m \qquad (5.32)$$

5.2.2.4 Estimation procedures

The causality effects and short-run dynamics within the group of the US, Japanese and ASEAN markets are examined throughout the period from January 1983 to August 2006. Besides, we pay more attention to causality effects in sub-periods in order to find structural changes before and after the occurrence of the 1997 crisis. Specifically, the estimation process is conducted as follows:

- Step 1: applying Granger test to explore causality effects in a system of seven variables of real interest rates including the US, Japanese, Singapore, Thailand, Malaysian, Indonesian and Filipino rates, covering from January 1983 to August 2006.
- Step 2: similar to Step 1, but data only cover the pre-crisis period from January 1983 to June 1997.
- Step 3: similar to Step 1, but data only cover the post-crisis period from July 1997 to August 2006.
- Step 4: applying G-IRF forecasts to trace how a shock to a real interest rate affects the current or future values of itself and other real interest rates. We have seven series of real interest rates, so we will present forty-nine forecasts in the form of graphs.

5.2.3 Data Collection and Processes

The data employed are comprised of monthly time series from January 1983 to August 2006, which comprises 284 observations. We have selected the real interest rates of ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore and Thailand), Japan as the regional rate and the United States as the world rate. To investigate the effect of liberalisation, the 1997 financial crisis and structural changes in ASEAN economies, we divide the period under consideration into four sub-periods: January 1983 through December 1989, January 1990 through June 1997, July 1997 through December 2000 and finally January 2001 through May 2006. The first two sub-periods refer to the pre-1997 crisis period. The next two sub-periods refer to the post-1997 crisis period

Real interest rates of these countries are constructed by subtracting the expected inflation rates from nominal interest rates. Following Kugler and Neusser (1993), Gagnon and Unferth (1995) and Goodwin and Grennes (1994), the expected inflation of each country was estimated using the ex post rates based on the consumer price index (CPI). Data sources are specified in Table 5.1. All the data are collected from Datastream.

The choice of the nominal interest rate is dictated by data availability; short-term money market rates are utilised due to the fact that long-term interest rates, such as government

bond yields are unavailable for most of the ASEAN economies. De Brouwer (1999) admits that although money market rates are only a relatively small set of the menu of financial instruments available, tests of integration may reveal a considerable amount of information about the integration of traded assets overall.

Table 5.1: Data specifications and sources

Data sample	Data period	Data frequency	Data source	Source code
Indonesia call money rate	01/1983 - 08/2006	Monthly	Datastream	IDI60B...
Japan 3-month money market rate	01/1983 - 08/2006	Monthly	Datastream	JPESSFON
Malaysia 3-month T-Bill rate	01/1983 - 08/2006	Monthly	Datastream	MYI60C...
Philippines 91-day T-Bill rate	01/1983 - 08/2006	Monthly	Datastream	PHGBILL3
Singapore 3-month interbank rate	01/1983 - 08/2006	Monthly	Datastream	SGI60B...
Thailand 3-month money market	01/1983 - 08/2006	Monthly	Datastream	THI60B...
US 3-month T-Bill rate	01/1983 - 08/2006	Monthly	Datastream	USESSFON
Indonesia consumer price index	01/1983 - 08/2006	Monthly	Datastream	IDI64..XF
Japan consumer price index	01/1983 - 08/2006	Monthly	Datastream	JPI64..XF
Malaysia consumer price index	01/1983 - 08/2006	Monthly	Datastream	MYI64..XF
Philippines consumer price index	01/1983 - 08/2006	Monthly	Datastream	PHI64..XF
Singapore consumer price index	01/1983 - 08/2006	Monthly	Datastream	SPI64..XF
Thailand consumer price index	01/1983 - 08/2006	Monthly	Datastream	THI64..XF
US consumer price index	01/1983 - 08/2006	Monthly	Datastream	USI64..XF

Note: Interest rates are nominal rates

5.3 EQUITY MARKET

5.3.1 Market Integration: CAPM with Trivariate GARCH Model

5.3.1.1 Methodology selection

So far, there have been two popular approaches to evaluate the state of integration in equity markets, namely cointegration tests and capital asset pricing models (CAPM). It is noted that other techniques, such as simple correlations, conditional correlations, volatility spillover, shock transmission, mainly focus on interpreting market linkages which are not completely the same as market integration. Therefore, we do not consider these techniques official ways to evaluate the equity market integration.

This dissertation is going to apply the CAPM with trivariate GARCH model (called CAPM-TGARCH hereafter) sequentially developed by Fratzscher (2001) and Bekaert et al (2005) to evaluate the state of international and regional integration in the ASEAN-5 equity markets. The CAPM-TGARCH is selected over other CAPM models and cointegration tests because of four main reasons as follows:

- ✓ First, the CAPM-TGARCH is a two-factor model extended from the traditional CAPM, one-factor model. Specifically, the CAPM-TGARCH divides the world market into the US market and a particular regional market and then allows individual markets to be priced.
- ✓ Second, compared to the other CAPM models and cointegration tests, the CAPM-TGARCH allows to clearly distinguishing indicators of market integration and market efficiency.
- ✓ Third, due to the nature of high frequency and heteroskedasticity data, the CAPM-TGARCH with GARCH specifications could be used better for the investigation of equity markets than the other traditional CAPM models and cointegration tests could be.
- ✓ Finally, while the CAPM-TGARCH may give answers to important research questions, such as the explanatory power of the US market and the regional market to local markets, or the time-varying degree of integration, the cointegration tests may not. Besides, the cointegration tests seem to be unclear about the direction of market integration in their findings.

Actually, the CAPM-TGARCH model is quite suitable for investigating the state of equity market integration. However, if applied to ASEAN markets, the model should change a bit. Particularly, Fratzscher develops this model to estimate the degree of international and regional integration in Euro area. The author allows existing bi-directional effects between the US and the Euro. Nevertheless, for market integration in East Asia, Bekaert et al (2005) advise to model one-way effects from the US to the region, not from the region back to the US. Therefore, in order to investigate the state of integration in the ASEAN equity markets, we will follow the Fratzscher CAPM-TGARCH, but allow only one-directional effects from the US to ASEAN instead of bi-directional ones.

5.3.1.2 CAPM with Trivariate GARCH model

The CAPM-TGARCH is estimated as follows:

$$r_{j,t} = \omega_{j,t-1} + \mu_{j,t} \tag{5.33}$$

$$\mu_{j,t} = \begin{vmatrix} \mu_{i,t} \\ \mu_{A,t} \\ \mu_{U,t} \end{vmatrix} = \begin{vmatrix} 0 & \gamma_{iA,t-1} & \gamma_{iU,t-1} \\ 0 & 0 & \gamma_{AU,t-1} \\ 0 & 0 & 0 \end{vmatrix} \begin{vmatrix} \varepsilon_{i,t} \\ \varepsilon_{A,t} \\ \varepsilon_{U,t-1} \end{vmatrix} + \begin{vmatrix} \varepsilon_{i,t} \\ \varepsilon_{A,t} \\ \varepsilon_{U,t} \end{vmatrix} \tag{5.34}$$

$$\omega_{j,t-1} = \begin{vmatrix} \omega_{i,t-1} \\ \omega_{A,t-1} \\ \omega_{U,t-1} \end{vmatrix} = \begin{vmatrix} \beta_{i0} \\ \beta_{A0} \\ \beta_{U0} \end{vmatrix} + \begin{vmatrix} \beta_{ii} & \beta_{iA} & \beta_{iU} \\ 0 & \beta_{AA} & \beta_{AU} \\ 0 & 0 & \beta_{UU} \end{vmatrix} \begin{vmatrix} X_{i,t-1} \\ X_{A,t-1} \\ X_{U,t-1} \end{vmatrix} \tag{5.35}$$

U and A denote the US market and ASEAN area, respectively. $r_{j,t}$ is a *3x1* vector of excess returns, $\omega_{j,t-1}$ a *3x1* vector of conditional mean returns. X_i, X_A and X_U are information on local, regional and global fundamentals, respectively. X_i is composed of the local excess return and dividend yield. X_A is composed of the regional excess return and regional dividend yield. X_U is composed of the world excess return, world dividend yield, the spread between the 90-day Eurodollar rate and the 3-month Treasury-bill yield, the difference between the US 10-year Treasury bond yield and the 3-month bill yield and the change in the 90-day Treasury-bill yield (Bekaert et al, 2005). The local innovation $\mu_{i,t}$ is explained through contemporaneous global shocks $\varepsilon_{U,t}$ and regional shocks $\varepsilon_{A,t}$ as well as a purely idiosyncratic component $\varepsilon_{i,t}$.

Due to the trading time difference, US shocks affect ASEAN markets on the following day ($\varepsilon_{U,t-1}$). It is reminded that the Fratzscher's original model allows bi-directional affects between the US and the region, but the CAPM-TGARCH in this dissertation only allows one-directional from the US to the region. Indicators of market efficiency and market integration are clearly distinguished in the CAPM-TGARCH model. Particularly, β_{ii}, β_{iA}, β_{iU}, β_{AA}, β_{AU} and β_{UU} are measures of the market efficiency. For instance, if β_{ii}, β_{iA} and β_{iU} are simultaneously equal to zero, the market *i* is fully efficient. $\gamma_{iA,t-1}$ and $\gamma_{iU,t-1}$ measure the degree of regional and international integration of market *i*. We model these parameters to be time-varying as:

$$\gamma_{iA,t-1} = \psi_{iA,0} + \psi_{iA,1} Z_{iA,t-1} \tag{5.36}$$

$$\gamma_{iU,t-1} = \psi_{iU,0} + \psi_{iU,1} Z_{iU,t-1} \tag{5.37}$$

$Z_{iA,t-1}$ and $Z_{iU,t-1}$ are information variables that capture the covariance risk of market i with the region and the US, respectively. Specifically, $Z_{iA,t-1}$ is equal to the sum of exports to and imports from the region divided by the sum of total exports and total imports in market i. Similarly, $Z_{iA,t-1}$ is equal to the sum of exports to and imports from the United States divided by the sum of total exports and total imports in market i (Bekaert et al, 2005). It is noted that we will estimate both ***constant level of integration*** (based on equations 5.33, 5.34, 5.35, 5.38 and 5.39) and ***time-varying levels of integration*** (based on equations 5.33-5.39)

Empirical studies document that equity market integration tends to be asymmetric[38]. That is, negative shocks are more strongly transmitted than positive ones. Due to conditional heteroskedasticity in the idiosyncratic innovation $\varepsilon_{j,t}$ with $\varepsilon_{j,t} \mid \Omega_{j,t-1} \sim N(0, \sigma^2_{\varepsilon,j,t})$ and the asymmetric impact of innovation, the *3x1* vector of conditional variance of $\varepsilon_{j,t}$ is modeled as:

$$\begin{aligned} H = \sigma^2_{\varepsilon,j,t} = \begin{vmatrix} \sigma^2_{\varepsilon,i,t} \\ \sigma^2_{\varepsilon,A,t} \\ \sigma^2_{\varepsilon,U,t} \end{vmatrix} &= \begin{vmatrix} \alpha_{i0} \\ \alpha_{A0} \\ \alpha_{U0} \end{vmatrix} + \begin{vmatrix} \alpha_i \sigma^2_{\varepsilon,i,t-1} \\ \alpha_A \sigma^2_{\varepsilon,A,t-1} \\ \alpha_U \sigma^2_{\varepsilon,U,t-1} \end{vmatrix} + \begin{vmatrix} \alpha_{ii} \varepsilon^2_{i,t-1} \\ \alpha_{AA} \varepsilon^2_{A,t-1} \\ \alpha_{UU} \varepsilon^2_{U,t-1} \end{vmatrix} + \begin{vmatrix} 0 & \varsigma_{iA} & \varsigma_{iU} \\ 0 & 0 & \varsigma_{AU} \\ 0 & 0 & 0 \end{vmatrix} \begin{vmatrix} \varepsilon^2_{i,t} \\ \varepsilon^2_{A,t} \\ \varepsilon^2_{U,t-1} \end{vmatrix} \\ + \begin{vmatrix} \eta_i \\ \eta_A \\ \eta_U \end{vmatrix} \begin{vmatrix} S^N_i \varepsilon^2_{i,t-1} \\ S^N_A \varepsilon^2_{A,t-1} \\ S^N_U \varepsilon^2_{U,t-1} \end{vmatrix} &+ \begin{vmatrix} 0 & \varphi_{iA} & \varphi_{iU} \\ 0 & 0 & \varphi_{AU} \\ 0 & 0 & 0 \end{vmatrix} \begin{vmatrix} S^N_i \varepsilon^2_{i,t} \\ S^N_A \varepsilon^2_{A,t} \\ S^N_U \varepsilon^2_{U,t-1} \end{vmatrix} \end{aligned} \tag{5.38}$$

with S^N as a dummy variable that is equal to one if the innovation is positive or zero otherwise. If $S^N > 0$, positive innovations will generate more volatility than negative shocks will do. If $S^N < 0$, negative shocks will generate more volatility compared to positive innovations. Otherwise, both positive and negative shocks have the same impact on volatility. ς_{iU} and ς_{iA} capture world and regional volatility spillover effects,

[38] See Campbell and Hentschel (1992), Bekaert and Wu (1997) and Bekaert et al (2005).

respectively. The GARCH model is estimated through maximum likelihood estimation of the log likelihood function:

$$L(\theta) = -(\frac{T}{2})\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}(\ln|\sigma_t| + \varepsilon_t'\sigma_t^{-1}\varepsilon_t) \qquad (5.39)$$

where σ_t refers to the time varying conditional variance-covariance matrix. T is the number of observations and θ the parameter vector to be calculated. We obtain initial values through the Simplex algorithm, and then estimate parameters through the BFGS (acronym for Broyden, Fletcher, Goldfarb and Shanno) algorithm[39].

5.3.1.3 Specification tests

If the CAPM-TGARCH model appropriately captures the data generating process, orthogonal conditions should hold as follows:

$$E(\varepsilon_{k,t}\varepsilon_{l,t}|\Omega_{t-1}) = 0, \quad \text{k, l = i, A, U,} \quad \forall k \neq l \qquad (5.40)$$

Equation 5.50 indicates that the idiosyncratic shocks of the local, regional and US markets are independent. If the unexpected share $\mu_{i,t}$ of the returns in market i is fully explained by international and regional shocks, the idiosyncratic innovations $\varepsilon_{i,t}$ are not only independent from international and regional shocks, but independent from shocks in other local markets n as well.

$$E(\varepsilon_{i,t}\varepsilon_{n,t}|\Omega_{t-1}) = 0, \quad \forall i \neq n \qquad (5.41)$$

These specification tests are really important because if the innovations are not independent, the integration measures γ_{t-1} may be biased. If these conditions are met, the conditional variance of $\mu_{i,t}$ and its conditional covariances for the local market i with international and regional shocks may be estimated as follows:

[39] See Estima, Rats version 6, User's Guide, Chapter 7: Non-linear estimation.

$$E(\mu_{i,t}^2 \mid \Omega_{t-1}) = \sigma_i^2 = \gamma_{iA,t-1}^2 \sigma_{A,t}^2 + \gamma_{iU,t-1}^2 \sigma_{U,t}^2 + \sigma_{\eta,i,t}^2 \quad (5.42)$$

$$E(\mu_{i,t}\mu_{k,t} \mid \Omega_{t-1}) = \sigma_{ik,t} = \gamma_{ik,t-1}\sigma_{k,t}^2, \quad \text{k = A, U} \quad (5.43)$$

These equations allow us to calculate the extent to which international and regional factors may affect the local return variance:

$$VR_{iA,t} = \frac{\gamma_{iA,t-1}^2 \sigma_{A,t}^2}{\sigma_{i,t}^2} \in [0,1] \quad (5.44)$$

$$VR_{iU,t} = \frac{\gamma_{iU,t-1}^2 \sigma_{U,t}^2}{\sigma_{i,t}^2} \in [0,1] \quad (5.45)$$

5.3.1.4 Estimation procedures

The above section has explained the CAPM-TGARCH in details. This section is going to describe how this model is applied to produce a comprehensive view of equity market integration in ASEAN. The estimation procedures include 10 steps as follows:

- Step 1: Dividing the whole data sample (from the 2nd January 1991 to the 27th December 2006) into three sub-periods: period 1 from the 2nd January 1991 to the 25th June 1997, period 2 from the 2nd July 1997 to the 27th December 2000, period 3 from the 3rd January 2001 to the 27th December 2006. As described in sub-section 5.3.3.1, all data are weekly national index returns. Dividing the data sample in this way helps investigate the effects of the 1997 financial crisis and structural changes on the state of equity market integration in ASEAN.
- Step 2: estimating the CAPM-TGARCH in the case that the indicator of market integration is constant. That means we exclude equations 5.36 and 5.37 when estimating this model.
- Step 3: analysing and evaluating the degree of regional and international integration based on the coefficients γ_{iA} and γ_{iU}, respectively. We expect a growing degree of

regional integration over time and the ASEAN markets tend to be integrated within the region rather than with the world.

- Step 4: analysing and evaluating the degree of market efficiency in the ASEAN markets based on the coefficients β_{ii}, β_{iA} and β_{iU}. If β_{ii}, β_{iA} and β_{iU} are simultaneously equal to zero, the market i is fully efficient. Actually, we consider that the equity markets in ASEAN are quite far from fully efficient.
- Step 5: analysing and evaluating the factors which directly impact conditional volatilities in the ASEAN equity markets, especially the volatility spillover effects from the US and region (see equation system 5.38). We also pay attention to asymmetric effects of positive and negative shocks on volatilities.
- Step 6: estimating the CAPM-TGARCH in the case that the indicator of market integration is time-varying. Following Bekaert et al (2005), we assume that the degree of market integration is varied in relation to the volume of export and import trading (see equations 5.36 and 5.37).
- Step 7: graphically analysing and evaluating the status of international and regional integration over time. Additionally, we calculate the average of integration degree in the time-varying model and compare to that in the constant model (step 3).
- Step 8: further investigating patterns in regional and global integration by examining how the estimated gammas change over specified periods. Following Bekaert et al (2005), we consider four periods: 1) the second half of the sample, 2) the Asian crisis period, 3) periods of abnormally negative US unexpected returns, and 4) periods of abnormally negative regional unexpected returns. "Abnormal" is defined as more than one standard deviation below zero. Simply, we regress estimated gammas on a constant and on a dummy variable that takes a value of one during these designated periods.
- Step 9: estimating time-varying variance ratio decompositions (see equations 5.44 and 5.45) to explore how much of the local return variance is explained by regional and world factors.
- Step 10: conducting specification tests to see whether the CAPM-GARCH model appropriately capture the data generating process.

5.3.2 Asymetric Dynamic Conditional Correlations

5.3.2.1 Methodology selection

This dissertation is going to apply Asymmetric Dynamic Conditional Correlation Multivariate GARCH model (ADCC-MVGARCH) in order to explore dynamic linkages among the US, Japanese and ASEAN-5 equity markets. Before introducing the ADCC-MVGARCH model in sub-section 5.3.2.2, we would like to summarise multivariate GARCH (MVGARCH) models and highlight the problems with these models, which had led to the development of ADCC-MVGARCH.

Bollerslev et al (1988) presented the VEC model, a common framework for multivariate volatility models. Given k as the number of underlying time series, the model requires $O(k^4)$ parameters to be calculated by maximum likelihood. A simpler model, the diagonal VECH, was also introduced to reduce the number of parameters to $O(k^2)$. However, ensuring the positive definiteness of the conditional covariance is very difficult when k increases to even a moderate size.

Bollerslev (1990) proposed the constant conditional correlation MVGARCH (CCC-MVGARCH) model. The constant correlation assumption makes estimating a large model feasible and ensures that the positive definiteness of the estimator. This model, however, does not construct consistent standard errors using the multi-stage estimation process. Moreover, Tsui and Yu (1999) pointed out the unreasonable assumption of constant correlation for several certain types of assets.

Engle and Kroner (1995) provided the BEKK (acronym for Baba, Engle, Kraft and Kroner) model to eliminate the problem of positive definiteness of the conditional covariance. However, the full BEKK model requires $O(k^4)$ parameters to be calculated and the individual coefficients is difficult to be interpreted exactly.

Alexander (2000) introduced the factor MVGARCH (F-MVGARCH) model to estimate large covariance matrices. The F-MVGARCH model uses univariate GARCH to estimate dynamic covariance matrices. This method helps reduce the number of estimated parameters to $O(k)$. Nevertheless, It faces troubles in interpreting the coefficients on the

univariate GARCH models and the poor performance in the case of less correlated systems.

Engle (2002) provided Dynamic Conditional Correlation MVGARCH (DCC-MVGARCH). This approach not only relaxes Bollerslev's constant correlation assumption, but also reduces the number of estimated parameters to $O(k)$, a noticeable improvement compared to the VECH and BEKK models. Cappiello et al (2004) extended this model to the ADCC-MVGARCH model to take into account the asymmetric effects of news on conditional second moments. In fact, Campbell and Hentschel (1992), Bekaert and Wu (1997) and Bekaert et al (2003) agree that negative shocks are more strongly transmitted than positive ones.

For the purpose of investigating dynamic linkages over the US, Japanese and ASEAN-5 markets, we apply the ADCC-MVGARCG proposed by Cappiello et al (2004). Furthermore, we visually examine the affects of negative and positive innovations on conditional volatilities and correlations occurring in these equity markets through the *news impact curves* (Engle and Ng, 1993) and *news impact surfaces* (Cappiello et al, 2004).

5.3.2.2 ADCC-MVGARCH model

The ADCC-MVGARCH model estimates the conditional covariance matrix H_t in two stages. First, univariate volatility models are applied to obtain $h_{i,t}$. Second, standardised residuals derived from the first stage are taken to measure the parameters of the conditional correlation. Particularly, we model dynamics between equity markets as follows:

$$r_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i r_{i,t-1} + \varepsilon_t \qquad (5.46)$$

The market (r_t) is a function of own past returns and cross-market past returns ($r_{i,t-1}$). α_i captures the lead-lag relationship between returns in different markets. ε_t is the

innovation for each market at time t with $\varepsilon_t | I_{t-1} \sim N(0, H_t)$. H_t can be decomposed as follows:

$$H_t = D_t R_t D_t \tag{5.47}$$

where D_t is the $k \times k$ diagonal matrix of time-varying standard deviations from univariate GARCH models with $h_{i,t}$ on the i^{th} diagonal and R_t is the time-varying correlation matrix.

The univariate volatility models will follow the Glosten, Jaganathan and Runkle (1993) GARCH model (GJR-GARCH) to capture asymmetries in volatilities:

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \gamma I[\varepsilon_{t-1} > 0] \varepsilon_{t-1}^2 + \beta h_{t-1} \tag{5.48}$$

γ detects asymmetries in volatilities. Particularly, if $\gamma > 0$, positive innovations seem to generate more volatility than negative shocks do. If $\gamma < 0$, negative shocks seem to generate more volatility compared to positive innovations. Otherwise, both positive and negative shocks have the same impact on volatility. The standardised residuals, $e_{i,t} = \varepsilon_{i,t} / \sqrt{h_{i,t}}$, are applied to measure conditional correlations (Engle 2002) as follows:

$$Q_t = (1 - a - b)\overline{Q} + a e_{t-1} e'_{t-1} + b Q_{t-1} \tag{5.49}$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \tag{5.50}$$

where $\overline{Q} = E[e_t e'_t]$ and where a and b are scalars. However, because this approach can neither explain parameters of news impacts nor asymmetries, Sheppard (2002) modifies the equation 5.50 as follows:

$$Q_t = (\overline{Q} - A'\overline{Q}A - B'\overline{Q}B - G'\overline{N}G) + A' e_{t-1} e'_{t-1} A + B' Q_{t-1} B + G' n_{t-1} n'_{t-1} G \tag{5.51}$$

where A, B, and G are diagonal parameter matrices, $n_t = I(e_t > 0) \circ e_t$ (with o indicating the Hadamard product), $\overline{N} = E[n_t n'_t]$. Because expectations are impossible, $\overline{Q}$ and $\overline{N}$

are approximately estimated as $T^{-1}\sum_{t=1}^{T} e_t e_t'$ and $T^{-1}\sum_{t=1}^{T} n_t n_t'$, respectively. $Q_t^* = [q_{ii,t}^*] = [\sqrt{q_{ii,t}}]$ is a diagonal matrix with the square root of the i^{th} diagonal element of Q_t on its i^{th} diagonal position. Q_t^* guarantees that $R_t = Q_t^{*-1} Q_t Q_t^{*-1}$ is a correlation matrix with ones on the diagonal and every other element less than one in absolute value, as long as Q_t is positive definite. R_t is typically in the form $\rho_{ij,t} = q_{ij,t} / \sqrt{q_{ii,t} q_{jj,t}}$.

5.3.2.3 News impact curves and surfaces

Engle and Ng (1993) suggested an interesting metric by which to analyse the effects of news on conditional heteroskedasticity. Holding constant the information dated *t-2* and earlier, we can examine the implied relation between ε_{t-1} and h_t. Engle and Ng (1993) call this curve, with all lagged conditional variances evaluated at the level of the unconditional variance of the stock return, the ***News Impact Curve*** because it relates past return shocks (news) to current volatility. This curve measures how new information is incorporated into volatility estimates.

The News Impact Curve for the GJR-GARCH model when the lagged conditional variance is evaluated at its unconditional level, σ^2, is given by

$$h_t = A + (\alpha + \gamma)\varepsilon_{t-1}^2, \text{ for } \varepsilon_{t-1} > 0 \qquad (5.52)$$

$$h_t = A + \alpha\varepsilon_{t-1}^2, \qquad \text{otherwise} \qquad (5.53)$$

where $A \equiv \omega + \beta\sigma^2$, σ is the unconditional return standard deviation, ω is the constant term, β is the parameter for the h_{t-1} term, α is the parameter for the ε_{t-1}^2 term and γ is the parameter for the $I[\varepsilon_{t-1} > 0]\varepsilon_{t-1}^2$

Kroner and Ng (1998) introduced a multivariate generalisation of the graphical news impact curve from Engle and Ng (1993). The multivariate generalisation plots the conditional correlation and covariance against shocks from the last period. They call these

"***News Impact Surfaces***". The correlation news impact surface for the ADCC-MVGARCH model is given by

$$f(e_1, e_2) \approx \tilde{c}_{ij} + (a_i a_j + g_i g_j) e_i e_j, \text{ for } e_1, e_2 > 0 \qquad (5.54)$$

$$f(e_1, e_2) \approx \tilde{c}_{ij} + a_i a_j e_i e_j, \qquad \text{otherwise} \qquad (5.55)$$

In particular, the correlation news impact surfaces are 3D-graphs describing the way joint news from different markets affect their correlation. Several theories have documented the asymmetry in volatilities (Campbell and Hentschel 1992), but no consistent theory has explained the asymmetry in correlations because of the sophistication of modeling joint news between markets. There are three forms of joint news: 1) positive (good) news and positive news, 2) positive news and negative (bad) news, and 3) negative news and negative news. What we would like to explore is to capture the asymmetric effects on correlations following different forms of joint news.

5.3.2.4 Specification tests

The robust conditional moment test (Wooldridge, 1990 and 1991) is applied to examine whether the specifications estimated appropriately capture the data dynamics. The test is used to detect whether moment conditions, $x_{g,t-1}$, can predict the generalised residual series. The generalised residual is constructed as $u_t = \varepsilon_{i,t}^2 - h_{i,t}$, which is expected to be zero. The test statistic is calculated as follows:

$$C = \left[(1/T) \sum_{t=1}^{T} u_t \lambda_{g,t-1} \right]^2 \left[(1/T) \sum_{t=1}^{T} u_t^2 \lambda_{g,t-1}^2 \right]^{-1} \qquad (5.56)$$

$\lambda_{g,t-1}$ is the residual from a regression of the moment conditions on the scores of the likelihood. C is asymptotically distributed $\chi_{(1)}$. Practically, the test statistic can be calculated in two steps. First, we regress moment conditions on the scores of the estimated model (the expected gradient of the generalised residuals with respect to the parameters. Second, we regress vector of ones on the product of the generalised residuals and the residuals from the first step. The moment conditions can be any function of any variable in the conditioning set. However, in order to keep the analysis tractable, we focus

on a few types of potential misspecification. The first and simplest is whether the sign of a lagged return can predict future volatility. In other word, $x_{i,t-1} = I[\varepsilon_{t-1} < 0]$ is a binary variable that indicates whether the past return was negative. Analogously, we can construct variables which measure a positive impact, or whether the signed magnitude of a past innovation can predict future volatility. Following Cappiello et al (2004), we apply four moment conditions to examine the volatility models:

$$x_{1,t-1} = I[\varepsilon_{t-1} < 0] \tag{5.57}$$

$$x_{2,t-1} = I[\varepsilon_{t-1} > 0] \tag{5.58}$$

$$x_{3,t-1} = \varepsilon_{t-1}^2 I[\varepsilon_{t-1} < 0] \tag{5.59}$$

$$x_{4,t-1} = \varepsilon_{t-1}^2 I[\varepsilon_{t-1} > 0] \tag{5.60}$$

Similar to examining volatility models, we also use the robust conditional moment test to examine correlation models. In this situation, the generalised residual is estimated as $u_{ij,t} = e_{i,t}e_{j,t} - \rho_{ij,t}$, which is expected to be zero. Following Cappiello et al (2004), we apply eight moment conditions to examine the correlation models:

$$x_{5,t-1} = I[e_{i,t-1} < 0]I[e_{j,t-1} < 0] \tag{5.61}$$

$$x_{6,t-1} = I[e_{i,t-1} > 0]I[e_{j,t-1} < 0] \tag{5.62}$$

$$x_{7,t-1} = I[e_{i,t-1} < 0]I[e_{j,t-1} > 0] \tag{5.63}$$

$$x_{8,t-1} = I[e_{i,t-1} > 0]I[e_{j,t-1} > 0] \tag{5.64}$$

$$x_{9,t-1} = e_{i,t-1}e_{j,t-1}I[e_{i,t-1} < 0]I[e_{j,t-1} < 0] \tag{5.65}$$

$$x_{10,t-1} = e_{i,t-1}e_{j,t-1}I[e_{i,t-1} > 0]I[e_{j,t-1} < 0] \tag{5.66}$$

$$x_{11,t-1} = e_{i,t-1}e_{j,t-1}I[e_{i,t-1} < 0]I[e_{j,t-1} > 0] \tag{5.67}$$

$$x_{12,t-1} = e_{i,t-1}e_{j,t-1}I[e_{i,t-1} > 0]I[e_{j,t-1} > 0] \tag{5.68}$$

5.3.2.5 Estimation procedures

We apply the ADCC-MVGARCH model proposed by Cappiello et al (2004) to investigate the time-varying correlation dynamics in the US, Japan and ASEAN-5 markets. Specifically, estimation procedures are as follows:

- Step 1: Using daily data for national indices covering from the 3rd January 1991 to the 29th December 2006. Since the Asian markets have considerably different trading hours with the US market, the returns on day *t* in Asian markets are relevant to the return on day *t-1* in the US market.
- Step 2: Estimating and analysing return spillover affects based on conditional mean equations (see equation 5.46).
- Step 3: Estimating and analysing conditional variances in univariate GJR-GARCH models (see equation 5.48). Especially, we pay attention to the asymmetric effects of shocks on the conditional variances. We expect a negative shock generates more volatility than a positive innovation on the same magnitude.
- Step 4: Using graphs of news impact curves to visually illustrate the asymmetric effects of positive and negative shocks on the conditional covariances (see equations 5.52 and 5.53).
- Step 5: Estimating and graphically analysing conditional correlations over time. We expect higher correlations between the ASEAN markets compared to those with the US and Japanese markets.
- Step 6: Using graphs of news impact surfaces to illustrate and analyse the asymmetric effects of joint shocks on the conditional correlations (see equations 5.54 and 5.55).
- Step 7: applying the robust conditional moment tests to see whether conditional volatility and conditional correlation models may capture the dynamics of data (from equations 5.57 to 5.68). Given seven variables, we will conduct 196 (=7x7x4) conditional moment tests for volatility models and 168 (=21x8) conditional moment tests for correlation models.

5.3.3 Data Collection and Processes

5.3.3.1 Data on equity market integration test

All data on equity market indices are calculated in the U.S. dollar by Datastream and have weekly frequency. There are two main reasons for choosing Datastream indices: first,

they are broader measures of stock market returns since they also include firms with smaller capitalization and therefore provide a more accurate presentation of the whole market. The sample period begins in January 1991 and ends in December 2006. We study six countries: the United States as the world market and five ASEAN countries including Indonesia, Malaysia, Philippines, Singapore and Thailand. The ASEAN market index is a weighted average of ASEAN countries excluding the country under investigation. Particularly, we compute the ASEAN market index, $R_{ASEAN/i,t}$, as

$$R_{ASEAN/i,t} = \frac{\sum_{k \neq i} w_{k,t} R_{k,t}}{\sum_{k \neq i} w_{k,t}}, \tag{5.69}$$

with k indexing the ASEAN markets, except market i and w_k, denoting the market capitalisation of market k. As data of high frequency (daily or intra-daily will contain too much noise while a too wide time grid (monthly or quarterly) will not capture the information content of changes in market return rates, so weekly data represents a balance between information and noise. Following Phylaktis and Xia (2007), our weekly returns are Wednesday-to-Wednesday returns. However, due to the differences in trading times, the stock return of US is on Tuesday-to-Tuesday basis. The continuous compounded returns to each index are calculated using

$$R_{k,t} = 100 \times \ln\left(\frac{P_{k,t}}{P_{k,t-1}}\right) \tag{5.70}$$

for k = the U.S., Indonesia, Malaysia, Philippines, Singapore and Thailand markets. All weekly excess returns are calculated in excess of the weekly risk-free rate and expressed in US dollars. Normally, the US one-month Treasury-bill rate is considered as the risk-free rate (see Bekaert et al 2005, Phylaktis and Xia 2007 and Asgharian and Karlsson 2006). However, this rate is dead during the period of 1996 to 2001. Thus, three-month Treasury-bill rate is used as the risk-free rate for this period. It is evident that these two rates have the correlation of 0.98 with each other approximately.

Table 5.2: Data specifications and sources

Variable description	Time period	Data frequency	Data source	Source code
World dividend yield	01/01/1991-26/12/2006	Weekly	Datastream	TOTMKWD
ASEAN dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMKSE(DY)
Indonesia dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMID$(DY)
Malaysia dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMMY$(DY)
Philippines dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMPH$(DY)
Singapore dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMSG$(DY)
Thailand dividend yield	02/01/1991-27/12/2006	Weekly	Datastream	TOTMTL$(DY)
US one-month Treasury-bill rate	01/01/1991-20/05/1996	Weekly	Datastream	USTBL1M
US one-month Treasury-bill rate	01/08/2001-26/12/2006		Datastream	FRTBS4W
US three-month Treasury-bill rate	01/01/1991-26/12/2006	Weekly	Datastream	USTBL3M
90-day Eurodollar rate	01/01/1991-26/12/2006	Weekly	Datastream	ECUSD3M
US 10-year Treasury bond yield	01/01/1991-26/12/2006	Weekly	Datastream	USBD10Y
Indonesia market capitalisation	02/01/1991-27/12/2006	Weekly	Datastream	TOTMID$(MV)
Malaysia market capitalisation	02/01/1991-27/12/2006	Weekly	Datastream	TOTMMY$(MV)
Philippines market capitalisation	02/01/1991-27/12/2006	Weekly	Datastream	TOTMPH$(MV)
Singapore market capitalisation	02/01/1991-27/12/2006	Weekly	Datastream	TOTMSG$(MV)
Thailand market capitalisation	02/01/1991-27/12/2006	Weekly	Datastream	TOTMTL$(MV)
Indonesia stock index	02/01/1991-27/12/2006	Weekly	Datastream	TOTMID$
Malaysia stock index	02/01/1991-27/12/2006	Weekly	Datastream	TOTMMY$
Philippines stock index	02/01/1991-27/12/2006	Weekly	Datastream	TOTMPH$
Singapore stock index	02/01/1991-27/12/2006	Weekly	Datastream	TOTMSG$
Thailand stock index	02/01/1991-27/12/2006	Weekly	Datastream	TOTMTL$
US stock index	01/01/1991-26/12/2006	Weekly	Datastream	TOTMKUS
Indonesia exports to Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0MYA
Indonesia exports to Philippines	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0PHA
Indonesia exports to Singapore	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0SPA
Indonesia exports to Thailand	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0THA
Indonesia exports to the US	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0USA
Indonesia exports to the World	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D0WDA
Malaysia exports to Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0IDA
Malaysia exports to Philippines	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0PHA
Malaysia exports to Singapore	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0SPA
Malaysia exports to Thailand	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0THA
Malaysia exports to the US	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0USA
Malaysia exports to the World	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D0WDA
Philippines exports to Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0IDA
Philippines exports to Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0MYA
Philippines exports to Singapore	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0SPA
Philippines exports to Thailand	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0THA
Philippines exports to the US	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0USA
Philippines exports to the World	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D0WDA
Singapore exports to Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D0MYA
Singapore exports to Philippines	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D0PHA
Singapore exports to Thailand	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D0THA
Singapore exports to the US	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D0USA
Singapore exports to the World	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D0WDA
Thailand exports to Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0IDA
Thailand exports to Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0MYA
Thailand exports to Philippines	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0PHA
Thailand exports to Singapore	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0SPA
Thailand exports to the US	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0USA
Thailand exports to the World	15/07/1990-15/06/2006	Monthly	Datastream	THI7D0WDA
Indonesia imports from Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1MYA
Indonesia imports from Philippines	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1PHA
Indonesia imports from Singapore	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1SPA
Indonesia imports from Thailand	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1THA
Indonesia imports from the US	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1USA
Indonesia imports from the World	15/07/1990-15/06/2006	Monthly	Datastream	IDI7D1WDA
Malaysia imports from Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1IDA

Malaysia imports from Philippines	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1PHA
Malaysia imports from Singapore	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1SPA
Malaysia imports from Thailand	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1THA
Malaysia imports from the US	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1USA
Malaysia imports from the World	15/07/1990-15/06/2006	Monthly	Datastream	MYI7D1WDA
Philippines imports from Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1IDA
Philippines imports from Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1MYA
Philippines imports from Singapore	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1SPA
Philippines imports from Thailand	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1THA
Philippines imports from the US	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1USA
Philippines imports from the World	15/07/1990-15/06/2006	Monthly	Datastream	PHI7D1WDA
Singapore imports from Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D1MYA
Singapore imports from Philippines	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D1PHA
Singapore imports from Thailand	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D1THA
Singapore imports from the US	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D1USA
Singapore imports from the World	15/07/1990-15/06/2006	Monthly	Datastream	SPI7D1WDA
Thailand imports from Indonesia	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1IDA
Thailand imports from Malaysia	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1MYA
Thailand imports from Philippines	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1PHA
Thailand imports from Singapore	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1SPA
Thailand imports from the US	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1USA
Thailand imports from the World	15/07/1990-15/06/2006	Monthly	Datastream	THI7D1WDA

Following Bekaert and Harvey (1995, 1997) and Ng (2000) and Bekaert et al (2005), we model time-varying market integration parameters on the basis of trade variables. The world (or the region) trade variable captures the covariance risk of market *i* with the US (or the region), being equal to the sum of exports to and imports from the US (or the region) divided by the sum of total exports and total imports in market *i*. Chen and Zhang (1997) study the relation between cross-market return correlation and bilateral trade and find that countries with heavier external trade to a region tend to have higher return correlations with that region. All the trade variables are monthly data, collected from Datastream and lagged by 6 months. Finally, as described in Table 5.2, the other data including dividend yields (world, regional and local yields), 90-day Eurodollar rate, 3-month Treasury-bill yield and US 10-year Treasury bond yield are also collected from Datastream.

5.3.3.2 Data on asymmetric dynamic conditional correlation test

All data are daily returns estimated from daily country index prices which are collected from Data Stream. Particularly, the continuous compounded returns to each index are calculated using

$$R_{k,t} = 100 \times \ln\left(\frac{P_{k,t}}{P_{k,t-1}}\right) \tag{5.71}$$

The main reason daily data are employed instead of weekly data is that we will apply Multivariate GARCH models (seven variables) which require a lot of observations in order to estimate dynamic linkages of stock markets. Besides, compared to weekly or longer frequency data, daily stock data may generate better analyses of how news can affect a market and can be transmitted from one market to another (Savva et al, 2005). Daily data for national indices cover from 03/01/1991 to 29/12/2006. Since the Asian markets have considerably different trading hours with the US market, the returns on day *t* in Asian markets are relevant to the return on day *t-1* in the US market.

Table 5.3: Data specifications and sources

Variable description	Time period	Data frequency	Data source	Source code
US national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMKUS
Indonesia national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMID$
Japan national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMJP$
Malaysia national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMMY$
Philippines national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMPH$
Singapore national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMSG$
Thailand national index	03/01/1991-29/12/2006	Daily	Datastream	TOTMTH$

5.4 CONCLUSIONS

This chapter has shown a consistent framework of measuring financial integration of ASEAN-5 markets. The research methods focus on two main financial markets: credit markets and equity markets. These methods are selected on the basis of three main principles: (1) addressing to research questions presented in Chapter I; (2) capturing the data characteristics; and (3) overcoming the limitations of empirical methods discussed in Chapter IV as much as possible.

With respect to the credit markets, the Johansen cointegration tests are used to investigate the state of integration. The Johansen cointegration test is an increasingly popular approach relaxing impractical assumptions of interest rate parity conditions. Besides, it allows to test the state of integration in a system of many variables without much of data

required in comparison with GARCH or other sophisticated approaches. We also use unrestricted VAR, G-IFR and G-VDC techniques to explore short-run dynamics within the region and with the world. The unrestricted VAR is useful in the case of weak cointegration in a group of variables. The G-IRF and G-VDC proposed by Pesaran and Shin (1998) overcome the disadvantage of the traditional IRF and VDC and allow the results to be invariant to any ordering of the variables.

With respect to the equity markets, CAPM-TGARCH (Fratzscher, 2001) is applied to estimate the degree of integration. The CAPM-TGARCH extends the traditional CAPM to two-factor model allowing individual markets to be priced by the US market and the regional market. Compared to other approaches, this model will give more clear answers of the integration direction and better fit high frequency and heteroskedasticity data. Time-varying dynamics between equity markets are also examined by using ADCC-MVGARCH (Cappiello et al, 2003). This approach appears to be a considerable improvement compared to other GARCH models, such as VECH, DCC or BEKK. Additionally, this approach also considers the asymmetric effects on conditional second moments. News impact curves and surfaces are used to visualise these effects on conditional volatilities and correlations.

The markets considered in this dissertation are Singapore, Thailand, Indonesia, Malaysia and the Philippines. The US and Japan are considered the world and regional markets, respectively. We exclude other ASEAN markets, such as Brunei Darussalam, Cambodia, Laos, Myanmar and Vietnam, because they do not have sufficient data required for empirical analysis. Their exclusion should not mean that they are unimportant, or that insights gained in this dissertation are not applicable to them. Generally, the research methods presented in this chapter try to answer whether the ASEAN-5 financial markets are being integrated globally or regionally and how strong they are linked together over time. Next chapter will report, analyse and discuss empirical results of credit market integration in details.

CHAPTER VI

ASEAN-5 CREDIT MARKET INTEGRATION: EMPIRICAL TESTS AND RESULTS

6.1 INTRODUCTION

Chapter VI aims to answer the first research question: *"How had the degrees of international and regional integration in ASEAN-5 credit markets changed over the period January 1983 to August 2006?"* (see section 1.2.1). Particularly, this chapter reports results of empirical tests on the state of long-term integration and short-term linkages in the ASEAN credit markets including: Singapore, Thailand, Indonesia, Malaysia and the Philippines. The US and Japanese rates are considered the global and regional rates, respectively.

As discussed in Chapter V, empirical tests of financial integration are conducted on the basis of Johansen's multivariate cointegration techniques. Johansen's cointegration approach is an advance econometric technique which is very popular and strong in investigating the existence of cointegrating vectors. Besides, in line with Nieh and Yau (2004), an unrestricted VAR model is employed to examine short-run linkages in this area (see sub-section 5.2.2.1). In order to conquer the difficulty of interpreting the estimated coefficients in the VAR model, generalised impulse response function (G-IRF) forecasts are also utilised. Improving the weakness of the orthogonalised IRF, the G-IRF proposed by Pesaran and Shin (1998) generate consistent results to any ordering of the variables.

Real short-term money market rates are used for empirical tests because long-term interest rates, such as government bond yields, are unavailable for most of the ASEAN economies. Moreover, although the money market rate is only a relatively small set of the menu of financial instruments available, tests of integration may reveal a considerable amount of information about the integration of traded assets overall. Data are monthly observations from January 1983 to May 2006, which comprises 281 observations.

The remainder of this chapter is organized as follows. Section 6.2 presents primary results of variable behaviours based on descriptive statistics. Next, section 6.3 reports, analyses and discusses empirical results. Finally, conclusions are offered in section 6.4

6.2 DESCRIPTIVE STATISTICS

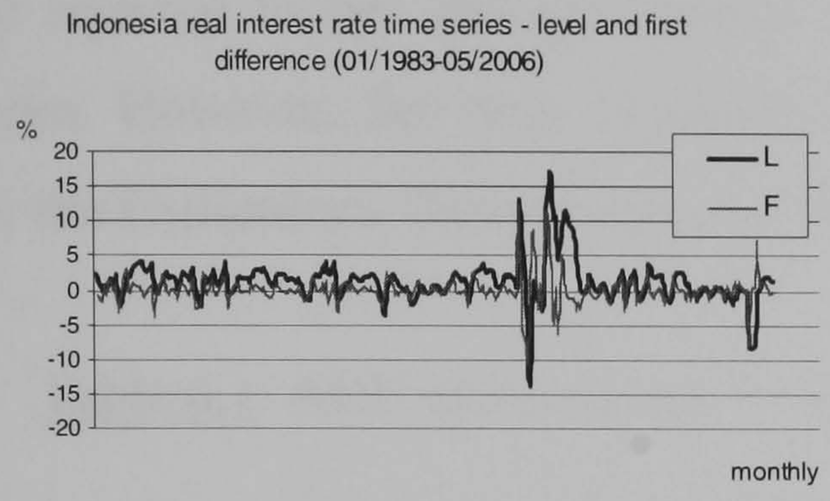
6.2.1 Integration Properties of Data

The objective of this section is to determine the univariate integration properties of real interest rates over time. A time series variable has the property of stationarity when it possesses a finite mean, variance and autocovariance function that are all independent of time. Analogously, a non-stationary series possesses a time dependent mean or autocovariance function. A stochastic time series is said to be integrated of order d if the series requires differencing d times in order to achieve stationarity (Engle and Granger 1987). Thus, the time series X_t is said to be integrated of order one, denoted $X_t \sim I(1)$, if its level series X_t is non-stationary but its first-differenced series ΔX_t is stationary, that is , $\Delta X_t \sim I(0)$. This section will provide first a graphical description of the data and then give a concise test of integration properties of data using the Augmented Dickey-Fuller (1981) unit root test as described in 5.2.

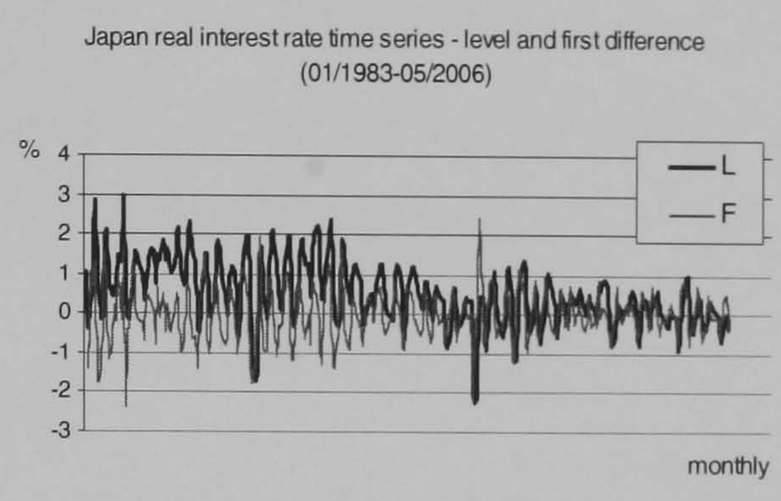
The first and simplest type of test one can apply to check for stationarity is to actually plot the time series and look for evidence of trend in mean, variance, autocorrelation and seasonality. If any such patterns are present then these are signs of non-stationarity and different mechanisms exist to turn the series into a stationary one. As plotted in Figure 6.1, the level of real interest rates of Japan, Malaysia, Singapore, Thailand, the Philippines and the US exhibit different fluctuations of variance and autocorrelation, which are the signs of non-stationarity. However, this is not clear in the case of Indonesia. For Indonesia, the real interest rate seems to have stable mean, variance and autocorrelation through the whole sample except the period of 08/1997-04/1999, the Asian financial crisis, in which the variance is much larger than other periods. In contrast to the level series, the graphs of the first differenced series all fluctuate about zero displaying both a constant finite mean and variance that are independent of time.

Therefore, the first difference of all time series seem to be stationary, which means I(1) for Japan, Malaysia, Singapore, Thailand, the Philippines and the US. Further tests need to be conducted to decide the integration order of Indonesia.

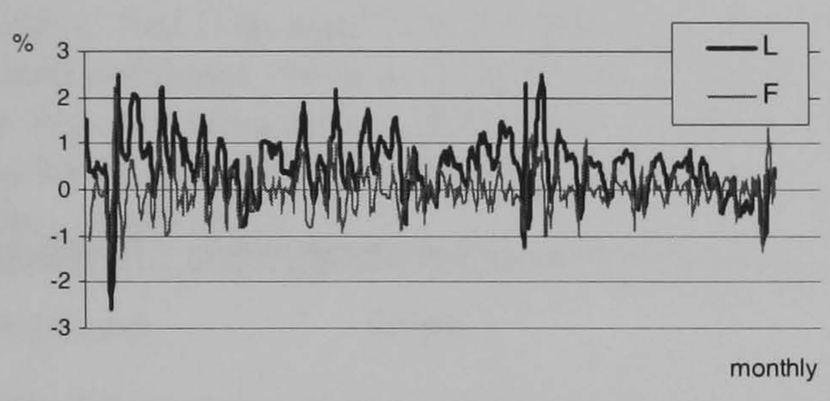
Figure 6.1: The level and first difference of real interest rates (January 1983-May 2006)



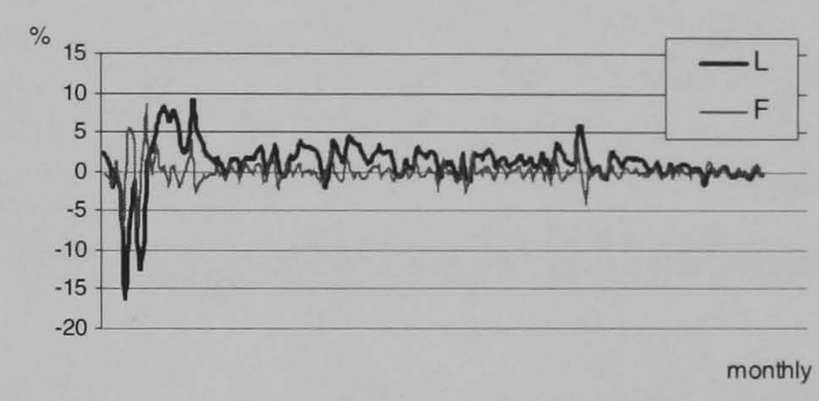
Indonesia real interest rate time series - level and first difference (01/1983-05/2006)



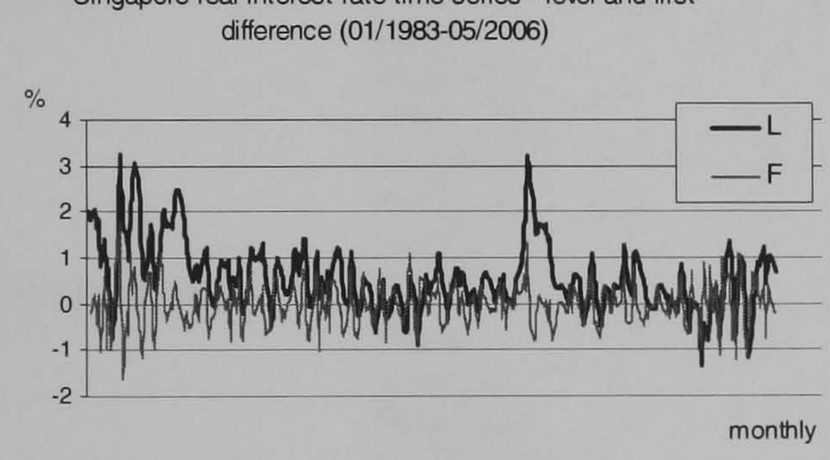
Japan real interest rate time series - level and first difference (01/1983-05/2006)



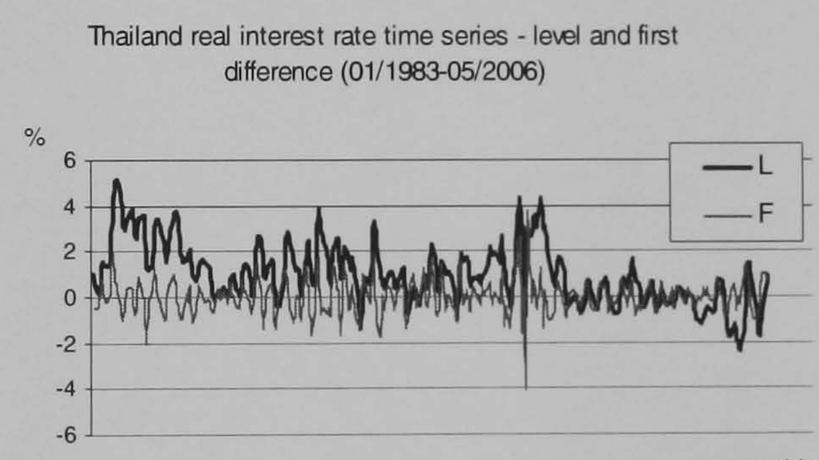
Malaysia real interest rate time series - level and first difference (01/1983-05/2006)



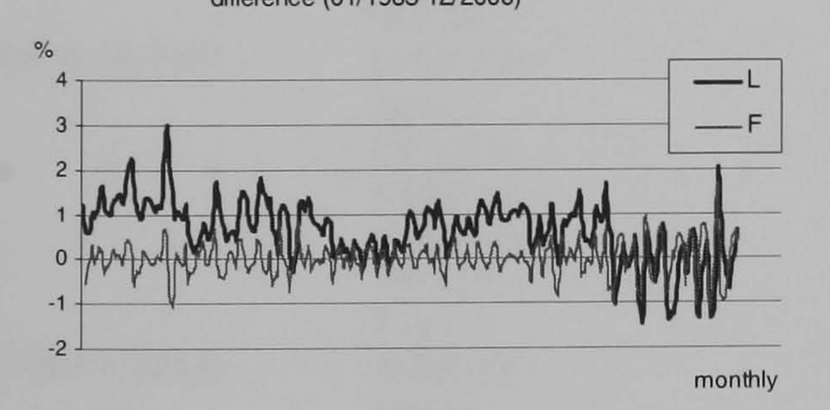
Philippines real interest rate time series - level and first difference (01/1983-05/2006)



Singapore real interest rate time series - level and first difference (01/1983-05/2006)



Thailand real interest rate time series - level and first difference (01/1983-05/2006)



The U.S real interest rate time series - level and first difference (01/1983-12/2006)

Note: "L" letter implies the level of real interest rates and "F" refers to the first difference

.

While the stationarity test described above makes use of subjective visual inspection of plots, a more formal statistical test, the augmented Dickey-Fuller (ADF) unit root test, is developed to help with determining stationarity (see section 5.2.1 for more description). Hamilton (1994) and Elder and Kennedy (2001) both argue that a strategy is necessary to determine which of the three ADF models should be employed in conducting the unit root test. In this study, we follow the determining rule of Doldado et al (1990) to determine the

appropriate model for each rate. Moreover, since the estimation might be biased if the lag length is pre-designated without rigorous determination, we adopt Modified Akaike's information criterion (MAIC) suggested by Ng and Perron (2001) to select the optimal number of lags based. Table 6.1 presents the results of the ADF tests, which show that the rates of Japan, Malaysia, Singapore, Thailand and the US have unit-roots in the level and are rejected to be "non-stationary" in the first differences, which insure an I(1) type series. However, the rates of Indonesia and Philippines are both I(0). Generally, except for the Philippines, these results are consistent with the plots' illustration.

Table 6.1: ADF unit root tests of real interest rates

We follow the determining rule of Doldado, Jenkinson, and Sosvilla-Rivero (DJS) (1990) to determine the appropriate model for each rate. Particularly, the determining rule by DJS (1990) is to test for the significance of trend coefficient in model C first (Equation 5.3), followed by testing for the significance of the drift coefficient in model B (Equation 5.2). If both outcomes result in insignificant, model A (Equation 5.1) is selected. The critical values for the ADF t statistics are from the Mackinnon (1991) table. The numbers within the brackets are the appropriate lag lengths for each interest rate based on Modified AIC suggested by Ng and Perro (2001). ** and *** indicate significance at the 5% and 1% levels, respectively.

Time period	Country	ADF unit root tests			
		Level		First difference	
		Model	Statistic values	Model	Statistic values
01/1983-05/2006	Indonesia	B	-4.91*** (3)	A	-13.48*** (0)
	Japan	C	-2.73 (10)	A	-13.48*** (0)
	Malaysia	C	-3.38 (15)	A	-14.77***(0)
	Philippines	A	-3.17*** (14)	A	-11.21*** (0)
	Singapore	A	-1.94 (15)	A	-17.85*** (0)
	Thailand	C	-2.79 (10)	A	-15.98*** (0)
	The US	C	-2.70 (11)	A	-11.34*** (0)
01/1983-12/1989	Indonesia	B	2.777 (6)	A	8.177*** (0)
	Japan	C	-1.797 (10)	A	-7.760*** (0)
	Malaysia	B	-2.098 (6)	A	-7.191*** (0)
	Philippines	A	-1.978** (4)	A	-5.417*** (0)
	Singapore	A	-0.750 (9)	A	-9.096*** (0)
	Thailand	C	-3.327 (6)	A	-6.216*** (0)
	The US	B	2.622 (3)	A	-5.743*** (0)
01/1990-06/1997	Indonesia	A	-0.94 (10)	A	-6.925*** (0)
	Japan	C	-2.254 (6)	A	-7.065*** (0)
	Malaysia	A	-0.102 (11)	A	-5.920*** (1)
	Philippines	B	-1.990 (9)	A	-6.976*** (0)
	Singapore	A	-1.922 (9)	A	-10.538*** (0)
	Thailand	B	-2.12 (10)	A	-9.044*** (0)
	The US	A	-0.209 (9)	A	-7.131*** (0)
07/1997-12/2000	Indonesia	B	-1.939 (8)	A	-5.378*** (0)
	Japan	A	-0.422 (9)	A	-4.304*** (0
	Malaysia	A	-0.517 (9)	A	-3.510*** (1)
	Philippines	B	-2.954 (0)	A	-3.929*** (1)
	Singapore	A	-1.242 (0)	A	-5.250*** (0)
	Thailand	A	-1.510 (3)	A	-5.438*** (1)
	The US	A	-0.574 (9)	A	-4.643*** (0)
01/2001-05/2006	Indonesia	A	-0.964 (9)	A	-5.418*** (1)
	Japan	C	-2.779 (6)	A	-7.034***(0)
	Malaysia	A	-1.088 (9)	A	-5.370*** (1)
	Philippines	A	-1.948 (3)	A	-6.543*** (0)
	Singapore	A	-1.432 (4)	A	-9.752*** (0)
	Thailand	A	-1.201 (9)	A	-5.092*** (0)
	The US	C	-1.669 (11)	A	-5.059*** (0)

6.2.2 Statistical analysis

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures, such as the number of observations, the central tendency and the dispersion. The mean (or average) and standard deviation are probably the most commonly used methods of describing central tendency and dispersion, respectively. Table 6.3 presents some basic descriptive statistics of the real interest rate of each country though 01/1983-05/2006. Additionally, the Table also shows the average of nominal rates and inflation rates under considered periods in order to explain more about the changes in real rates. It is noted that all rates are three-month rates or simply equal to one-year rates divided by four.

Figure 6.1 and Table 6.2 shows that the behaviours of the US and Thailand real interest rates are quite similar to each other: high in the periods of 1983-1989 and 1997-1998; low in the periods of 1990-1997 and 1998-2000; and negative from 2001. To some extent, the pattern of Singapore real interest rate is also similar to that of the US over the period from January 1983 to December 2000. For other economies, there is little evidence that their real interest rates are connected to that of the US.

For the Japanese real interest rate, the mean of 0.513% is lower than those of the other two developed economies, the US and Singapore, in the sample. Figure 6.1 also shows that the pattern of Japanese real interest rate is quite different from those of the US and other ASEAN economies. In fact, the real interest rate of Japan has been sharply decreasing over time, specifically, from 0.97% in period 1983-1989 to 0.079% in period 2001-2006. Ito (2003) considers that Japan is trapped in a deflationary spiral in which deflationary expectations are combined with the zero nominal interest rate. Deflation can be quite costly and the zero lower bound on nominal interest rates means that the overnight interest rate can no longer be used as the instrument of monetary policy (Ito and Mishkin, 2004).

As presented in Table 6.2 and Figure 6.1, the real interest rate of Singapore has been quite stable, fluctuating around 0.3%, except for the pre-1985 period and the Asian crisis period. Actually, the period 1975-1985 is the first stage of liberalisation process, relaxing interest rate controls in Singapore (Baharumshah et al, 2005). The Singapore interest rate

was positively high during this period to attract more investments from abroad. Regarding the Asian crisis, the real interest rate of Singapore was also high during this period mainly because the Monetary Authority of Singapore managed the exchange rate to lower inflation (Parrado, 2004). In fact, the mean of inflation rate was -0.156% in the period 1997-1998.

Table 6.2: Basic statistics of real interest rates (01/1983 – 05/2006)

Countries	Time period	Observations	Real rates (%)		Mean - Nominal rates (%)	Mean - Inflation rates (%)
			Mean	Standard deviation		
Indonesia	01/1983-05/2006	281	1.315	3.098	3.833	2.559
	01/1983-12/1989	84	1.594	1.390	3.389	2.123
	01/1990-06/1997	90	1.085	1.548	3.109	2.024
	07/1997-12/1998	18	3.020	8.986	14.030	11.045
	07/1997-12/2000	42	3.121	6.503	8.435	5.314
	01/2001-05/2006	65	0.107	2.296	2.432	2.325
Japan	01/1983-05/2006	281	0.513	0.814	0.709	0.284
	01/1983-12/1989	84	0.970	0.849	1.341	0.549
	01/1990-06/1997	90	0.545	0.851	0.899	0.354
	07/1997-12/1998	18	0.204	0.796	0.166	-0.038
	07/1997-12/2000	42	0.202	0.629	0.107	-0.095
	01/2001-05/2006	65	0.079	0.416	0.020	-0.059
Malaysia	01/1983-05/2006	281	0.495	0.670	1.150	0.767
	01/1983-12/1989	84	0.621	0.757	1.091	0.821
	01/1990-06/1997	90	0.663	0.579	1.544	0.881
	07/1997-12/1998	18	0.431	1.007	1.682	1.251
	07/1997-12/2000	42	0.418	0.738	1.177	0.759
	01/2001-05/2006	65	0.149	0.469	0.665	0.517
Philippines	01/1983-05/2006	281	1.201	2.835	3.472	2.305
	01/1983-12/1989	84	1.149	4.765	4.657	3.226
	01/1990-06/1997	90	1.625	1.377	3.856	2.231
	07/1997-12/1998	18	1.405	0.660	3.776	2.371
	07/1997-12/2000	42	1.614	1.462	3.040	1.426
	01/2001-05/2006	65	0.415	0.841	1.690	1.276
Singapore	01/1983-05/2006	281	0.591	0.743	0.919	0.431
	01/1983-12/1989	84	0.774	0.792	1.356	0.582
	01/1990-06/1997	90	0.329	0.473	0.916	0.588
	07/1997-12/1998	18	1.430	0.773	1.274	-0.156
	07/1997-12/2000	42	0.743	0.833	0.875	0.131
	01/2001-05/2006	65	0.259	0.583	0.389	0.130
Thailand	01/1983-05/2006	281	1.003	1.353	1.916	1.039
	01/1983-12/1989	84	1.787	1.289	2.588	1.167
	01/1990-06/1997	90	1.092	0.966	2.368	1.266
	07/1997-12/1998	18	2.405	1.369	3.631	1.226
	07/1997-12/2000	42	1.133	1.509	1.822	0.689
	01/2001-05/2006	65	-0.220	0.868	0.495	0.715
The U.S.	01/1983-05/2006	281	0.637	0.683	2.066	0.896
	01/1983-12/1989	84	1.108	0.527	2.066	1.209
	01/1990-06/1997	90	0.590	0.419	1.350	0.760
	07/1997-12/1998	18	1.026	0.195	1.412	0.386
	07/1997-12/2000	42	0.827	0.372	1.458	0.631
	01/2001-05/2006	65	-0.029	0.759	0.647	0.676

For the Indonesian real interest rate, the mean of 1.315% is the highest one compared to those of other countries over the period from January 1983 to May 2006 (see Table 6.2). This is mainly due to the fact that the mean of Indonesian real interest rate was substantially high during the Asian crisis. Actually, Indonesia adopted a high (nominal) interest rate policy against the fast increase of inflation rate during the Asian crisis (Fane, 2000). As plotted in Figure 6.1, Indonesia confronted with negative real interest rates over the period from November 1997 to June 1998 when hyperinflation (60–70%) occurred because of the sharp currency depreciation and market chaos. Besides, Indonesia shows the highest volatility of real interest rate, particularly, 3.098% on average and, especially, 8.986% over the period from July 1997 to December 1998.

In contrast to Indonesia, Malaysia has the lowest level of real interest rate, 0.495% on average, over the period from January 1983 to May 2006 (see Table 6.2). However, the real interest rate of Malaysia has been quite stable, which can be attributed to Malaysia's traditionally strong fiscal policy, prudent management and efficient supervision (Mills and Wang, 2006). Both Table 6.2 and Figure 6.1 show that the Malaysian real interest rate was fluctuated most in the pre-1985 and Asian crisis periods. The pre-1985 period relates to a brief recession in the early 1980s, mainly due to the slump in commodity prices over the world.

The Filipino real interest rate has kept stable throughout the sample period, particularly, fluctuating around 1.149% in the 1983-1989 period, 1.625% in the 1990-1997 period, 1.614% in the 1997-2000 period and 0.415% in the 2001-2006 period. This has been the case even when the ex-post real rate was extremely volatile, most notably during the mid-1980s (see Figure 6.1) when the country first experienced severe political unrest, with inflation soaring to double digits.

6.2.3 Correlations of real interest rates

In order to get knowledge of the relationship between national real rates, cross-country correlations are estimated in Table 6.3. High correlation would indicate the high level of similarity and linkage between time series of real interest rates. Financial liberalisation efforts in the East Asian countries followed almost the same pattern. Foreign exchange controls, as well as, the ceilings on deposits and lending rates were progressively

removed, though at different times. Singapore (1975) and Malaysia (1978) were among the first countries to liberalise their interest rate controls. In Indonesia and Philippines, interest rates were fully deregulated in the early 1980s. Thailand did not abolish their interest rate ceilings until mid- to late 1980s. In Japan, interest rate deregulation began gradually in 1979 and was only completed in 1994, while its foreign exchange transactions were liberalized in 1980 (Baharumshah et al, 2005). Therefore, we would expect high correlations of the ASEAN real interest rates with each other as well as with the world during the period of January 1983 to May 2006.

Surprisingly, regarding to the relationships between the US and ASEAN, the correlations of real interest rates are weak and unstable except for the group of the US, Singapore and Thailand. Particularly, the correlations between the US and Indonesia were getting closer over the period 1983-1997, but have been divergent since the Asian crisis. For the Philippines and Malaysia, there is no evidence that their real interest rates have been converged to that of the US. Actually, the correlations of -0.40 and -0.30 imply that the Philippines and Malaysia had divergent relationships with the US during the Asian crisis, respectively. In ASEAN, Singapore and, especially, Thailand have increasingly connected to the US over time. In fact, the period 2001-2006 documented the correlations of 0.54 and 0.71 between Singapore's and Thailand's real interest rates with that of the US, respectively.

For the relationships between Japan and ASEAN, similar to the case of the US, the correlations of real interest rates are inconsiderable and unstable except for the group of Japan, Singapore and Thailand. Specifically, Indonesia and Malaysia have reverse linkages with Japan; and the Philippines appear not to be related to Japan for the whole period 1983-2006. However, Singapore and Thailand were positively correlated to Japan over the pre- and post-Asian crisis periods even though the levels of their correlations are much less than those with the US. Japan and the US have been getting closer over time. In fact, the correlations of their real interest rates were 0.08 in period 1990-1997, 0.29 in period 1997-2000 and up to 0.43 in period 2001-2006.

Regarding the relationships within ASEAN, Thailand appears to be the country that has had the most impact on others. For Malaysia, Thailand has taken over the role of Singapore in this country since the Asian crisis. Particularly, the correlation of real

interest rates between Singapore and Malaysia was 0.31 in period 1983-1989 down to 0.27 in period 1990-1009 while that between Thailand and Malaysia was 0.28 in period 1997-2000 up to 0.31 in period 1991-2006. Thailand and Singapore has had a long and strong relationship over the period 1983-2006. Especially, the correlation of their real interest rates was 0.61 during the Asian crisis.

Table 6.3: Cross-country correlations of real interest rates

IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and US, United States.

		IN	JP	MA	PH	SG	TL	US
01/1983-05/2006	IN	1						
	JP	-0.0686	1					
	MA	0.2895	-0.0241	1				
	PH	0.0862	-0.0372	0.3132	1			
	SG	0.0185	0.1926	0.3109	0.1428	1		
	TL	0.1469	0.3682	0.2362	-0.1041	0.4733	1	
	US	0.1347	0.3862	0.1786	0.0357	0.5063	0.6160	1
01/1983-12/1989	IN	1						
	JP	-0.0263	1					
	MA	0.4051	-0.1665	1				
	PH	0.0893	-0.1365	0.4187	1			
	SG	0.2789	0.0554	0.6753	0.2476	1		
	TL	-0.0639	0.2939	-0.0678	-0.3673	0.2547	1	
	US	0.1672	0.3222	0.2322	-0.0205	0.4087	0.4238	1
01/1990-06/1997	IN	1						
	JP	-0.1534	1					
	MA	0.0461	-0.1205	1				
	PH	0.0392	0.0089	0.1269	1			
	SG	-0.0484	0.1749	0.2706	0.0261	1		
	TL	0.1160	0.2615	0.1416	0.0723	0.2857	1	
	US	0.3755	0.0759	-0.1291	-0.1218	0.2187	0.3058	1
07/1997-12/2000	IN	1						
	JP	-0.2035	1					
	MA	0.4443	-0.2910	1				
	PH	0.1088	0.0662	0.0523	1			
	SG	-0.3345	-0.2051	-0.0979	-0.1059	1		
	TL	0.1312	-0.0989	0.2846	-0.0754	0.6122	1	
	US	-0.1341	0.2935	-0.3016	-0.4028	0.2767	0.4257	1
01/2001-05/2006	IN	1						
	JP	-0.2341	1					
	MA	0.3046	-0.0040	1				
	PH	0.2430	0.1049	0.3066	1			
	SG	0.1178	0.2131	-0.1297	0.0894	1		
	TL	-0.0676	0.3651	0.3106	0.1906	0.3992	1	
	US	-0.1569	0.4279	0.1199	0.1309	0.5433	0.7109	1

6.3 EMPIRICAL RESULTS

6.3.1 Global and Regional Integration

6.3.1.1 Global and regional integration: multivariate cointegration tests

This sub-section applies Johansen's multivariate cointegration techniques to estimate the degree of international and regional integration in the ASEAN-5 credit markets. These markets are expected to integrate more within the region than with the world over time. Table 6.4 presents Johansen's multivariate cointegration tests. In order to avoid the over-rejection of Johansen's trace and eigenvalue tests, we employ the adjusted statistics suggested by Reinsel and Ahn (1988), which is strongly advised by Cheung and Lai (1993) and Osterholm (2003). The adjusted statistics by Reinsel and Ahn are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables.

The first considered group is composed of seven countries' real interest rates which are rates of ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore and Thailand), Japan as a regionally dominated rate and the US as a world rate. We find that there are three cointegrating vectors according to the adjusted trace test and two cointegrating vectors according to adjusted maximum eigenvalue test, which reflects long-term linkages of real rates between ASEAN and Japan as long as the world market, but there is still no appearance of full integration. This result is consistent with Phylaktis (1999) and Anoruo et al (2002).

In order to distinguish the role of world rate and Japan rate on ASEAN rates, we consider two more groups: one including the US rate but excluding Japanese rate; and another one including the Japan rate but excluding the US rate. Table 6.4 shows that ASEAN countries have had more cointegrating vectors with the world rate than with the local rate (Japanese one). This implies that the US has been more connected to the ASEAN than Japan has.

Another interesting question is whether there is the existence of full credit market integration within the ASEAN. We further investigate the market integration by looking

at a sample including ASEAN only. The results are very interesting supporting the theory of financial integration in this area. Particularly, when putting aside the US and Japanese rates, there are four cointegrating vectors in the system of five real rates of ASEAN. According to Goodwin and Grennes (1994), this should indicate the existence of one common trend within ASEAN area and, reflecting a fully integrated credit market in the long-run.

Table 6.4: Johansen's multivariate cointegration tests (January 1983-May 2006)

IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and US, United States. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. * and ** indicate significance at the 10% and 5% levels, respectively.

Group of countries	AIC's lag length	Ho: rank = r	Model	Adjusted trace statistics	Adjusted λ_{max} statistics
US, JP, IN, MA, PH, SG, TL	8	r = 0	2	188.5660**	74.3101**
	8	r ≤ 1	2	114.2560**	38.8594*
	8	r ≤ 2	2	75.3965*	28.2135
	8	r ≤ 3	2	47.1830	24.4780
	8	r ≤ 4	2	22.7050	12.2008
	8	r ≤ 5	2	10.5043	7.4929
	8	r ≤ 6	2	3.0114	3.0114
US, IN, MA, PH, SG, TL	8	r = 0	2	178.7827**	76.8112**
	8	r ≤ 1	2	101.9715**	33.1002**
	8	r ≤ 2	2	68.8713**	28.7144**
	8	r ≤ 3	2	40.1569**	22.8021**
	8	r ≤ 4	2	17.3549	13.1858
	8	r ≤ 5	2	4.1690	4.1690
JP, IN, MA, PH, SG, TL	10	r = 0	2	153.9783**	54.7326**
	10	r ≤ 1	2	99.2458**	47.1943**
	10	r ≤ 2	2	52.0515*	29.2928**
	10	r ≤ 3	2	22.7587	12.7535
	10	r ≤ 4	2	10.0052	7.2515
	10	r ≤ 5	2	2.7537	2.7537
IN, MA, PH, SG, TL	8	r = 0	2	167.8345**	80.9710**
	8	r ≤ 1	2	86.8634**	34.9626**
	8	r ≤ 2	2	51.9009**	29.8458**
	8	r ≤ 3	2	22.0551**	17.3756**
	8	r ≤ 4	2	4.6795	4.6795

6.3.1.2 ASEAN-5 integration: bivariate cointegration tests

Sub-section 6.3.1.2 has found evidence of full credit market integration in the ASEAN-5 area. This sub-section is going to explore the bivariate real interest rate linkages in this area. For the Philippines and Indonesia, since their real interest rates, as noted in 6.2.1.

are stationary over the period of January 1983 through May 2006, only a simple OLS test is needed to investigate the relationship between them.

Table 6.5: Johansen's bivariate cointegration tests on ASEAN (January 1983–May 2006)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; MA, Malaysia; PH, Philippines; SG, Singapore; and TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
SG, IN (11)	r = 0	2	26.7098**	21.0060**	[1 -0.4964]	1.3798
	r ≤ 1	2	5.7038	5.7038		
SG, MA (14)	r = 0	2	22.4878**	17.0761**	[1 -1.7036]	2.0132
	r ≤ 1	2	5.4118	5.4118		
SG, PH (15)	r = 0	2	35.0274**	28.3843**	[1 -0.5751]	1.4329
	r ≤ 1	2	6.6431	6.6431		
SG, TL (10)	r = 0	4	26.5470*	16.6648		
	r ≤ 1	4	9.8821	9.8821		
IN, MA (10)	r = 0	2	24.2558**	17.1022**	[1 -0.7927]	0.0192
	r ≤ 1	2	7.1536	7.1536		
IN, TL (13)	r = 0	2	22.3728**	16.3580**	[1 -0.5504]	1.1103
	r ≤ 1	2	6.0149	6.0149		
MA, PH (13)	r = 0	2	41.1222**	34.1315**	[1 -0.4786]	1.7753
	r ≤ 1	2	6.9906	6.9906		
MA, TL (14)	r = 0	2	25.0503**	20.5117**	[1 -0.2878]	13.2829***
	r ≤ 1	2	4.5386	4.5386		
PH, TL (11)	r = 0	2	48.8574**	43.3512**	[1 -0.7984]	0.4212
	r ≤ 1	2	5.5062	5.5062		

As reported in Table 6.5, one cointegrating vector exists in every combination of real interest rates, except for the pair of Singapore and Thailand. This indicates a high degree of credit market integration within the ASEAN-5 area. More interestingly, the results support the validity of real interest rate parity (RIRP). Indeed, except for the cointegrating vector of Malaysia and Thailand, others are not significantly different from a [1 -1] vector. These results are in line with Phylaktis (1999). In the case of the Singapore-Thailand combination, the findings from Johansen's test are not consistent. Particularly, the adjusted trace test reports one cointegrating vector, but the adjusted eigenvalue test results in no cointegrating vector. Therefore, we do not have enough evidence to determine whether Singapore and Thailand are cointegrated. For the pair of real rates of

Indonesia and the Philippines, because of the stationary property of time series exists, we only need to consider a following simple regression:

$$r_t = \alpha + \beta r_t^* + v_t$$

Where, r_t is the domestic real interest rate; r_t^* is the foreign real interest rate; v_t is the residual; α and β are constant and slope coefficient, respectively. If RIRP holds, α and β should equal 0 and 1, respectively. The OLS regression results in α=0.0942 which is not significantly different from 0 and β=1.2021 which is also not significantly different from 1. Therefore, there is the existence of RIRP between Indonesia and the Philippines.

For further investigation of structural changes, we consider the real rate relationship within ASEAN-5 in two periods: pre-crisis (January 1983–June 1997) and post-crisis (July 1997–May 2006) and four sub-periods: January 1983–December 1989, January 1990–June 1997, July 1997–December 2000 and January 2001–May 2006. It is noted that the first and second sub-periods refer to the first and second stages of financial liberalisation in East Asia (Baharumshah et al, 2005). In the first stage, foreign exchange controls, as well as, the ceilings on deposits and lending rates were progressively removed. The second stage of the liberalization process witnessed the opening up of the capital accounts. The third sub-period refers to the Asian crisis-period. And, the final sub-periods is the period of regional financial cooperation (Sopanha and Guerin, 2006). The results are reported in Tables 6.6 and 6.7

Generally, among the ASEAN-5 credit markets, the group of Thailand, Indonesia and Malaysia has crucially close relationships with each other. Especially, Thailand has been cointegrated with both Indonesia and Malaysia all the time. For the pair of Indonesia and Malaysia, Tables 6.6 and 6.7 document two cointegrating vectors in the periods of January 1990-June 1997 and January 2001-May 2006 and no one in the rest. It is reminded that the Indonesian credit market is integrated in long term and has one cointegrating vector with the Malaysian credit market over the period 1983-2006 as evidenced in Table 6.5. A question is how may we explain these results? De Brouwer (1999) advises that cointegration is most evident in tests over the full (period) sample. Cointegration tests on a sub-period help provide more information about the behaviour of time series in that period. In the case of Indonesia and Malaysia, we may conclude that

they have been cointegrated over the 1983-2006 period and cointegrated most in the two sub-periods: one from January 1990 to June 1997 (the second stage of financial liberalisation) and another from January 2001 to May 2006 (the stage of regional financial cooperation).

Table 6.6: Johansen's bivariate cointegration tests on ASEAN (Pre-crisis periods)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; MA, Malaysia; PH, Philippines; SG, Singapore; and TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 01/1983-12/1989						
SG, IN (7)	r = 0	2	14.1615	10.4653		
	r ≤ 1	2	3.6963	3.6963		
SG, MA (8)	r = 0	2	12.4148	7.0093		
	r ≤ 1	2	5.4055	5.4055		
SG, PH (7)	r = 0	2	10.8227	6.2065		
	r ≤ 1	2	4.6162	4.6162		
SG, TL (8)	r = 0	2	21.9098**	20.1702**	[1 -0.462]	14.8957***
	r ≤ 1	2	1.7397	1.7397		
IN, MA (5)	r = 0	4	21.4498	14.4925		
	r ≤ 1	4	6.9573	6.9573		
IN, PH (6)	r = 0	2	37.5525**	32.2707**	[1 -0.001]	31.3912***
	r ≤ 1	2	5.2819	5.2819		
IN, TL (4)	r = 0	2	17.8814*	14.2763*	[1 -0.132]	5.3869**
	r ≤ 1	2	3.6051	3.6051		
MA, PH (8)	r = 0	2	16.9943	11.4425		
	r ≤ 1	2	5.5518	5.5518		
MA, TL (7)	r = 0	2	16.9550*	14.7068*	[1 -0.310]	7.6780***
	r ≤ 1	2	2.2482	2.2482		
PH, TL (7)	r = 0	2	9.0768	6.5636		
	r ≤ 1	2	2.5133	2.5133		
Period of 01/1990-06/1997						
SG, IN (8)	r = 0	4	20.9748	17.8798*		
	r ≤ 1	4	3.0950	3.0950		
SG, MA (6)	r = 0	4	20.0321	14.0211		
	r ≤ 1	4	6.0110	6.0110		
SG, PH (5)	r = 0	4	24.6784*	15.0928		
	r ≤ 1	4	9.5856	9.5856		
SG, TL (8)	r = 0	4	22.5621*	19.1777*	[1, -0.572]	6.3522**
	r ≤ 1	4	3.3844	3.3844		
IN, MA (8)	r = 0	2	24.6445**	20.9391**	[1 -2.974]	7.5484***
	r ≤ 1	2	3.7053	3.7053		
IN, PH (6)	r = 0	2	21.6795**	15.1620**	[1 -0.909]	0.0258
	r ≤ 1	2	6.5175	6.5175		
IN, TL (5)	r = 0	2	33.6040**	26.2636**	[1 -1.399]	1.0831
	r ≤ 1	2	7.3404	7.3404		
MA, PH (5)	r = 0	4	23.9054*	15.6321		
	r ≤ 1	4	8.2733	8.2733		
MA, TL (6)	r = 0	2	21.2463**	15.1469*	[1 -0.6868]	2.1666
	r ≤ 1	2	6.0994	6.0994		
PH, TL (6)	r = 0	2	17.8278	10.2915		
	r ≤ 1	2	7.4496	7.4496		

Table 6.7: Johansen's bivariate cointegration tests on ASEAN-5 (Post-crisis periods)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; MA, Malaysia; PH, Philippines; SG, Singapore; and TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 07/1997-12/2000						
SG, IN (7)	r = 0	3	22.9594**	18.3385**	[1 -0.1945]	3.8935**
	r ≤ 1	3	4.6209	4.6209		
SG, MA (4)	r = 0	2	20.2687**	17.2870**	[1 -8.9772]	9.8901***
	r ≤ 1	2	2.9817	2.9817		
SG, PH (4)	r = 0	2	6.7472	4.9077		
	r ≤ 1	2	1.8395	1.8395		
SG, TL (7)	r = 0	4	24.8723*	15.8821		
	r ≤ 1	4	8.9902	8.9902		
IN, MA (8)	r = 0	2	13.0061	9.8679		
	r ≤ 1	2	3.1382	3.1382		
IN, PH (3)	r = 0	2	17.3764	12.4562		
	r ≤ 1	2	4.9202	4.9202		
IN, TL (7)	r = 0	2	23.4603**	18.2512**	[1 3.6402]	15.0428***
	r ≤ 1	2	5.2091	5.2091		
MA, PH (4)	r = 0	2	14.1936	8.6194		
	r ≤ 1	2	5.5742	5.5742		
MA, TL (8)	r = 0	2	25.9155**	19.9845**	[1 -0.1099]	19.0895***
	r ≤ 1	2	5.9310	5.9310		
PH, TL (8)	r = 0	2	5.9716	4.4496		
	r ≤ 1	2	1.5221	1.5221		
Period of 01/2001-05/2006						
SG, IN (7)	r = 0	2	11.7092	9.3094		
	r ≤ 1	2	2.3997	2.3997		
SG, MA (7)	r = 0	2	13.1057	10.5694		
	r ≤ 1	2	2.5363	2.5363		
SG, PH (8)	r = 0	2	8.1435	6.1907		
	r ≤ 1	2	1.9528	1.9528		
SG, TL (7)	r = 0	2	12.1861	8.4979		
	r ≤ 1	2	3.6882	3.6882		
IN, MA (5)	r = 0	2	28.4996**	24.8166**	[1 -4.3186]	16.3357***
	r ≤ 1	2	3.6831	3.6831		
IN, PH (4)	r = 0	2	14.7638	12.1512		
	r ≤ 1	2	2.6126	2.6126		
IN, TL (8)	r = 0	2	27.1647**	21.7400**	[1 -3.172]	17.0071***
	r ≤ 1	2	5.4247	5.4247		
MA, PH (4)	r = 0	2	11.0638	7.3819		
	r ≤ 1	2	3.6818	3.6818		
MA, TL (8)	r = 0	2	18.5290*	16.3824**	[1 -0.9223]	0.0928
	r ≤ 1	2	2.1465	2.1465		
PH, TL (8)	r = 0	2	13.1499	8.9865		
	r ≤ 1	2	4.1633	4.1633		

Given ten cointegrating vectors with Singapore, Indonesia and Malaysia over the four sub-periods, the Thailand credit market appears to play a considerable role in the ASEAN. Noticeably, while we cannot conclude the existence of any cointegrating vector between the Thailand and Singapore credit markets over the full period from 1983 to 2006 (see Table 6.5); we may find the evidence of their cointegration from 1983 to 1997

(the first and second stages of financial liberalisation). This may imply that the Thailand and Singapore credit markets had seemingly been integrated with each other until the Asian crisis in July 1997.

With five cointegrating vectors (see Table 6.6), the ASEAN credit markets were most connected to each other over the 1990-1997 period when the ASEAN economies relaxed restrictions on their capital accounts. Additionally, this period also documented three pairs of RIRP: Indonesia-Philippines, Indonesia-Thailand and Malaysia-Thailand. Surprisingly, with three cointegrating vectors (see Table 6.7), the financial cooperation period from 2000 to 2006 seems to be the period the ASEAN credit markets have been less integrated with each other compared to all other periods. However, the evidence of RIRP between Malaysia and Thailand is still found in this period of time.

6.3.1.3 Japan and ASEAN-5 integration: bivariate cointegration tests

This sub-section looks at the linkage between ASEAN-5 and Japan, the biggest financial market in East Asia. Table 6.8 shows only one cointegrating vector over the period from January 1983 to May 2006 between Japan and the Philippines, implying there is only a weak linkage between Japan and the ASEAN-5. However, this cointegrating vector also fail to reject [1 -1] vector, which supports the validity of RIRP.

Table 6.8: Johansen's bivariate cointegration tests on Japan and ASEAN (1983-2006)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
JP, IN (12)	r = 0	4	25.5584*	16.4854		
	r ≤ 1	4	9.0730	9.0730		
JP, MA (14)	r = 0	2	16.6055	15.2175*		
	r ≤ 1	2	1.3880	1.3880		
JP, PH (12)	r = 0	2	45.3376**	42.7428**	[1 -0.7408]	0.4754
	r ≤ 1	2	2.5948	2.5948		
JP, SG (10)	r = 0	2	16.5371	13.1244		
	r ≤ 1	2	3.4127	3.4127		
JP, TL (13)	r = 0	2	15.5495	11.0106		
	r ≤ 1	2	4.5388	4.5388		

Similar to sub-section 6.3.1.2, we further look at the linkage in pre-crisis and post-crisis periods. As presented in Tables 6.9, there is no cointegrating vector before 1997 crisis, implying there was no linkage between the Japan and ASEAN-5 credit markets during this period. This is possibly resulted from the fact the interest rate deregulation in Japan had not been completed till 1994 while the ASEAN-5 had done it soon before that (from mid-1970s to late-1980s).

However, there were three cointegrating vectors (Japan-Indonesia, Japan-Malaysia and Japan-Singapore) in the 1997-2000 period and three cointegrating vectors (Japan-Malaysia, Japan-Philippines and Japan-Singapore) from 2001 to 2006 (see Table 6.10). For the pair of Japan and Malaysia, no cointegrating vector before the Asian crisis and two after that indicate that the Malaysian credit market has been more integrated to Japan since the Asian crisis in 1997. Similarly, for the pair of Japan and Singapore, we also find a strong progress towards credit market integration with each other since the Asian crisis.

Table 6.9: Johansen's bivariate cointegration tests on Japan and ASEAN (Pre-crisis)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; and TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see 5.2 for more details). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 01/1983-12/1989						
JP, IN (8)	r = 0	2	16.2828	8.9749		
	r ≤ 1	2	7.3077	7.3077		
JP, MA (8)	r = 0	4	21.7589	16.1733		
	r ≤ 1	4	5.5856	5.5856		
JP, PH (8)	r = 0	2	14.5102	9.5322		
	r ≤ 1	2	4.9780	4.9780		
JP, SG (8)	r = 0	4	22.5223	15.4414		
	r ≤ 1	4	7.0809	7.0809		
JP, TL (8)	r = 0	2	11.3664	8.0992		
	r ≤ 1	2	3.2672	3.2672		
Period of 01/1990-06/1997						
JP, IN (4)	r = 0	2	13.7570	12.2165		
	r ≤ 1	2	1.5406	1.5406		
JP, MA (8)	r = 0	2	12.9974	12.0134		
	r ≤ 1	2	0.9840	0.9840		
JP, PH (7)	r = 0	2	11.2456	9.6538		
	r ≤ 1	2	1.5919	1.5919		
JP, SG (7)	r = 0	2	8.0563	5.4764		
	r ≤ 1	2	2.5799	2.5799		
JP, TL (4)	r = 0	2	13.7245	11.5804		
	r ≤ 1	2	2.1442	2.1442		

Given one cointegrating vector between Japan and the Philippines in the period 2001-2006, we may conclude that their credit markets have been very close to each other since 1983 and they have been most connected since 2001. Finally, we cannot see any cointegration between Japan and Thailand over the whole 1983-2006 period. Actually, as a result in sub-section 6.3.1.2, the Thailand credit market appears to have had more influences on the other ASEAN than the Japan credit market has so far.

Table 6.10: Johansen's bivariate cointegration tests on Japan and ASEAN (Post-crisis)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; and TL, Thailand. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 07/1997-12/2000						
JP, IN (2)	r = 0	2	43.0461**	36.5431**	[1 0.0016]	31.7442***
	r ≤ 1	2	6.5031	6.5031		
JP, MA (8)	r = 0	2	21.7516**	19.5295**	[1 0.0496]	25.1860***
	r ≤ 1	2	2.2221	2.2221		
JP, PH (4)	r = 0	4	20.1706	14.1386		
	r ≤ 1	4	6.0320	6.0320		
JP, SG (8)	r = 0	2	29.5223**	24.4432**	[1 0.0474]	31.1456***
	r ≤ 1	2	5.0790	5.0790		
JP, TL (8)	r = 0	4	21.4466	19.4884**		
	r ≤ 1	4	1.9582	1.9582		
Period of 01/2001-05/2006						
JP, IN (8)	r = 0	2	15.0722	12.1657		
	r ≤ 1	2	2.9064	2.9064		
JP, MA (4)	r = 0	2	20.3844**	14.2092*	[1 -0.1344]	5.2446**
	r ≤ 1	2	6.1753	6.1753		
JP, PH (5)	r = 0	2	23.6465**	20.7199**	[1 -0.1794]	20.3471***
	r ≤ 1	2	2.9266	2.9266		
JP, SG (8)	r = 0	2	22.1341**	17.9531**	[1 -0.1524]	17.8447***
	r ≤ 1	2	4.1808	4.1808		
JP, TL (2)	r = 0	2	14.6164	8.1070		
	r ≤ 1	2	6.5094	6.5094		

6.3.1.4 US and ASEAN-5 integration: bivariate cointegration tests

Johansen's multivariate cointegration test in sub-section 6.3.1.1 shows that although there is not the existence of full credit market integration between the US and ASEAN-5, a close relationship between them is evident. This section is going to investigate the linkage

between the US rate as the world rate and each of the ASEAN-5 rates. Table 6.11 presents cointegration tests for the period January 1983-May 2006. We find three cointegrating vectors: US-Indonesia, US-Philippines and US-Malaysia, in which the first two support the validity of RIRP. It is interesting that the rate of Japan, considered as a regional rate, and the rate of Singapore, the only developed country in ASEAN-5, are not cointegrated with the US.

Table 6.11: Johansen's bivariate cointegration tests on the US and ASEAN (1983-2006)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and US, United States. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
US, IN (12)	r = 0	2	22.2677**	19.1298**	[1 -0.5752]	0.9305
	r ≤ 1	2	3.1379	3.1379		
US, JP (12)	r = 0	2	10.3358	6.9036		
	r ≤ 1	2	3.4322	3.4322		
US, MA (14)	r = 0	2	22.1912**	18.4695**	[1 -2.1547]	6.4364**
	r ≤ 1	2	3.7217	3.7217		
US, PH (11)	r = 0	2	50.6918**	47.4339**	[1 -0.6538]	1.2563
	r ≤ 1	2	3.2580	3.2580		
US, SG (12)	r = 0	4	26.3327**	16.4271		
	r ≤ 1	4	9.9055	9.9055		
US, TL (12)	r = 0	4	22.3875	15.6677		
	r ≤ 1	4	6.7199	6.7199		

In order to get a deep understanding of linkages between the US and ASEAN-5 credit markets, we further divide the sample into two smaller periods, pre and post crisis, and four sub-periods: January 1983-December 1989, January 1990-June 1997, July 1997-December 2000 and January 2001-May 2006. Table 6.12 reports cointegration results in the pre-crisis period including two sub-periods: January 1983-December 1989 and January 1990-June 1997. It is interesting that while we cannot find any cointegrating vector between the US and Singapore as well as the US and Thailand over the full period 1983-2006 (see Table 6.11); we do find them in the sub-periods of 1983-1989 and 1990-1997, respectively. Besides, they are the only two cointegrated with the US before the Asian crisis. Additionally, both of them support the validity of RIRP.

Table 6.12: Johansen's bivariate cointegration tests on the US and ASEAN (Pre-crisis)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and US, United States. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 01/1983-12/1989						
US, IN (7)	r = 0	2	12.6940	8.4374		
	r ≤ 1	2	4.2566	4.2566		
US, JP (4)	r = 0	2	16.8326	10.2142		
	r ≤ 1	2	6.6183	6.6183		
US, MA (4)	r = 0	2	16.7282	11.8503		
	r ≤ 1	2	4.8767	4.8779		
US, PH (5)	r = 0	2	13.2884	9.8280		
	r ≤ 1	2	3.4604	3.4604		
US, SG (6)	r = 0	2	21.2499*	16.3761**	[1 -0.6706]	2.3578
	r ≤ 1	2	4.8738	4.8738		
US, TL (6)	r = 0	2	17.6931	13.6847		
	r ≤ 1	2	4.0083	4.0083		
Period of 01/1990-06/1997						
US, IN (8)	r = 0	2	9.9720	7.3063		
	r ≤ 1	2	2.6656	2.6656		
US, JP (8)	r = 0	2	7.0037	4.0795		
	r ≤ 1	2	2.9242	2.9242		
US, MA (8)	r = 0	2	13.5341	10.2289		
	r ≤ 1	2	3.3053	3.3053		
US, PH (4)	r = 0	4	20.1074	14.7238		
	r ≤ 1	4	5.3836	5.3836		
US, SG (8)	r = 0	2	13.8160	11.6451		
	r ≤ 1	2	2.1708	2.1708		
US, TL (5)	r = 0	2	18.3708*	15.0860*	[1 -0.9436]	0.0147
	r ≤ 1	2	3.2847	3.2847		

Table 6.13 presents Johansen's cointegration results in post-crisis period including two sub-periods: July 1997-December 2000 and January 2001-May 2006. We find two cointegrating vectors: US-Indonesia, US-Philippines; both of them are in the 1997-2000 period and neither supports the theory of RIRP. There was no cointegration between the US and each of the ASEAN-5 reported in the 2001-2006 period. Surprisingly, Table 6.11 reports a credit market cointegration between the US and Malaysia over the full period 1983-2006, but Tables 6.12 and 6.13 show no cointegration in any of the four sub-periods. De Brouwer (1999) advises that estimation of a cointegrating vector over short periods may not be informative and, indeed, cointegration is most evident (and perhaps the vectors most plausible) in tests over the full sample.

Focusing on Singapore, Thailand, Indonesia and the Philippines, we find out an interesting common feature that they were cointegrated with the US for a particular sub-period of time, but have been no longer after that. This may be explained that these markets first tend to integrate with the world market (the US). However, after a specific time of integration process, they realise they are really not ready for that or the international integration may harm their current financial development. Therefore, they concentrate on developing national financial systems and shift from the target of international integration to regional integration. Actually, sub-section 6.3.1.2 has shown a noticeably high level of credit market integration within the ASEAN.

Table 6.13: Johansen's bivariate cointegration tests on the US and ASEAN (Post-crisis)

The numbers within the brackets are the appropriate lag lengths for each interest rate based on Akaike's information criterion. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and US, United States. The elaborate works developed by Johansen (1988, 1994) and Johansen and Juselius (1990) are composed of five models: model 1 (no constant), model 2 (restricted constant), model 3 (unrestricted constant), model 4 (restricted trend) and model 5 (unrestricted constant and trend). The model selection procedure is followed by Nieh and Lee (2001) (see section 5.2). Adjusted statistics by Reinsel and Ahn (1988) are estimated by multiplying Johansen's trace and λ_{max} statistics by a factor of *(T-np)/T* in which T is the number of observations; n is the number of variables; and p is the number of lags in VAR. Cointegrating vectors are normalized on the first country real rate in the country pair. The last column is the probability of the LR test (which is distributed as a χ_1^2) for examining whether the null hypothesis of the cointegrating vector is equal to [1 -1]. If the null hypothesis is rejected, there is no evidence of real interest rate parity (RIRP). *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Countries	Ho: (rank = r)	Model	Adjusted trace statistics	Adjusted λ_{max} statistics	Cointegrating vector	RIRP [1 -1]
Period of 07/1997-12/2000						
US, IN (2)	r = 0	4	28.0036**	19.3893**	[1 0.0275]	11.1248***
	r ≤ 1	4	8.6142	8.6142		
US, JP (8)	r = 0	2	13.0359	10.6170		
	r ≤ 1	2	2.4189	2.4189		
US, MA (8)	r = 0	2	16.4815	13.1028		
	r ≤ 1	2	3.3786	3.3786		
US, PH (4)	r = 0	2	18.9630*	15.0346*	[1 0.2779]	11.8928***
	r ≤ 1	2	3.9285	3.9285		
US, SG (8)	r = 0	2	10.2525	8.3818		
	r ≤ 1	2	1.8706	1.8706		
US, TL (8)	r = 0	2	15.6868	13.4162		
	r ≤ 1	2	2.2706	2.2706		
Period of 01/2001-05/2006						
US, IN (8)	r = 0	2	14.5572	10.4519		
	r ≤ 1	2	4.1054	4.1054		
US, JP (8)	r = 0	2	8.2279	7.3974		
	r ≤ 1	2	0.8306	0.8306		
US, MA (8)	r = 0	2	12.6376	9.2563		
	r ≤ 1	2	3.3813	3.3813		
US, PH (7)	r = 0	2	13.4835	9.5730		
	r ≤ 1	2	3.9105	3.9105		
US, SG (8)	r = 0	4	20.4734	15.0002		
	r ≤ 1	4	5.4732	5.4732		
US, TL (5)	r = 0	4	23.6563	13.4762		
	r ≤ 1	4	10.1801	10.1801		

6.3.2 Global and Regional Causal Effects

This section explains causal effects across the US, Japan and ASEAN-5 credit markets in two periods: pre-crisis period (January 1983-June 1997) and post-crisis period (July 1997-May 2006). Particularly, for each period, we look at causal effects between the US and Japan, the US and ASEAN, Japan and the ASEAN and causal effects within the ASEAN. VAR order 5 for both periods is selected by the Akaike's information criterion. Specification tests show that the goodness of fit is high in all equations (see Tables 6.14 and 6.15). In fact, the adjusted *R*-squared in the pre- and post crisis periods are 0.78 and 0.75 on average, respectively. However, specification tests also document the existence of serial correlations and non-normality of residuals in most of cases. Serial correlation and non-normality produce unbiased regression coefficients, but inefficient standard errors. Therefore, the *t*-test may be overstated and not statistically significant as they actually appear (Azar, 2005). Besides, Table 6.14 and Table 6.15 show that signs of coefficients vary across lag length, which makes us difficult to determine the general sign of causal effects. However, this challenge could be overcome through impulse response functions (IRF) in section 6.3.3.

6.3.2.1 Pre-crisis analysis

As presented in Table 6.14, the US and Japan credit markets had bi-directional causality with each other and both did considerably affect the ASEAN except for Indonesia in the pre-crisis period. It is noted that all of these effects are one-directional from the US and Japan to the ASEAN. In line with our expectation, these results imply the dominant roles of the US and Japan before the 1997 crisis. This is also consistent with Phylaktis (1999). In fact, fluctuations of the US real interest rate had significant impact on Malaysia, Singapore and Thailand. Especially, Malaysia responded quickly and strongly to real interest rate movements from the US. Fluctuations of the Japanese real interest rates had significant effects on the Philippines, Singapore and Thailand.

For causal effects within the ASEAN, past changes of Thailand and Philippines' real rates not only significantly influenced themselves, but also significantly affected all other regional markets except for Indonesia. Indonesia appears to play an insignificant role in the short-run interest rate dynamics within the region. In fact, fluctuations in the

Indonesian credit market were only affected by itself and Singapore. Although Singapore accounted for great changes in the Indonesian credit market and had strong bi-directional causal effects with Thailand, its general impact within the ASEAN appear to be less than those of the Philippines and Thailand.

Table 6.14: VAR model estimations of causal effects in pre-crisis period (1983-1997)

VAR order 5 is chosen using AIC. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and U.S., the United States. Serial correlation test is Lagrange multiplier (LM) test of residual serial correlation with the null hypothesis of no serial correlation. Normality test is LM test multibased on the test of skewness and kurtosis of residuals with the null hypothesis of normality. Heteroscedasticity test is LM test based on the regression of squared residuals on squared fitted values. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively

Independent variables	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand	The U.S.
IN(-1)	1.0275***	-0.0166	-0.0294	0.0424	-0.0134	0.0239	0.0277
IN(-2)	-0.4238***	0.0172	0.0105	-0.1050	0.0138	0.0254	-0.0088
IN(-3)	-0.0830	0.0214	0.0381	0.1008	0.0574	0.0184	0.0135
IN(-4)	0.2588**	0.0028	-0.0305	0.0037	-0.0507	-0.0389	-0.0026
IN(-5)	-0.1845**	-0.0415	0.0141	0.1009	-0.0199	0.0370	0.0027
JP(-1)	-0.0231	0.8859***	0.0116	0.1082	0.1925***	0.1114	-0.0112
JP(-2)	0.0581	-0.1827*	-0.0141	0.2061	-0.0801	-0.1205	-0.1175**
JP(-3)	-0.1401	-0.4329***	0.0931	-0.6269**	-0.0861	-0.0720	0.0438
JP(-4)	0.1688	0.5386***	-0.0990	0.6888**	0.2163**	0.3433**	0.0959*
JP(-5)	-0.0846	0.0764	-0.0057	-0.43725*	-0.2009***	-0.1032	-0.0727
MA(-1)	0.2440	-0.0339	0.9669***	0.0628	0.0746	-0.1120	-0.0371
MA(-2)	-0.2387	-0.2502*	-0.1805	-0.0945	-0.1664	0.0496	0.0246
MA(-3)	0.1223	0.3500***	-0.4714***	-0.4025	-0.1342	0.1822	-0.0320
MA(-4)	0.1912	0.0086	0.4763***	0.3508	0.2234**	-0.1613	0.1266
MA(-5)	-0.2952	-0.1110	-0.1313	0.3384	-0.1479*	0.1782	-0.0701
PH(-1)	0.0997	-0.0142	0.0794***	1.4393***	0.0737***	0.0812*	-0.0039
PH(-2)	-0.1455	0.0555	-0.0755	-0.6267***	-0.0984***	-0.0053	-0.0139
PH(-3)	0.0775	-0.0060	0.0088	-0.3024**	0.0493	-0.1029	0.0057
PH(-4)	-0.0796	-0.0816	0.0068	0.6137***	-0.0311	0.1496**	-0.0111
PH(-5)	0.0642	0.0608	-0.0007	-0.2471***	0.0184	-0.0922**	0.0258
SG(-1)	-0.4517*	0.0867	-0.0588	0.3503	0.6605***	0.2479	0.0940
SG(-2)	0.5787**	-0.0673	-0.1518	-0.2890	0.1240	0.1559	0.0197
SG(-3)	-0.2615	0.1879	0.1189	0.1962	-0.42132***	-0.3727**	-0.0162
SG(-4)	-0.0795	-0.1461	-0.0516	0.2382	0.25392**	0.3498*	-0.0253
SG(-5)	0.1936	-0.0864	-0.0248	-0.4745	0.0429	-0.2537*	0.0191
TL(-1)	0.0267	-0.0891	-0.0582	-0.2258	0.0113	0.99208***	0.0237
TL(-2)	0.1850	0.0795	0.1032	0.3619*	-0.0840	-0.40157***	-0.0063
TL(-3)	-0.2712	0.0352	0.0421	0.0342	0.2640***	-0.0846	0.0136
TL(-4)	0.2670	-0.1469	-0.1049	-0.3127	-0.1599**	0.2965**	-0.0007
TL(-5)	0.0168	0.0749	0.1778***	0.1820	0.1116**	-0.1531	0.0215
US(-1)	0.5671	0.1047	0.4162***	-0.5144	0.3045**	-0.1903	1.1030***
US(-2)	-0.6588	0.0541	-0.6413***	0.1311	-0.3151	0.0915	-0.2023
US(-3)	0.5055	0.42579*	0.5881***	0.7016	0.2206	0.6162*	-0.3586***
US(-4)	0.1195	-0.47299*	-0.1853	-0.9109	-0.1640	-0.7305**	0.2730**
US(-5)	-0.3757	0.0948	-0.1041	0.4289	0.0379	0.4266*	-0.0032
R^2 adjusted	0.7055	0.7849	0.7298	0.8858	0.7452	0.7707	0.8618
Serial correlation	17.3087	74.4962***	32.3249***	55.0804***	30.8487***	31.4794	30.6569***
Normality	402.3159***	57.5986***	3.9212	227.5586***	0.6482	12.4849***	0.6584
Heteroscedasticity	8.5728***	0.0102	0.3269	22.1404***	0.2862	0.1351	2.8606

An important feature in the behaviour of real interest rates is that all of them were substantially accounted by their own changes in the past, especially the Philippines, Indonesia and Japan. Based on the magnitude of coefficients, the impact of their own past variances is not only statistically significant, but economically considerable as well. Besides, we find that the coefficients of their own first lags ($\beta_{i,1}$ in equation 5.20) are always positive and largest compared to other coefficients in the same equation, implying current fluctuations of all real interest rates are positively related to and most explained by their last month changes.

6.3.2.2 Post-crisis analysis

Opposite to the results of causal effects in the pre-crisis period, the U.S rate seems to have played an insignificant role since the 1997 financial crisis (see Table 6.15). Instead of bi-directional causal effects with the Japanese rate, there is one-way causal effect only from Japan to the U.S market. Since the Asian crisis, the US appears to have lost its position as a dominant market against the ASEAN. Table 6.15 shows that the US real interest rate has been statistically affected by real interest rates volatilities from the ASEAN, such as the Philippines and Singapore. Although still significantly impacting the ASEAN, similar to the US, Japan has lost its dominant position against the ASEAN. Or, we may say short-run dynamics between the Japan and ASEAN credit markets have become balanced. Particularly, Japan has had bi-directional causal effects with Singapore and Thailand instead of one-way effect on Singapore and Thailand as before.

Similar to Ji and Kim (2005), we find short-run dynamics in the ASEAN have greatly changed since the Asian crisis. The ASEAN markets have not only more connected to each other, but more affected developed financial markets, such as the US and Japan, as well. Specifically, replacing the position of the Philippines in the previous period, Malaysia together with Indonesia has considerably increased their influence within the ASEAN. The Philippines and Thailand have expanded their impact to the US and Japan, respectively. More interestingly, the Singapore market plays a significant role in the regional as well as international markets, which is in line with Anoruo et al (2002). In fact, Singapore not only has close relationships with all regional markets, but also strongly affects the two biggest financial markets (the US and Japan) in the world. With one-way effects on the US, Singapore appears to considerably affect the world credit

market. Although Singapore has two-way causalities with Japan, Singapore credit market may impact Japan for a period longer than the Japanese credit market may do on Singapore.

Table 6.15: VAR model estimations of causal effects in post-crisis period (1997-2006)

VAR order 5 is chosen using AIC. IN stands for Indonesia; JP, Japan; MA, Malaysia; PH, Philippines; SG, Singapore; TL, Thailand; and U.S., the United States. Serial correlation test is Lagrange multiplier (LM) test of residual serial correlation with the null hypothesis of no serial correlation. Normality test is LM test multibased on the test of skewness and kurtosis of residuals with the null hypothesis of normality. Heteroscedasticity test is LM test based on the regression of squared residuals on squared fitted values. *, ** and *** denote significance at the 10%, 5% and 1% levels, respectively.

Independent variables	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand	The U.S.
IN(-1)	0.9243***	-0.0220	0.0193	-0.0047	0.0461**	0.0577*	-0.0111
IN(-2)	-0.3251**	0.0345	-0.0179	0.0183	0.0465	-0.0244	-0.0055
IN(-3)	0.1063	-0.0058	-0.0080	-0.0094	-0.0603**	-0.0262	0.0113
IN(-4)	-0.1706	-0.0094	-0.0044	-0.0129	0.0663**	0.0048	0.0020
IN(-5)	0.1877*	0.0043	0.0145	0.1009***	-0.0256	0.0436	0.0094
JP(-1)	-0.7861	0.7155**	0.1429	0.3253	-0.5719***	-0.2556	-0.0979
JP(-2)	1.7138*	-0.3459**	0.0751	0.0883	-0.0996	-0.6712**	-0.3734***
JP(-3)	0.2169	-0.4580***	-0.2228	-0.1152	0.1089	-0.1256	0.1854
JP(-4)	-0.3156	0.4661***	0.0353	-0.2449	-0.1917	0.0255	-0.2350
JP(-5)	1.8977**	-0.2114	-0.2243	0.1370	-0.0936	-0.2324	0.0129
MA(-1)	0.8409	0.0166	0.7542***	-0.2619	-0.0123	0.35748*	0.0644
MA(-2)	0.9855	-0.2195*	0.0892	0.3722	0.1812	0.0518	0.0318
MA(-3)	1.9086**	0.1914*	-0.4372**	0.1622	-0.0789	-0.2273	-0.0404
MA(-4)	1.1192	-0.0198	0.3527**	-0.3060	0.3182*	0.0126	0.1404
MA(-5)	0.1578	0.1356	-0.2151	0.0541	0.3530**	-0.0238	-0.0805
PH(-1)	0.0955	0.0320	0.0013	0.6672***	0.0133	0.1025	-0.0587
PH(-2)	0.0747	0.0241	0.0307	0.1665	0.0056	-0.1262	0.0734
PH(-3)	-0.4817	-0.0559	0.0166	-0.5347***	0.0869	0.0576	0.0491
PH(-4)	0.0778	0.0656	0.0333	0.2143	0.0080	0.1284	-0.1651***
PH(-5)	-0.1774	-0.0448	0.0379	-0.0074	-0.0983	-0.1118	0.1223***
SG(-1)	0.3104	0.1562**	0.0534	-0.1274	0.5113***	0.1659	0.1847**
SG(-2)	-0.0494	-0.2812***	-0.1169	0.3905*	0.4022***	-0.2417	-0.1254
SG(-3)	-0.4147	0.1043	0.0264	-0.0965	-0.3337**	-0.2182	-0.1016
SG(-4)	-0.5265	0.1962**	0.1261	0.1046	-0.0443	0.1927	0.1501
SG(-5)	0.5719	-0.1086	0.0121	0.2635	0.4227***	0.3976**	0.0500
TL(-1)	-0.6061	0.0080	0.0557	-0.2177	-0.0803	0.4023***	0.0762
TL(-2)	0.3681	0.1291**	-0.0952	0.0687	0.0307	0.4003***	-0.0357
TL(-3)	1.2433***	-0.0970	0.1020	0.3274**	0.2106**	-0.30698**	-0.0763
TL(-4)	-0.7349	-0.1042	-0.0678	-0.1546	-0.0327	-0.0228	0.0272
TL(-5)	0.7116*	-0.0045	0.0416	-0.2794*	-0.2533***	0.2557**	-0.0693
US(-1)	0.9708	-0.0318	-0.1867	0.0719	0.0285	0.0557	1.1716***
US(-2)	-1.1327	0.1699	0.2688	-0.1225	0.0654	0.1092	-0.5591***
US(-3)	0.5069	-0.0657	-0.3892*	-0.0297	-0.0853	0.1039	-0.0816
US(-4)	-0.42151	-0.0011	0.1274	0.2005	0.0628	0.0051	0.4715***
US(-5)	-0.46679	0.1115	0.0758	0.2884	0.2196	-0.0400	-0.0928
R^2 adjusted	0.8042	0.6937	0.6256	0.7298	0.7224	0.8040	0.8593
Serial correlation	31.14***	32.6100**	34.6276***	41.1181***	28.1862***	51.4223***	26.3095***
Normality	5.2058*	3.7649	5.3792*	109.2846***	0.6559	6.9600**	0.5870
Heteroscedasticity	0.7002	0.3656	0.0316	3.7796*	0.6895	.1625	3.1203*

To summaries, we may draw five main points. First, the US and Japan credit markets had played dominant roles against the ASEAN until the 1997 crisis. Second, the ASEAN credit markets have growingly connected to each other over time. Noticeably, Thailand has had great impact on other regional markets all the time. Next, with strong and long lasting effects on other ASEAN, Japan and the US, Singapore - the only developed in the ASEAN - appears to take a significant position in the regional and the world credit markets. And, finally, a common behaviour of real interest rates over the two periods is that they are positively related to and most explained by their last month changes.

6.3.3 Generalised Impulse Response Function Forecasts

To conquer the difficulty of interpreting the estimated coefficients of a VAR model, this section uses the generalised IRF (G-IRF) proposed by Pesaran and Shin (1988) in order to examine short-run dynamics across the US, Japan and ASEAN credit markets before and after the Asian crisis. These models overcome the shortcoming of traditional IRF, having the advantage of being invariant to the ordering of the variables.

The IRF identifies the effect of a one standard deviation shock in one market to one of the innovations on current and future values of other market. The higher the response (positive) is, the stronger the linkage or shock transmissions between the markets would be. Given the results from causal effects in section 6.3.2, we first expect all of the credit markets strongly respond to their own shocks. Second, we expect strong responses of the ASEAN credit markets to a shock in the US and Japan during the pre-crisis period. Finally, a growing shock transmission would also be expected within the ASEAN over time. It is noted that the pre-crisis period is from January 1983 to June 1997; the post-crisis period from July 1997 to May 2006. All results are presented in Figures 6.2-6.8. These results also report whether the response is significantly different from zero based on the significance of 5%.

6.3.3.1 Generalised impulse responses to a shock in the US

Figure 6.2 illustrates the response of the US, Japan and ASEAN credit markets to a shock from the US. Specific figures are detailed in Appendix 1. Particularly, for the US, the

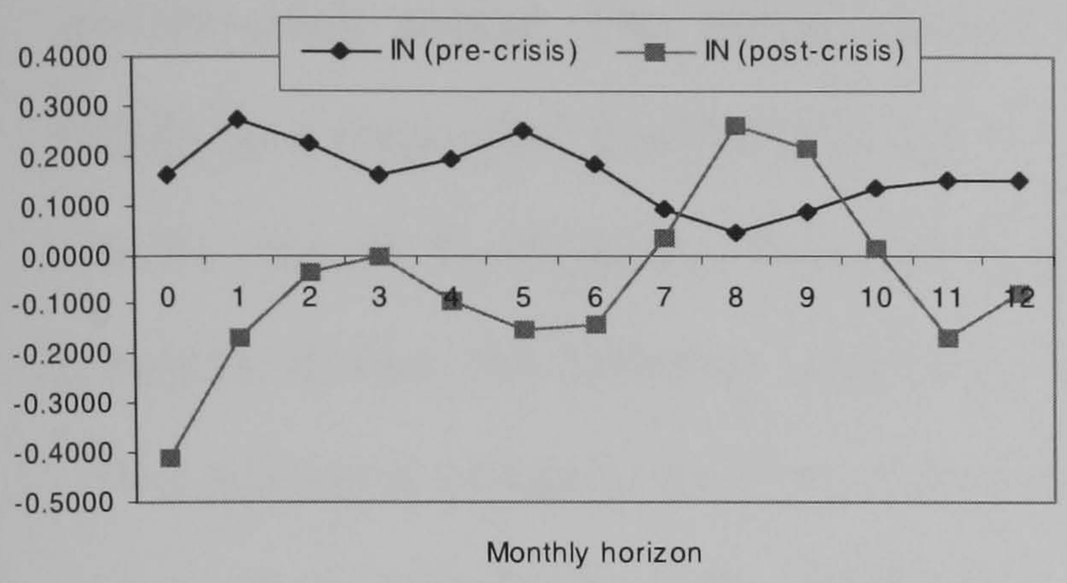
response to its own shock fluctuated from 26.6% in the first month down to 7.7% in the twelfth month over the pre-crisis period. Compared to the pre-crisis period, the response in the post-crisis period was more variable and complicated. First it reached its maximum level of 35.8% in the first month and then quickly declined to 2.4% in the next three months. However, the response did not die out; instead, it moved up and kept shaking around 3% throughout the whole horizon.

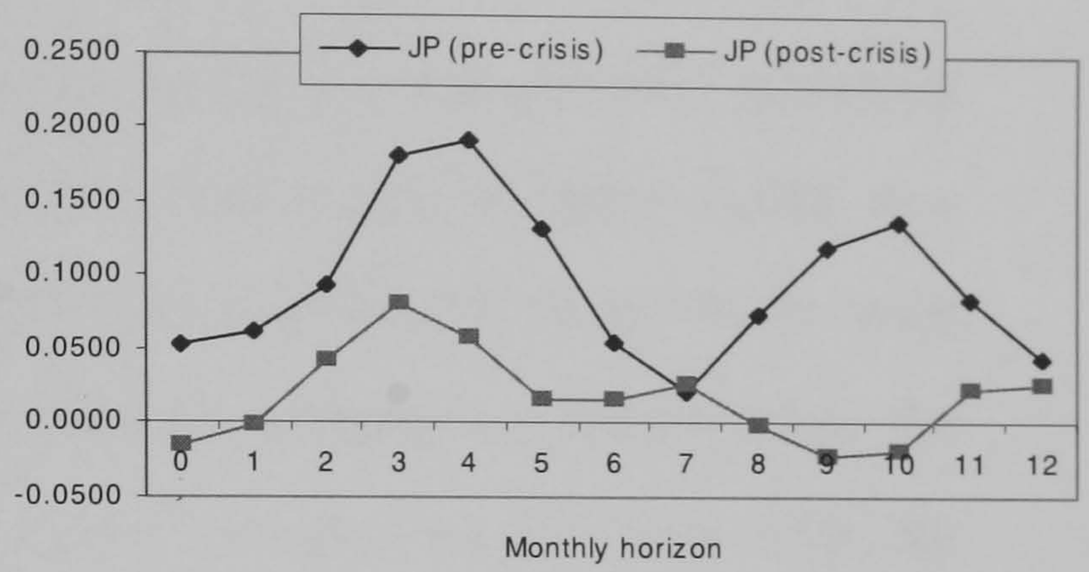
For Japan, the positive response was long-lasting and fluctuated within the band of 2%-18% in the pre-crisis period. However, in the post-crisis period, the US shock appears to have had short-term and moderate influence. In fact, the response of the Japanese credit market was moderately about 4.4%, 8.1% and 5.9% in the second, third and fourth months, respectively, but negligible after that.

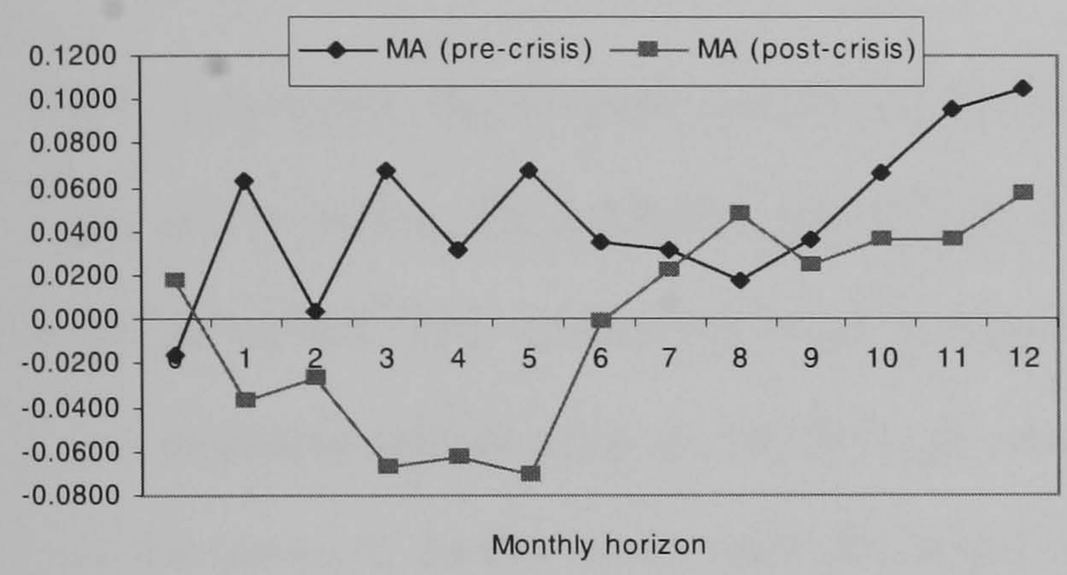
For Indonesia, the response was positively strong and lasted over twelve months in the pre-crisis period. In fact, it fluctuated within the band of 4% to 27% during this time. In the post-crisis period, the response was widely spread from -40% to 26%, but mostly in negative form. This considerably negative response would imply a strong diversification between the US and Indonesia since the Asian crisis. Besides, a noticeable behaviour of the Indonesian credit market over this period is that the response to a US shock tended to revert to its original level (0%) in about three-month time.

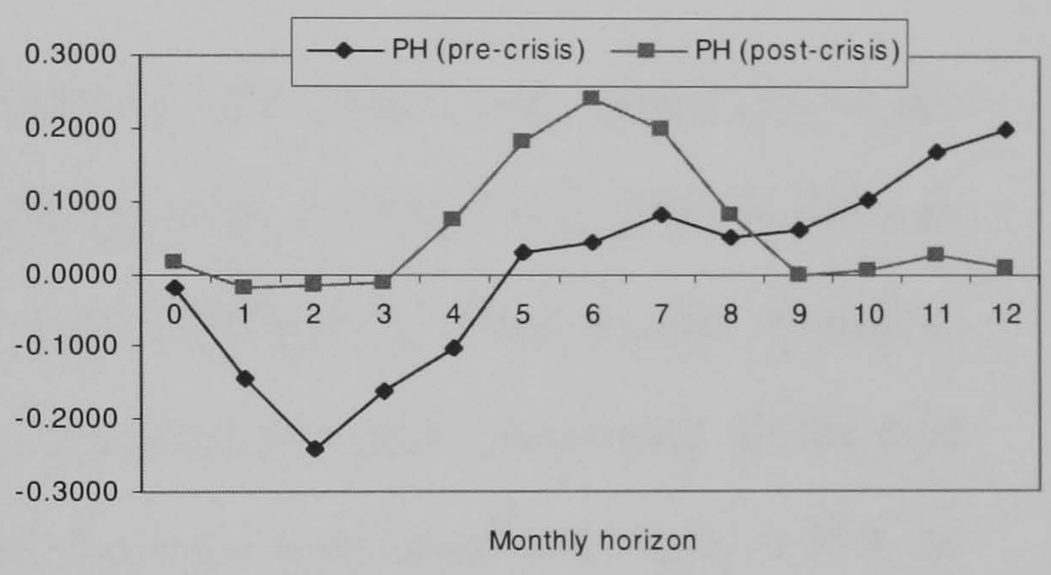
For Malaysia, the US shock appears to have long-term impact on the credit market innovation. In the pre-crisis period, the response could be described in two patterns. First, it often fluctuated around the mean of 3% for the period of first eight months, and then went straight to 10.5% in month twelve. There was no signal that the response would die out soon. In the post-crisis period, the response followed two clear directions. First, the response went down from 1.8% to -7.1% for the first five months, implying a divergent linkage between the US and Malaysia. To some extent, the behaviour of this response also contrasted with the first pattern in the pre-crisis period. At the point of month five, the response changed its direction and move up to 5.7% in month twelve. Clearly, positive responses were found for periods, pre-and post-crisis, but they were built up more slowly in the latter.

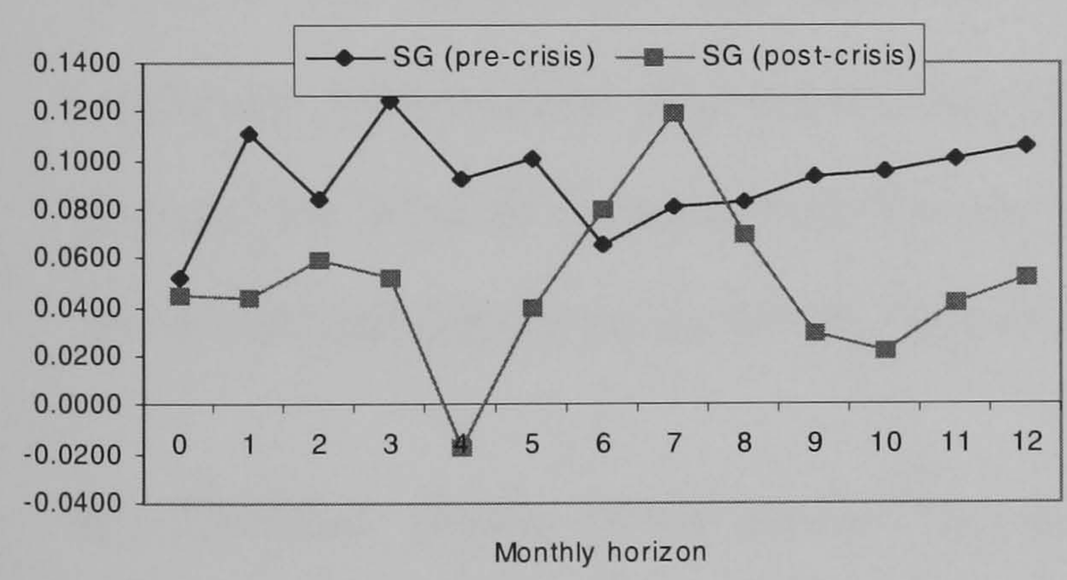
Figure 6.2: Generalised impulse responses to a shock in the US

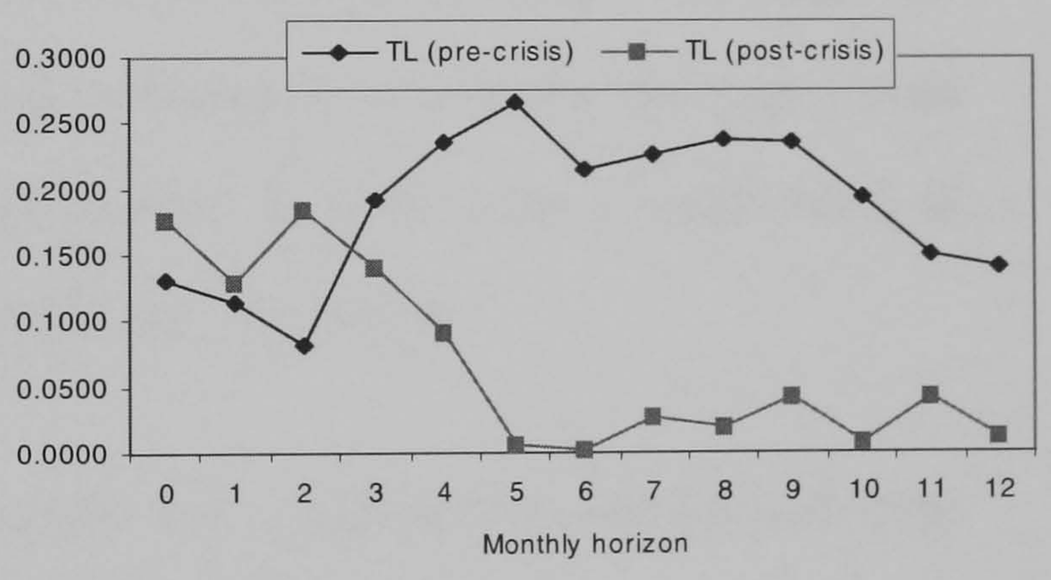


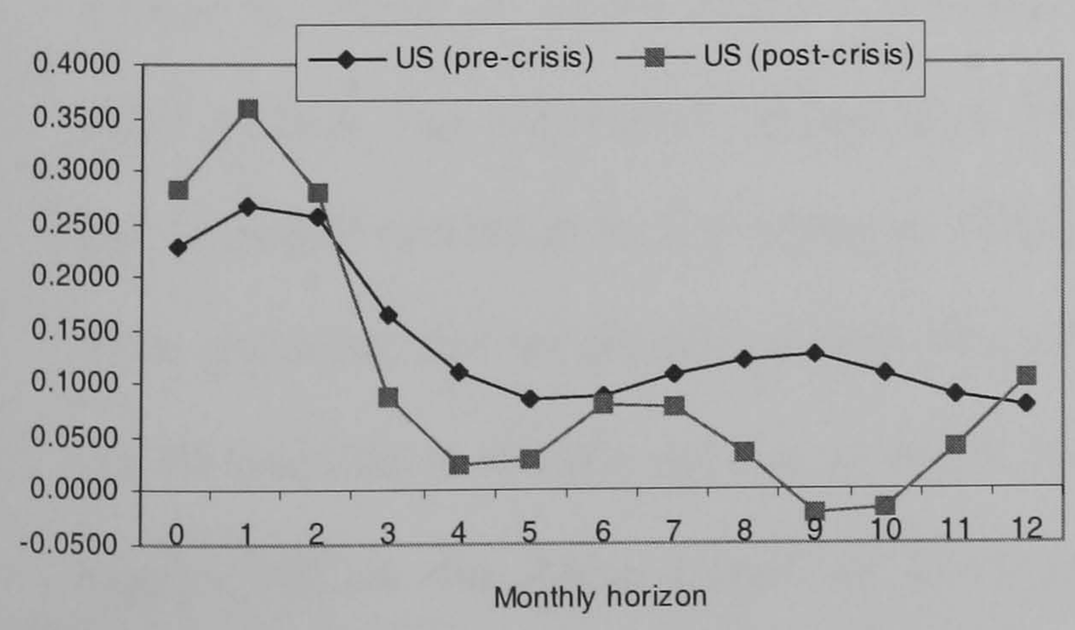












Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

For the Philippines, the response widely varied in the -23.9%-19.9% band, indicating more-than-one directional linkages between the US and the Philippines credit markets in the pre-crisis period. The shock transmission from the US really occurred when the Philippines responded positively to the US shock in month five and gradually moved up till the end of the horizon. The post-crisis response had a special shape similar to a parabola. In fact, the response reached the maximum level of 24.23% in month six, went down and approximately died out in month nine. In short, compared to the pre-crisis, the impact of the US shock on the Philippines market was stronger since the Asian crisis, but it would only last for a shorter period of time.

For Singapore, the response was considerably positive and lasted long, especially in the pre-crisis period. Particularly, the response fluctuated with the band of 5.25%-12.48% in the pre-crisis. The maximum level of response was 12.48% in the third month. Actually, the response varied most in the first six months, and then gradually increasing till the end of the horizon. In the post-crisis, the band of response was more widened, from -1.77% to 11.92%. The maximum response was 11.92% in the seventh month. Although the Singapore credit market responded positively to the US shock in both pre- and post- crisis periods, the level of response was stronger in the former. This indicates a higher level of shock transmission from the US to Singapore before the Asian crisis.

For Thailand, similar to the case of Singapore, there was a substantial positive and long-lasting response to a shock in the US over the pre-crisis. Thailand appears to have been the most influenced market in the ASEAN during this time. The response fluctuated within the band of 11.33-26.61%. It peaked at 26.61% in the fifth month. In the post-crisis period, the maximum response of 18.38% was obtained in the second month, and then sharply reverted to the original level. The responses from month seven to twelve were positive, but insignificant and reverted back to zero in the two-month time. These results indicate a sizable degree of shock transmission from the US to the Thailand credit market before the Asian crisis; or to some extent the Thailand credit market could be vulnerable in the face of a US shock during this period of time.

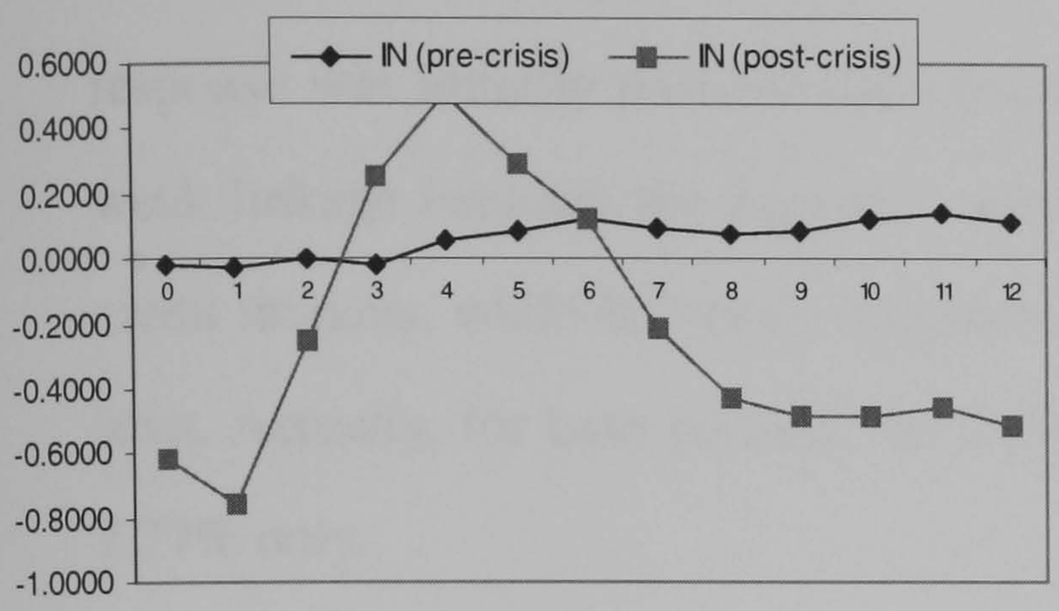
6.3.3.2 Generalised impulse responses to a shock in Japan

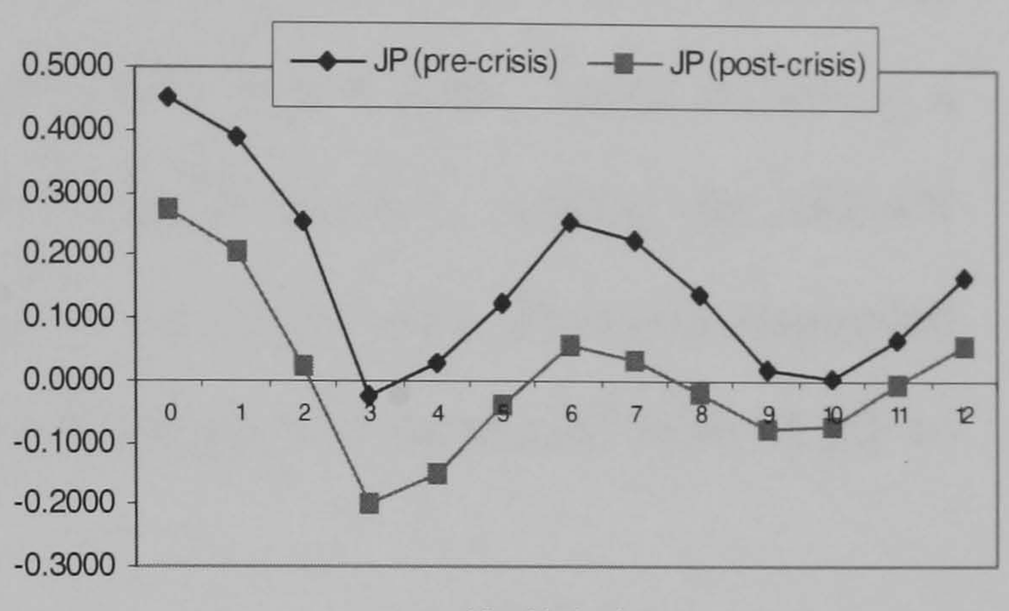
Figure 6.3 illustrates the response of the Japanese, US and ASEAN credit markets to a shock in Japan. Specifically, for Japan in the pre-crisis period, the response to its own shock was highly positive (maximum at 45.39%) and long-lasting over the horizon of twelve months. In contrast, the response in the post-crisis period was mostly positive within the first month and much lower compared to the period before. Besides, we find the response to a shock before the Asian crisis and the response to a shock after the crisis had similar patterns, implying a stable connection of responses to the same shock throughout the twelve-month horizon.

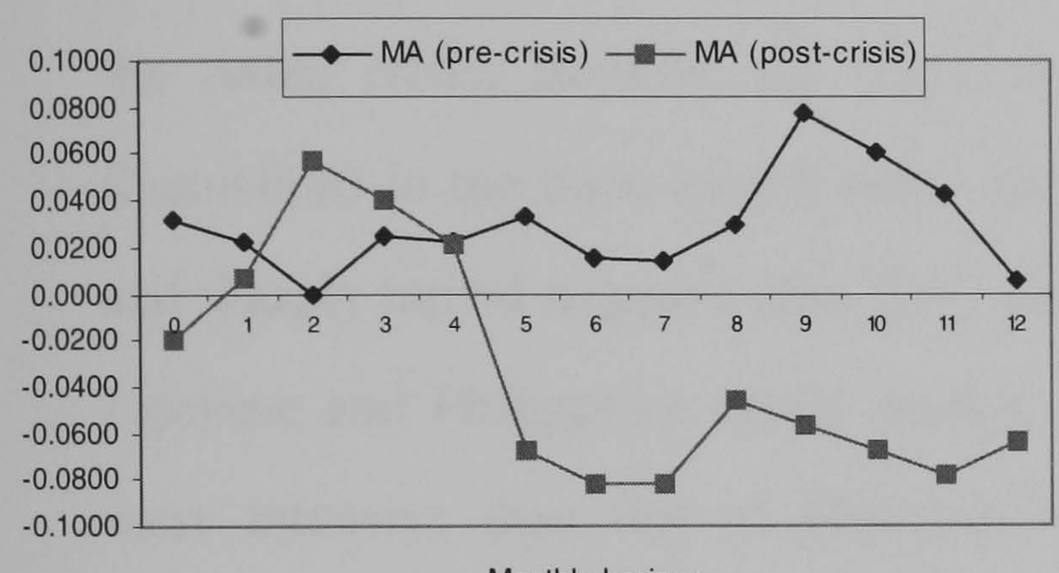
Generally, the US credit market had moderate positive responses to a shock in Japan before the Asian crisis. The response tended to increase slightly over time: 2.68% initially, 6.63% in the sixth month and peaked at 7.74% in the twelfth month. Actually, despite its position as the most developed financial market in Asia, also one of the biggest financial markets in the world, the impact of a shock from the Japanese credit market on the US was just the same (or even lower) as the ASEAN markets may did on (see Figures 6.4-6.8). In the post-crisis period, we find highly negative response of the US, implying opportunities for risk diversification between Japan and the US, the two biggest financial markets in the world. In fact, the response was substantially negative in the first ten months, and then turned to slightly positive in months eleven and twelve. The response varied in the band of -25.47% - 5.23%.

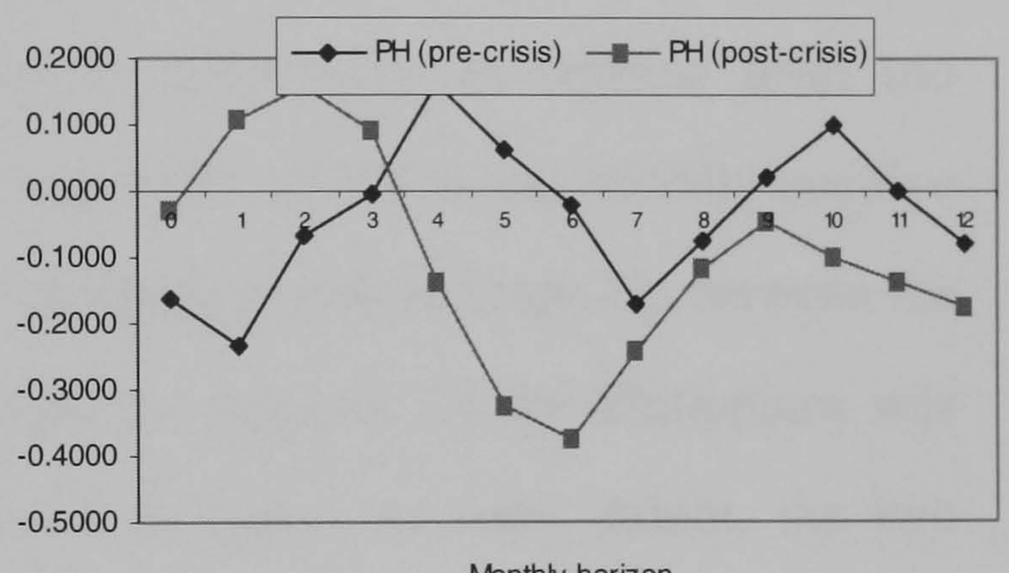
The Indonesian credit market had a positive delayed response to a shock in Japan in the pre-crisis period. In deed, the response was negligible in the first three months, turned to 5.38% in the fourth month and then remained rather stable to the end of twelve-month horizon. After the Asian crisis, the response fluctuated in a very large range of -75.43% - 50.62%. The response was extremely negative in the first two months, positive from month three to six and then turned back to negative over the rest of the horizon. Among the ASEAN credit markets, Indonesia is the one who responded most to a shock in Japan, either in positive or negative directions.

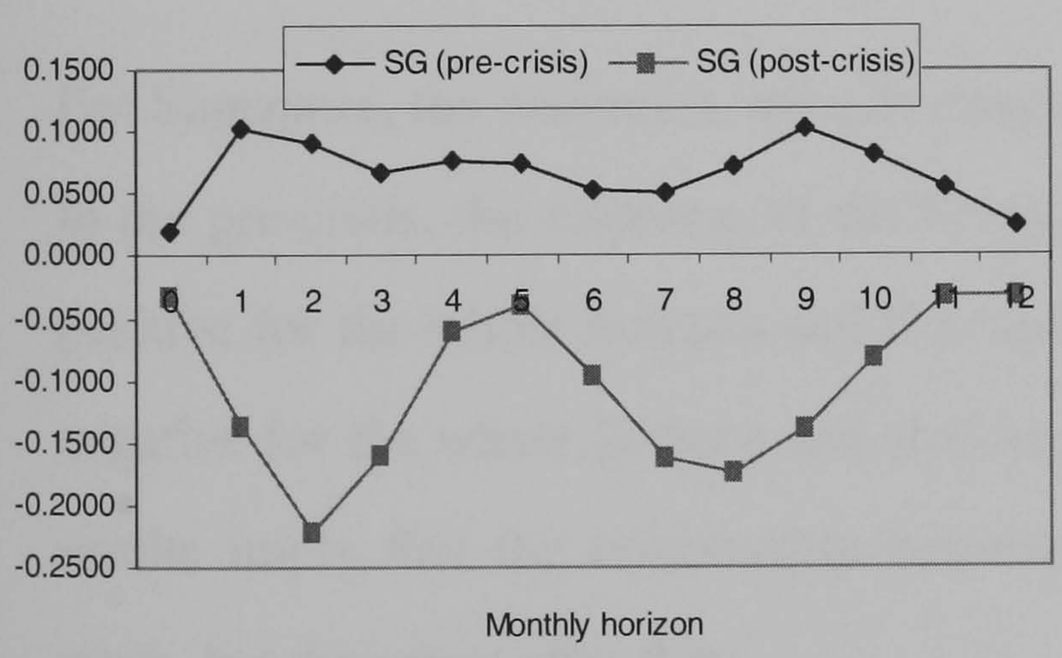
Figure 6.3: Generalised impulse responses to a shock in Japan

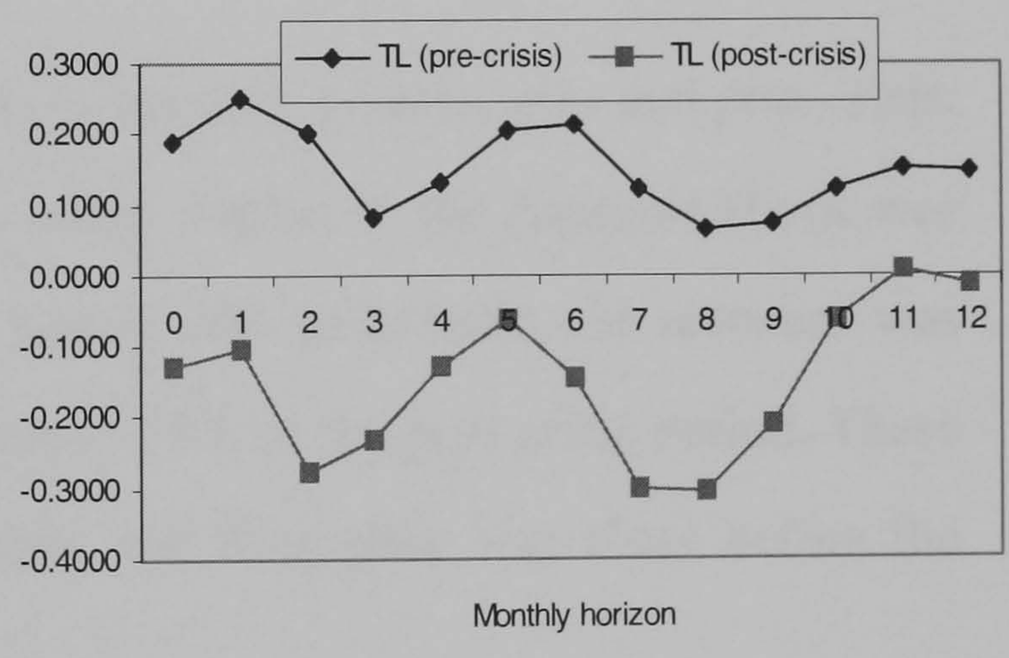


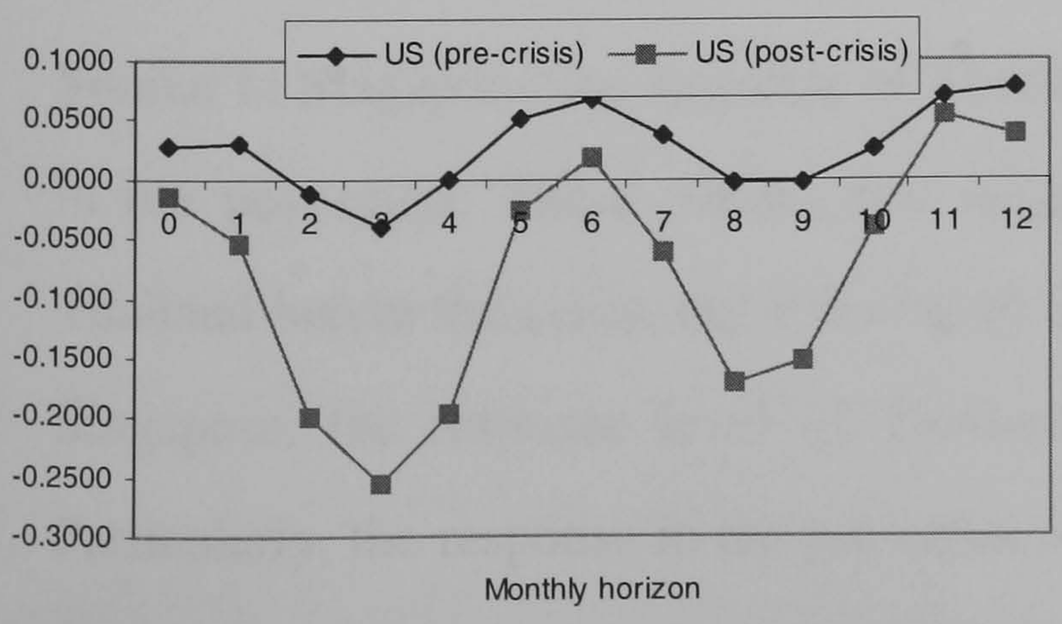












Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

For Malaysia, the response was positive throughout the twelve-month horizon and moderately fluctuated within the band of 0%-7.77% during the pre-crisis period. The maximum level of response was at 7.77% in the ninth month. In the post-crisis period, the response was initially positive and turned negative after four months, partly reflecting a weak linkage between the Japanese and Malaysian credit markets. Among the ASEAN credit markets, while Indonesia responded most to a shock in Japan, Malaysia responded least. Actually, for both periods, the response of Malaysia was fluctuated from -8.2% to 7.77% only.

For the Philippines, the response fluctuated within the band of -23.27% to 16.4% before the Asian crisis. Besides, the response tended to revert back its original level (no fluctuation) in the three-month time. After the crisis, the response was initially positive and sharply turned negative after three months, implying a weak relationship between the Japanese and Philippines credit market. Although the response of the Philippines was more intensive than that of Malaysia to a shock in Japan, to some extent, the two responses had similar patterns in the post-crisis period.

For Singapore, the responses were in clear patterns for both periods, pre- and post-crisis. In the pre-crisis, the response of the Singapore credit market to the Japanese shock was positive for the whole horizon and fluctuating around 7%. In contrast, the response was negative for the whole horizon and shaking around -15% in the post-crisis period. These results imply that the relationship between Japan and Singapore was close before the crisis, but divergent after that.

Similar to Singapore, the response of Thailand was positive in the pre-crisis and negative in the post-crisis. These results also suggest a close relationship between Japan and Thailand before the crisis, but a divergent after that. However, different from the case of Singapore, the response level of Thailand to a shock in Japan was much stronger. Particularly, the response in the pre-crisis was fluctuated from 6.52% to 24.88%; and the response in the post-crisis from -30.72% to 0%.

6.3.3.3 Generalised impulse responses to a shock in the ASEAN

Figure 6.4 illustrates the response of the US, Japan and ASEAN credit markets to a shock in Indonesia. Particularly, for Indonesia, the response to its own shock was extremely large at the beginning and died out after three months. The patterns of response were the same either in pre- or post-crisis, but the level of response was higher in the latter. For the US, given the results of positive responses, there should be the existence of shock transmission from the Indonesian credit market to the US either in pre- or post-crisis. However, with more positive responses combined with higher levels, Indonesia appears to have had more impact on the US during the pre-crisis period. For Japan, the positive response was moderate and turned negative in every two- or three-month time, implying a low level of shock transmission from the Indonesian credit market to Japan either in pre- or post-crisis periods. Indonesia had a significant impact on Malaysia, Singapore, Thailand and, especially, the Philippines in the pre-crisis period. In fact, the response of the Philippines credit market to a shock in Indonesia was highest at 66.34% in month seven. For Malaysia, Singapore and Thailand, the response was moderately positive, mostly fluctuated around 7% and long-lasting. However, Indonesia declined its regional impact in the post-crisis period. Specifically, the positive response of Malaysia lowered, fluctuating around 2%. For the Philippines, the response was insignificant in the first three months and then fluctuated around 14%. For Singapore and Thailand, most of responses were negative, which is opposite to those in the pre-crisis period.

Figure 6.5 illustrates the response of the US, Japan and ASEAN credit markets to a shock in Malaysia. Particularly, for Malaysia in the pre-crisis period, the most striking responses to its own shock were the ones in the first two months. In fact, the immediate, one-month and two-month responses were 40.5%, 37.02% and 26.44%, respectively. Positive responses were also found in month six to nine, but at moderate rates. In the post-crisis period, the response was significantly positive in the first four months, down from the initial response of 36.43% to the four-month response of 4.3%. For the US, the positive response was moderate in two periods. In the pre-crisis, the response was negligible in the first three months, turned significantly positive and lasted till the end of twelve-month horizon. In the post-crisis, the US responded positively in the first six months. Clearly,

the response behaviour was different for each period, but the Malaysian shock would significantly impact the US credit market over time. In contrast, a shock in Malaysian credit market had weak influence on Japan over the two periods. In fact, among thirteen responses, only four positive ones with the average rate of 7% were reported in the pre-crisis. Similarly, in the post-crisis, we also find only four positive responses with the mean of 5%. Considering the ASEAN credit markets, we find that the Malaysian shock had the most influence on Indonesia, especially in the post-crisis period. Particularly, in pre-crisis, most of responses were significantly positive throughout the twelve-month horizon, fluctuating within the band of 6.94%-22.62%. In the post-crisis, all of responses were substantially positive and fluctuated in a range of 18.91%-89.91%. The Philippines and Thailand both had their strong positive responses to a shock in Malaysian credit market. For the Philippines, the positive response was more intensive in the pre-crisis period, fluctuating within the band of 6.12%-51.57%. For Thailand, the positive response was also stronger in the pre-crisis, but lasted longer in the post-crisis. Generally, both of these markets were been significantly impacted by a shock in Malaysia over time. Among the ASEAN credit markets, Singapore seems to be the one who absorbed least impact from the Malaysian shock, especially after the Asian crisis. In fact, there were only two positive responses with the rates of 4.47% and 7.05% in month two and month three in the post-crisis period, respectively.

Figure 6.6 illustrates the response of the US, Japan and ASEAN credit markets to a shock in the Philippines. Particularly, the Philippines seem to be impacted most by its own shock in the pre-crisis period. In fact, the response was extremely positive in a range of 31.22%-170.89% over the first ten months. In the post-crisis, the impact was significantly reduced. This is, the range of positive response lowered to 36.58%-66.65% and lasted in the first two months only. There was seemingly no impact of shock transmission from the Philippines to the US before the Asian crisis since all of the responses were negative. In the post-crisis, positive responses with the mean of 6.5% were found in months three, seven, eight, nine and ten. Although the response rate from the US was still limited, this result implies that the Philippines increased its impact on the US over time. For Japan, the response behaviours were quite similar in both periods and tended to revert to zero in two- or three-month time. However, the response in the pre-crisis was more variable,

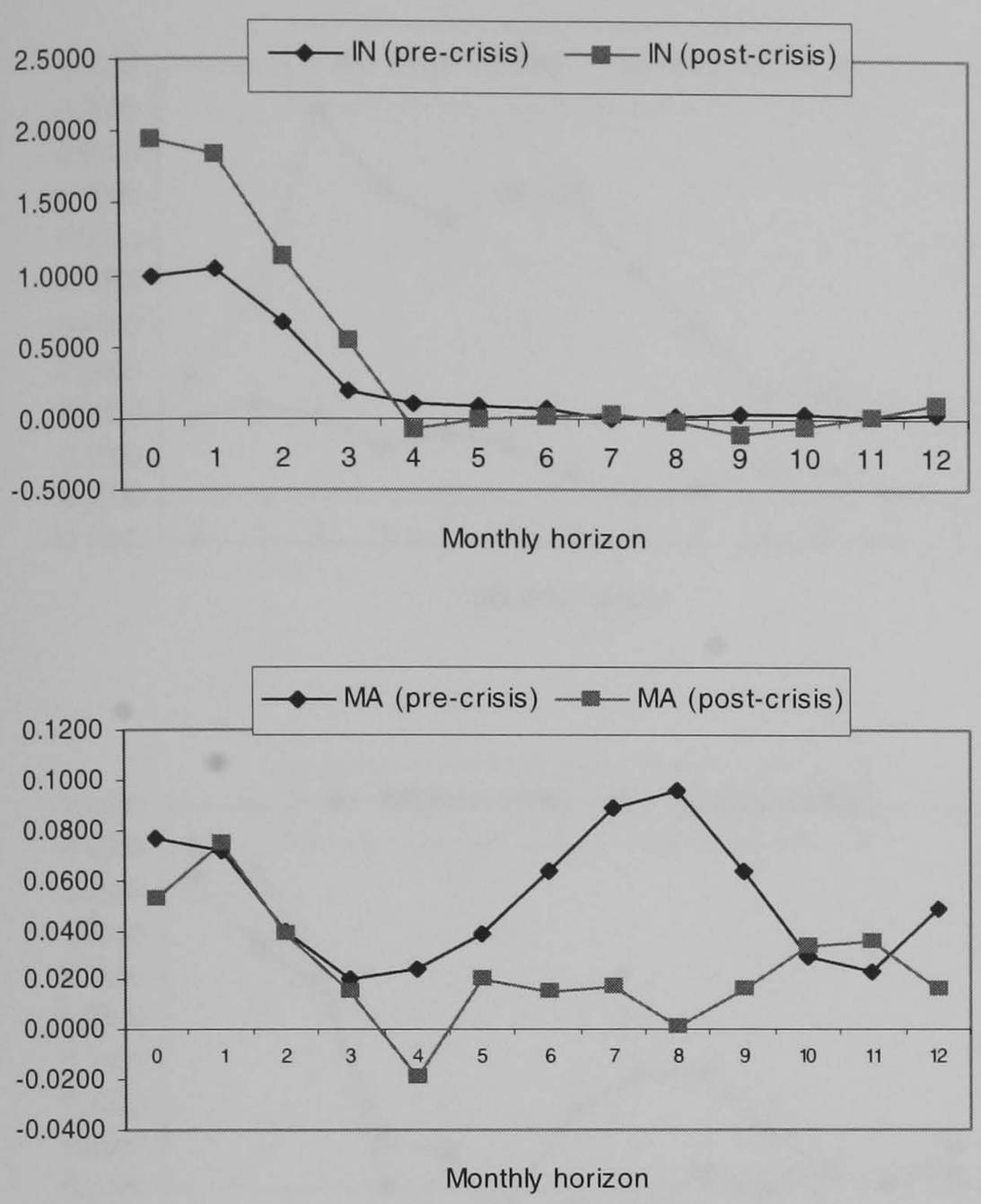
from -6.58% to 8.61%, compared to that in the post-crisis, from -1.23 to 5.58%. Generally, a shock in the Filipino credit market had a low impact on Japan, especially after the Asian crisis. Among the ASEAN credit markets, Indonesia appears to be affected most by a shock in the Philippines. In the pre-crisis, the positive impact existed in a short period, but quite high. In fact, the response of Indonesia was positive in the first three months, fluctuating in the band of 6.71%-22.85%. In the post-crisis, all of the responses were significantly positive over the twelve-month horizon, implying a considerable long-run impact from the Philippines to Indonesia. For Malaysia, the response in the pre- and post- crisis periods was positive in the first four and seven months, respectively. In short, the impact of a shock in the Philippines was stronger and longer-lasting in the post-crisis. Singapore had immediate and two-month delayed positive response to a shock in the Philippines in the pre- and post-crisis periods, respectively. However, with few positive responses max at 7.77%, the Singapore credit market was not influenced much by the Philippines over the whole period 1983-2006. For Thailand, the pictures of shock transmissions from the Philippines are clearly for both periods. In the pre-crisis, Thailand had a divergent relationship with the Philippines. A shock from the Philippines credit market had divergent impact throughout the whole twelve-month horizon. In fact, the negative response varied from -7.63% to -27.63% during this period of time. In contrast, with significantly positive responses, Singapore became closer to the Philippines after the Asian crisis. The response peaked at 11.68% in the first month, downed to zero in month seven, and then turn positive again till month eleven.

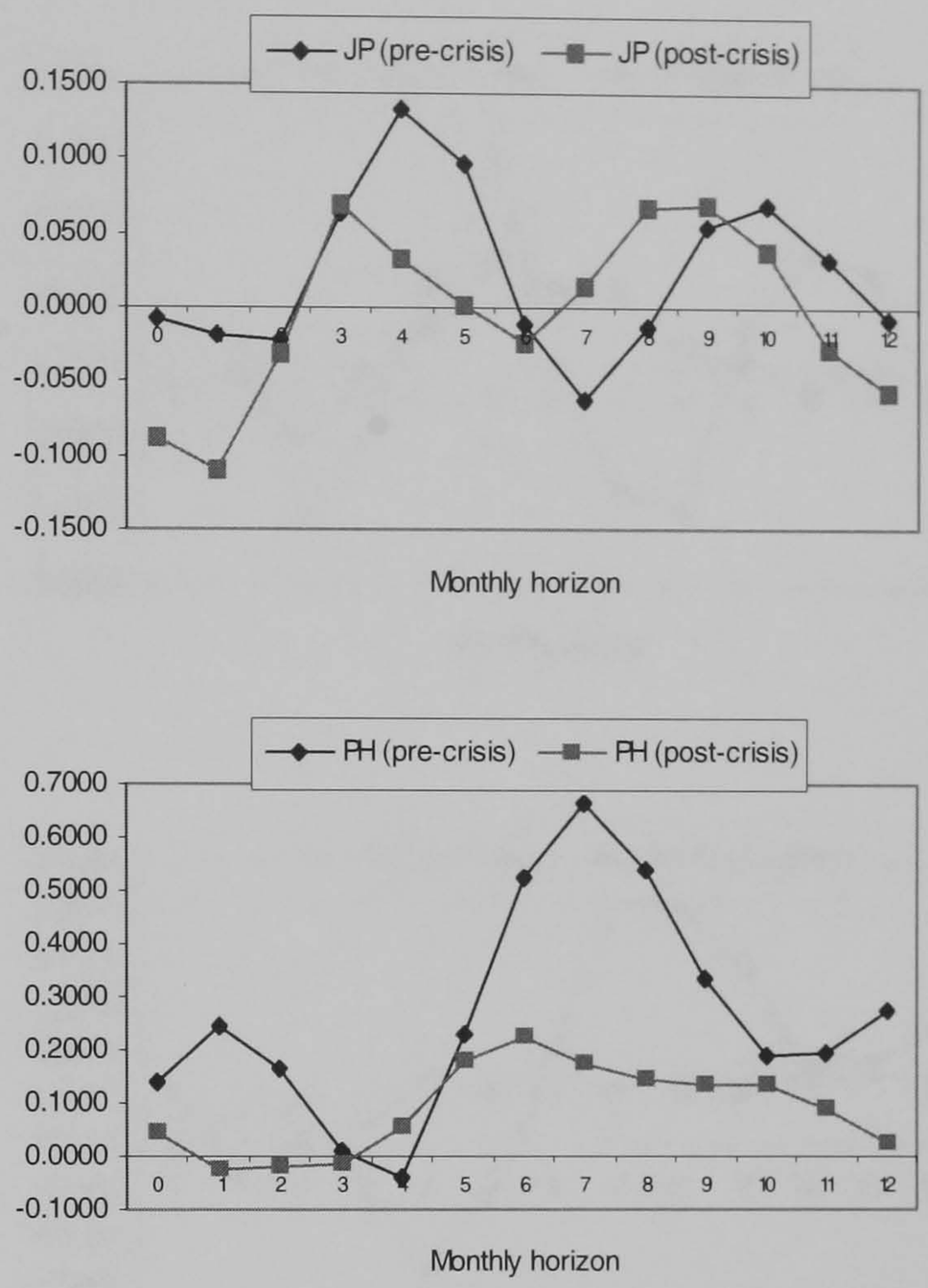
Figure 6.7 illustrates the response of the US, Japan and ASEAN credit markets to a shock in Singapore. Generally, the Singapore credit market significantly affected all other markets including the US and Japan, the two biggest ones in the world, implying the considerable role of the Singapore financial market not only in the region, but in the world as well. These results are consistent with the findings in section 6.3.2. Particularly, Singapore was influenced most by its own shock over the whole period 1982-2006. All of responses were positive either in pre- or post crisis periods, but apparently higher in the latter. A noticeable feature of the response behaviour is that the response was strongest in

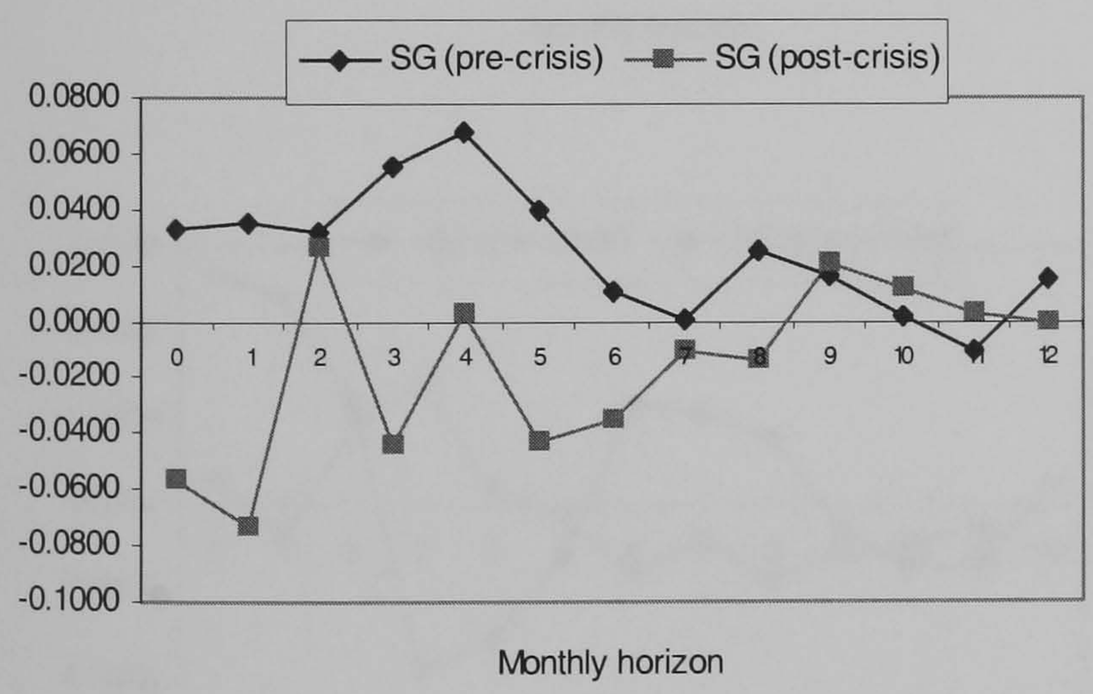
the first two months after the shock. For the US and Japan, the positive responses were significant and long lasting. It is interesting that these responses were evidently higher and lasted longer than those of Singapore to shocks in the US and Japan. This is, the Singapore credit market seems to impact the biggest world credit market more than being impacted. The Singapore credit market also affected other regional markets over the period 1983-2006. For Indonesia, the positive responses were moderate, but long-lasting before the Asian crisis; delayed till the eighth month, but substantially high - max at 41.94% - after the Asian crisis. For the Philippines, Malaysia and Thailand, the positive responses were also considerably high and long-lasting in both pre- and post-crisis periods. Similar to the cases of the US and Japan, the Singapore credit market seems to affect other regional markets more than being affected.

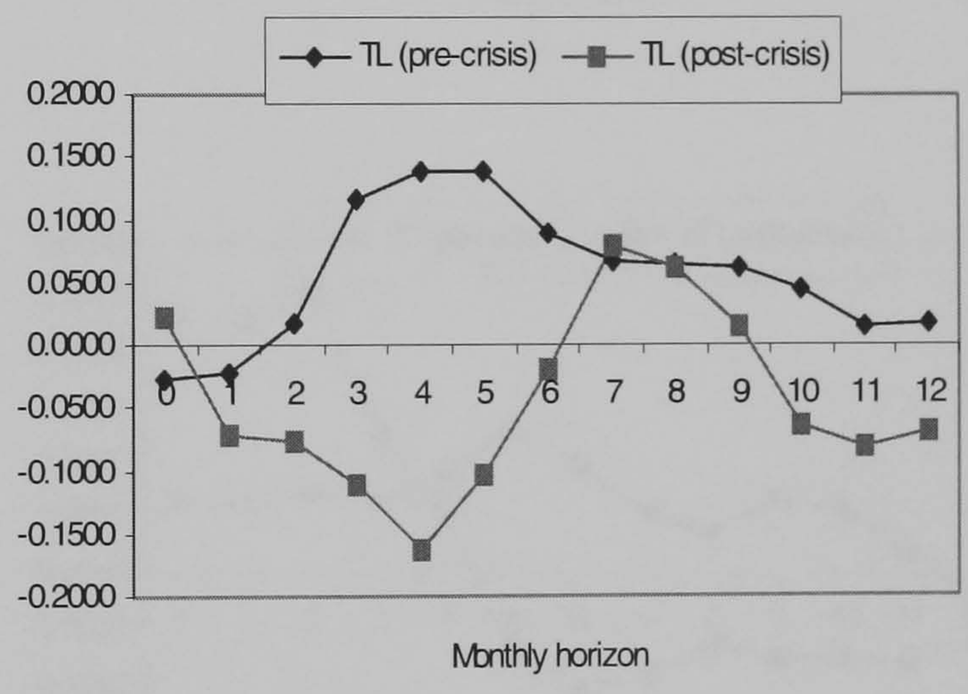
Figure 6.8 illustrates the response of the US, Japan and ASEAN credit markets to a shock in Thailand. Particularly, similar to other credit markets, Thailand responded most to its own shock. In the pre-crisis period, all of responses were significantly positive throughout the twelve-month horizon and had their mean and maximum of 27.38% and 67.30%, respectively. In the post-crisis period, the highest positive responses to its own shock were in the first four months and tended to die out over time. For the US and Japan, the Thailand credit market really had high positive impact in the pre-crisis period. In fact, the responses of the US and Japan were strongly positive for the whole twelve-month horizon and had the average of 10.40% and 6%, respectively. Evidently, a shock in Thailand may have more effect on the US than on Japan during this period of time. For the ASEAN credit markets, a shock in Thailand generated more impact on Malaysia, Singapore and Thailand in the pre-crisis period. However, the shock transmission impact on these countries, especially Singapore, was reduced in the post-crisis period. In fact, during this period of time, the positive responses of Singapore were 4.98% and 9.30% in the second and third months, respectively. Indonesia appears to be the market which suffered most shock transmission impact from the Thailand credit market over the whole period 1983-2006. With higher positive responses in the post-crisis period, it seems that the impact from Thailand on Indonesia has increased over time.

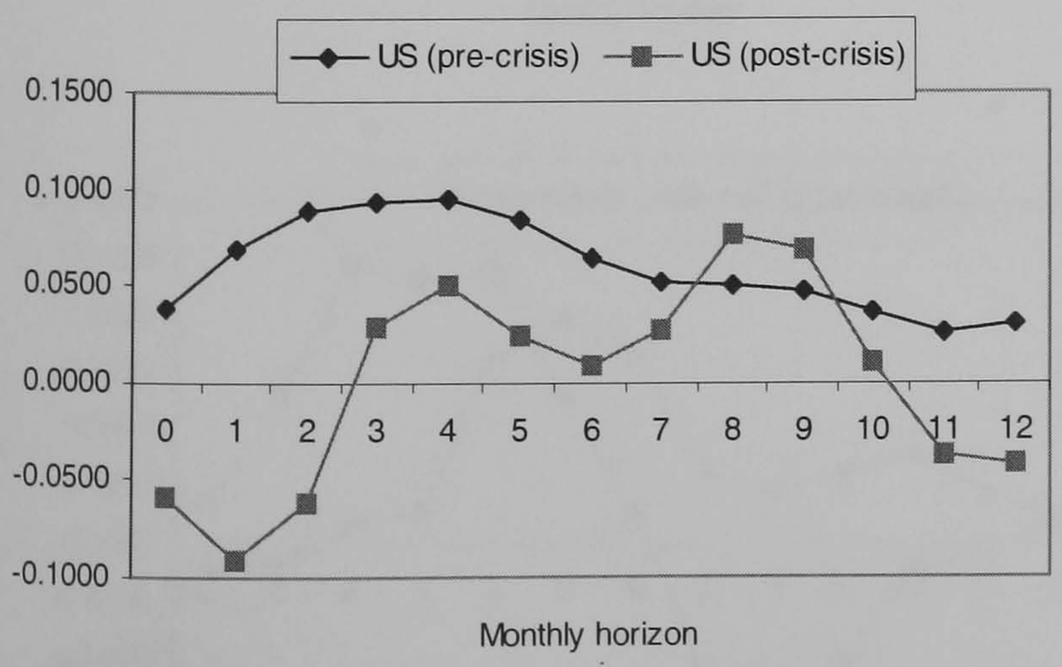
Figure 6.4: Generalised impulse responses to a shock in Indonesia





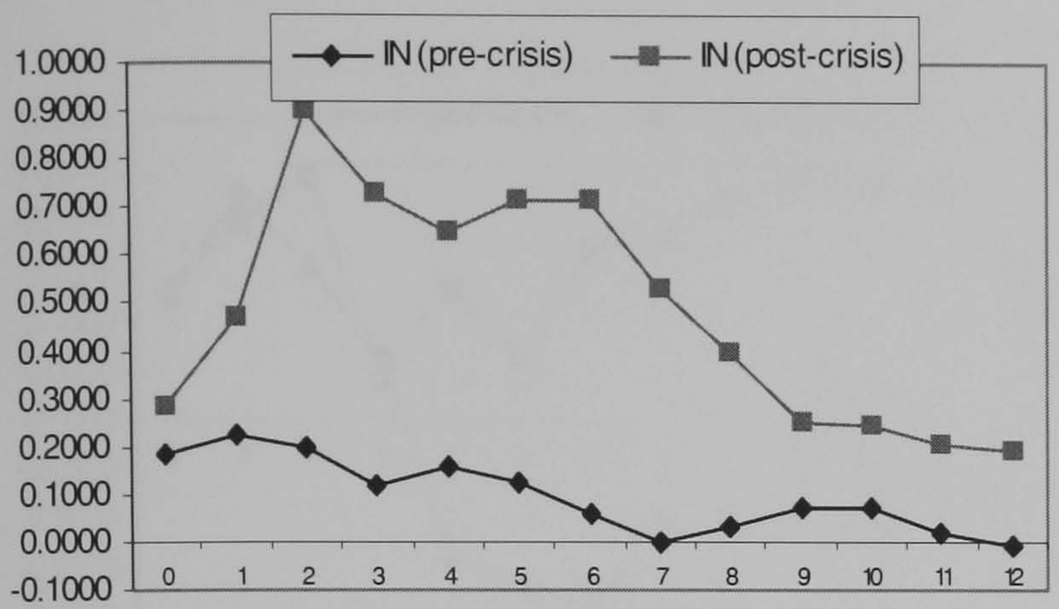


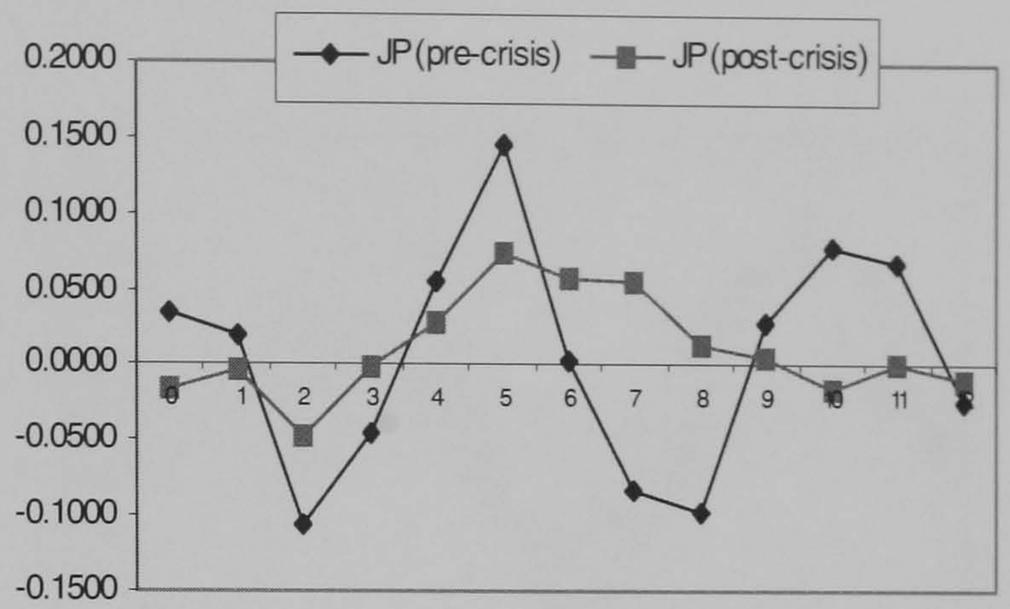


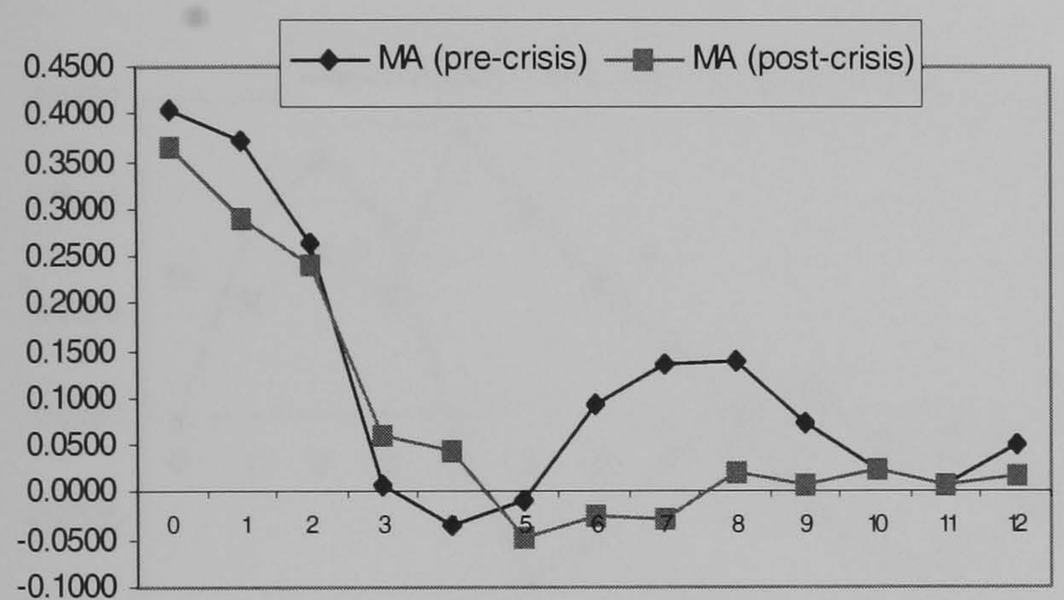


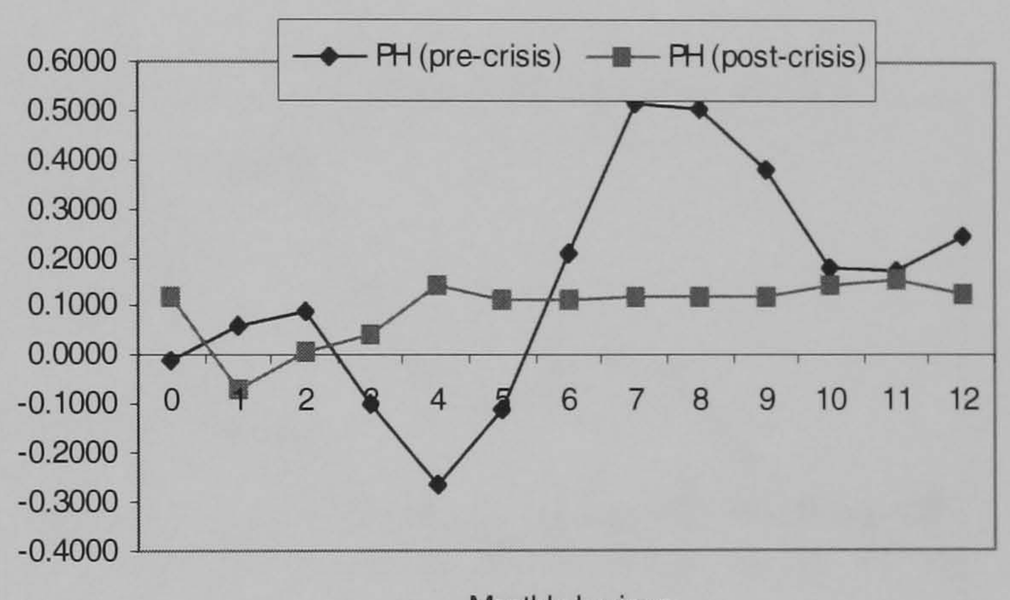
Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

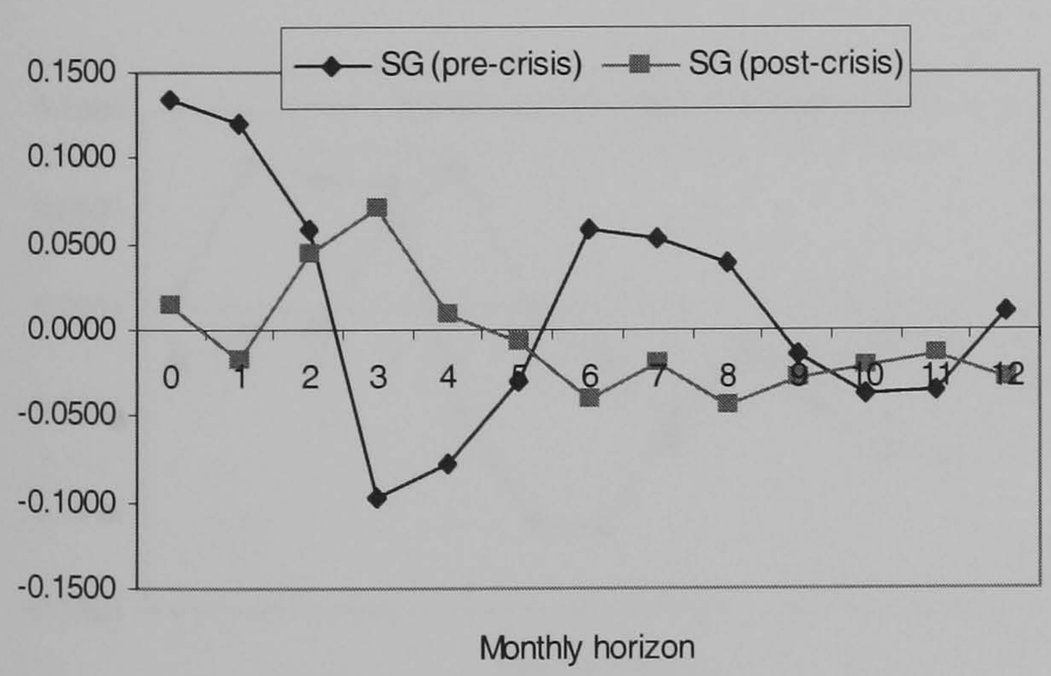
Figure 6.5: Generalised impulse responses to a shock in Malaysia

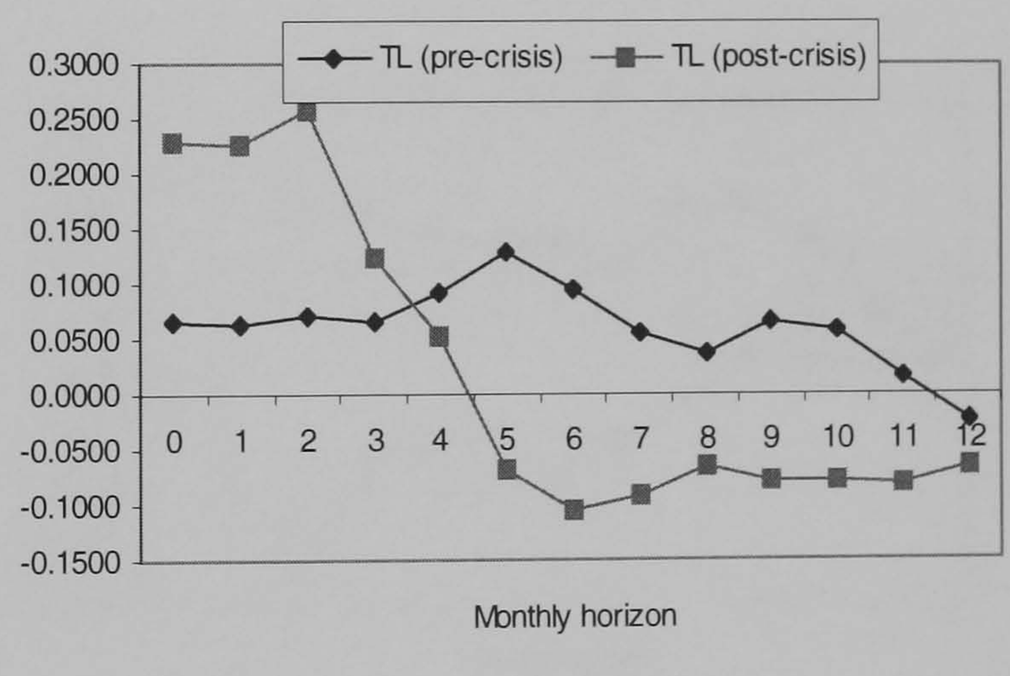


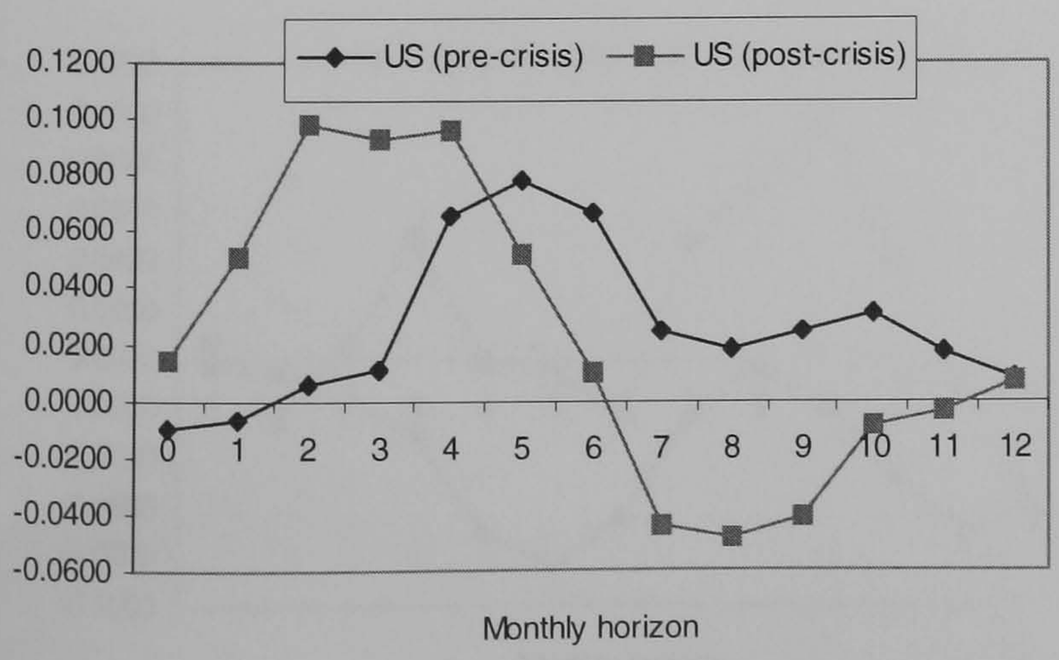






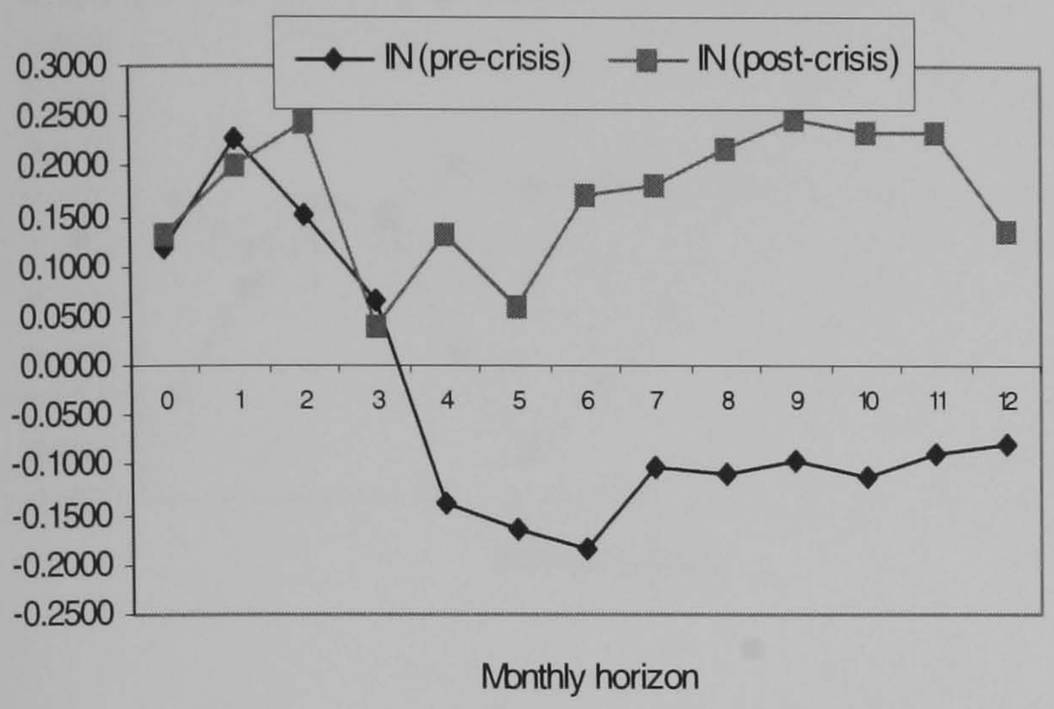


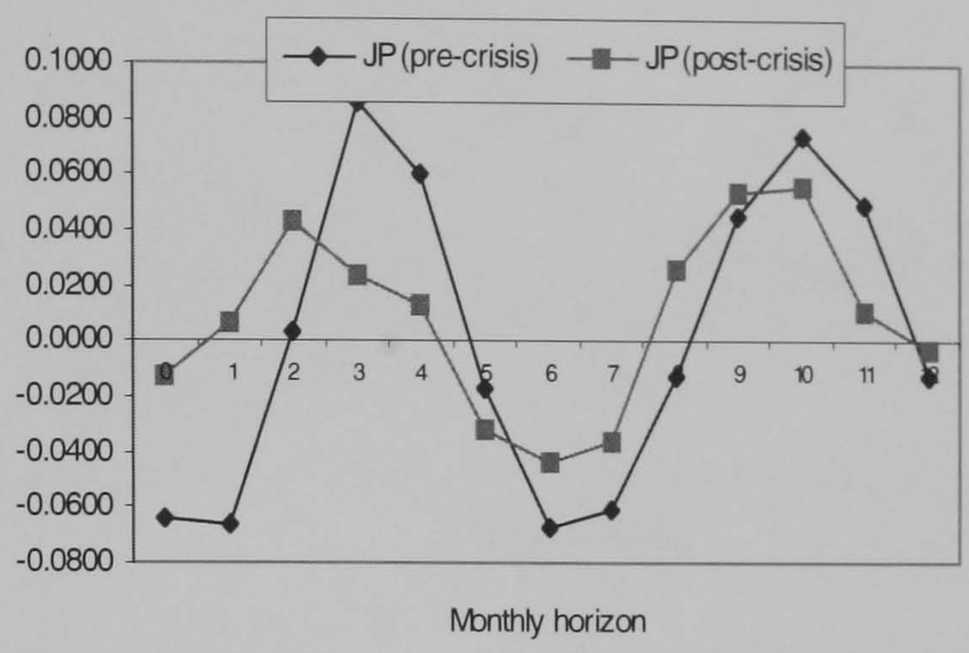


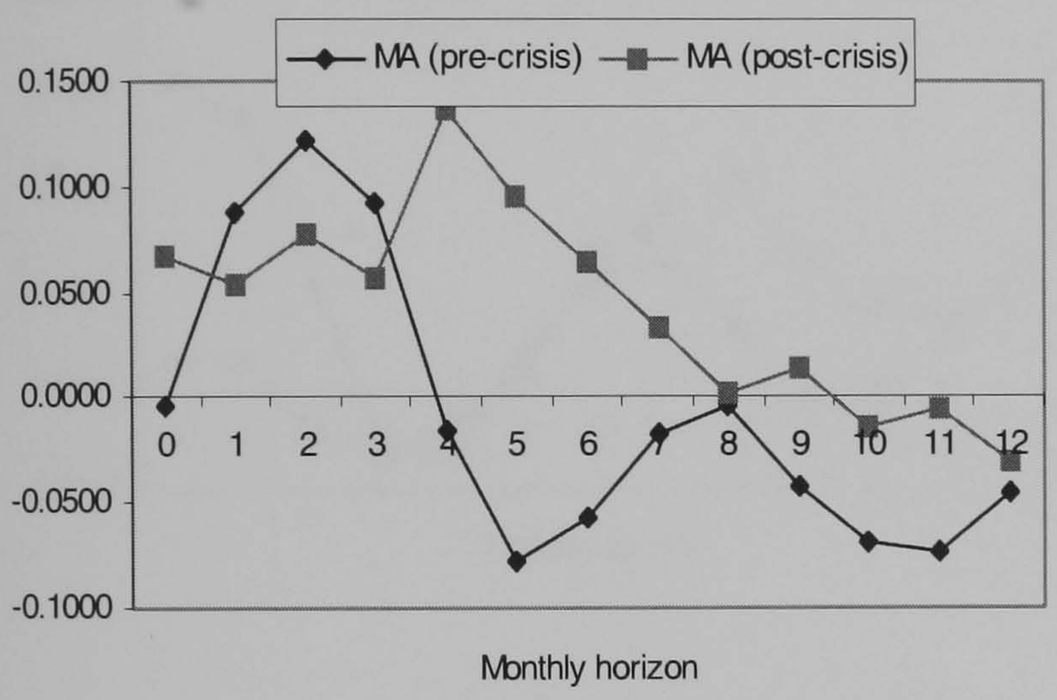


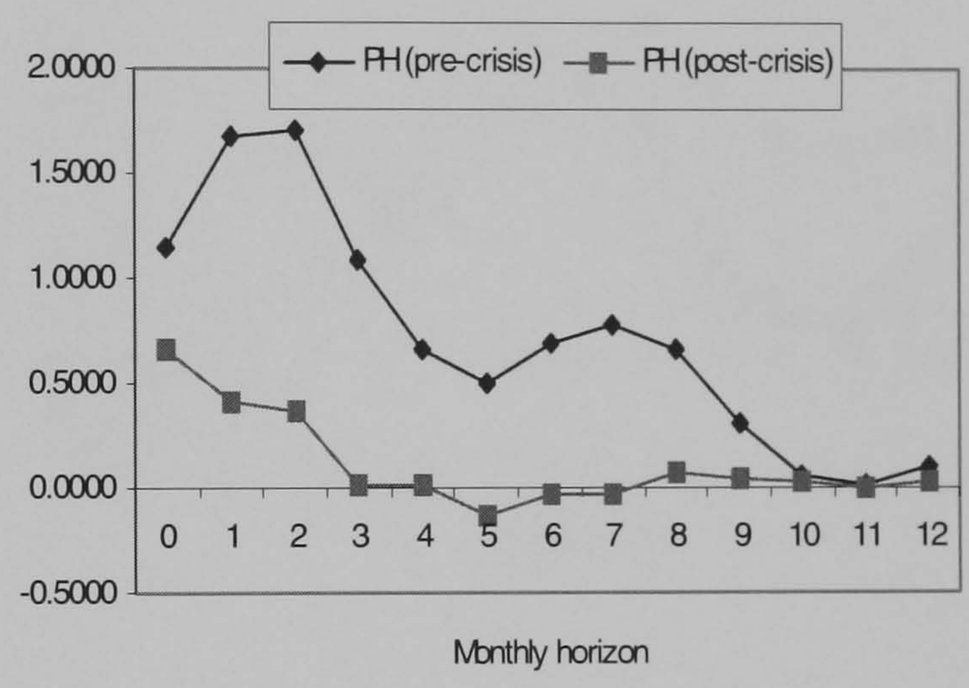
Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

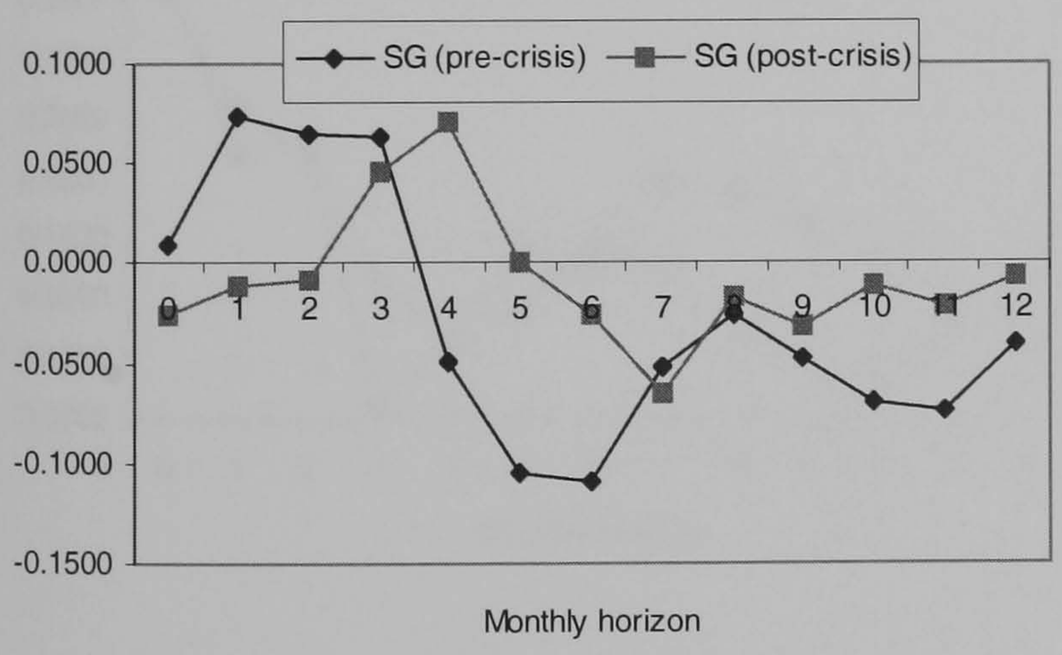
Figure 6.6: Generalised impulse responses to a shock in the Philippines

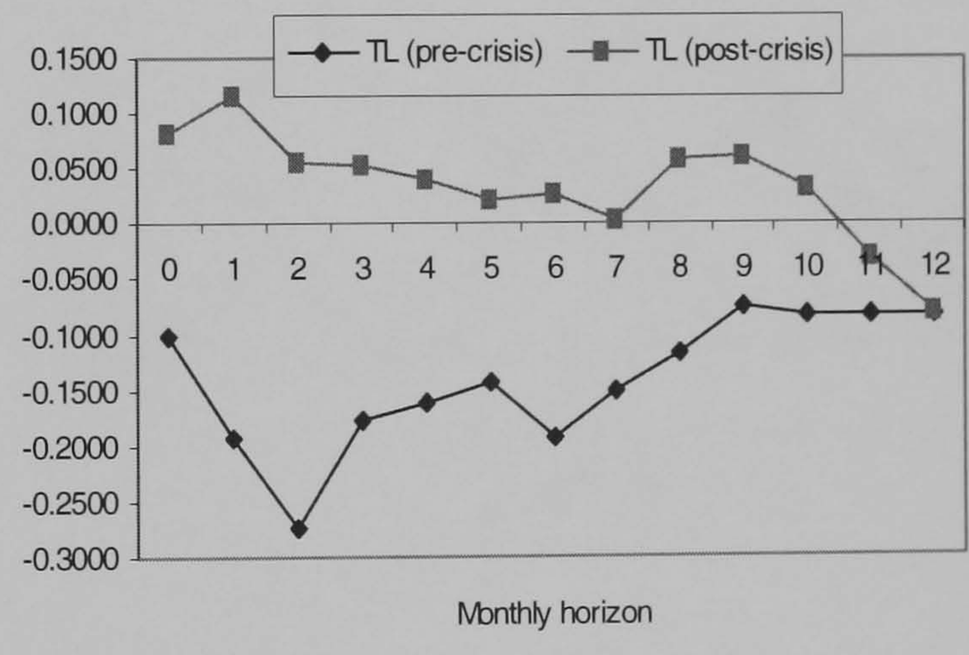


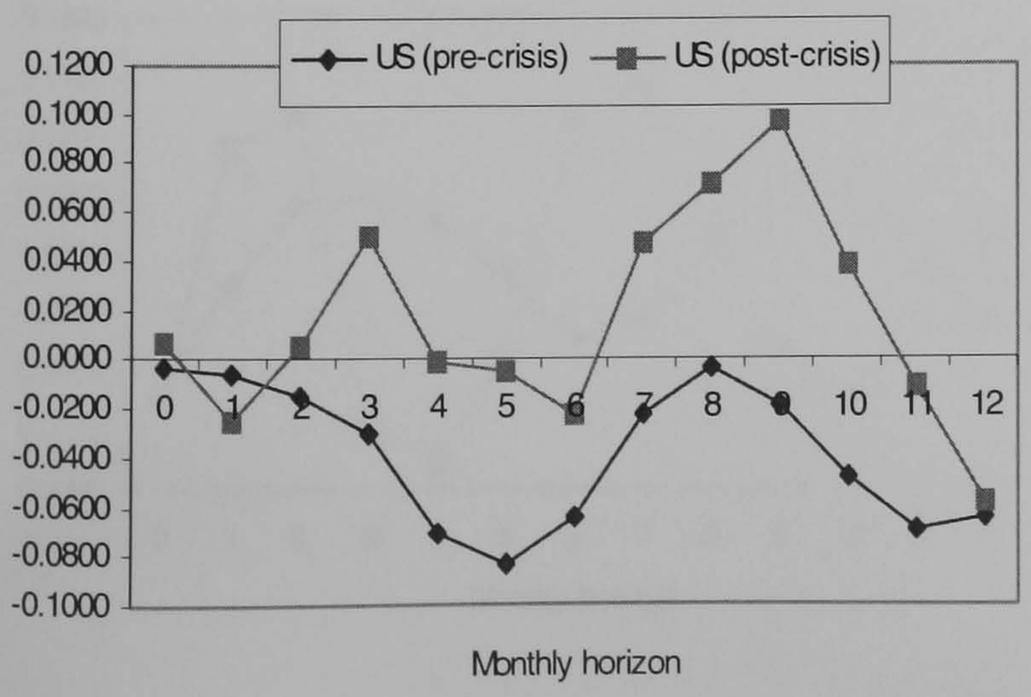






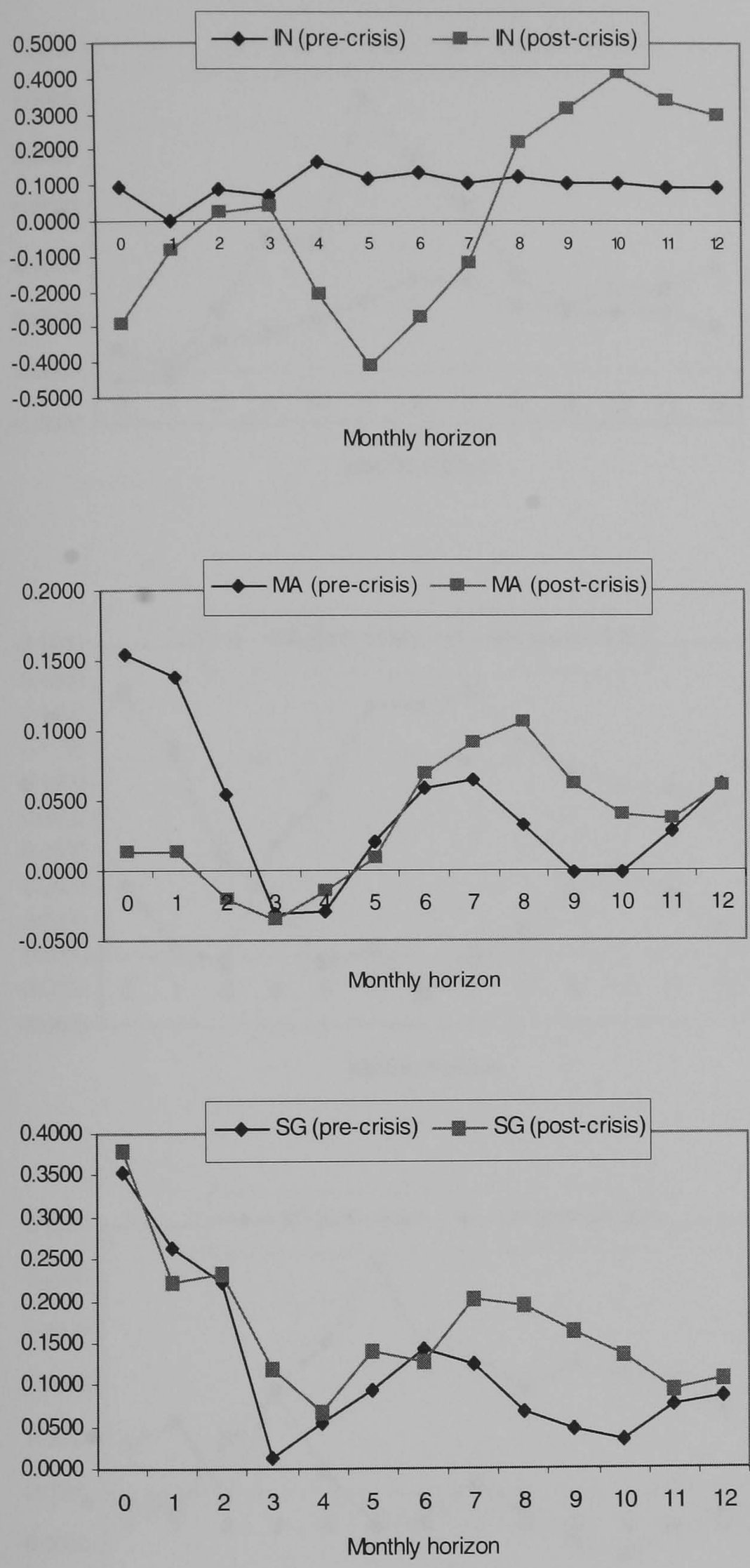






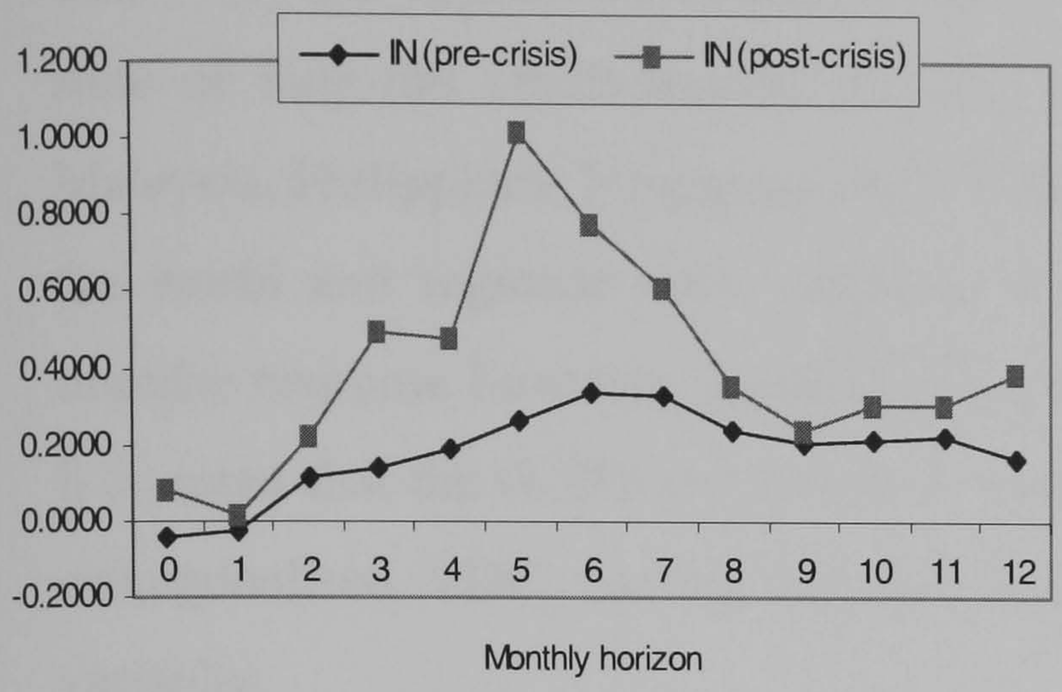
Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

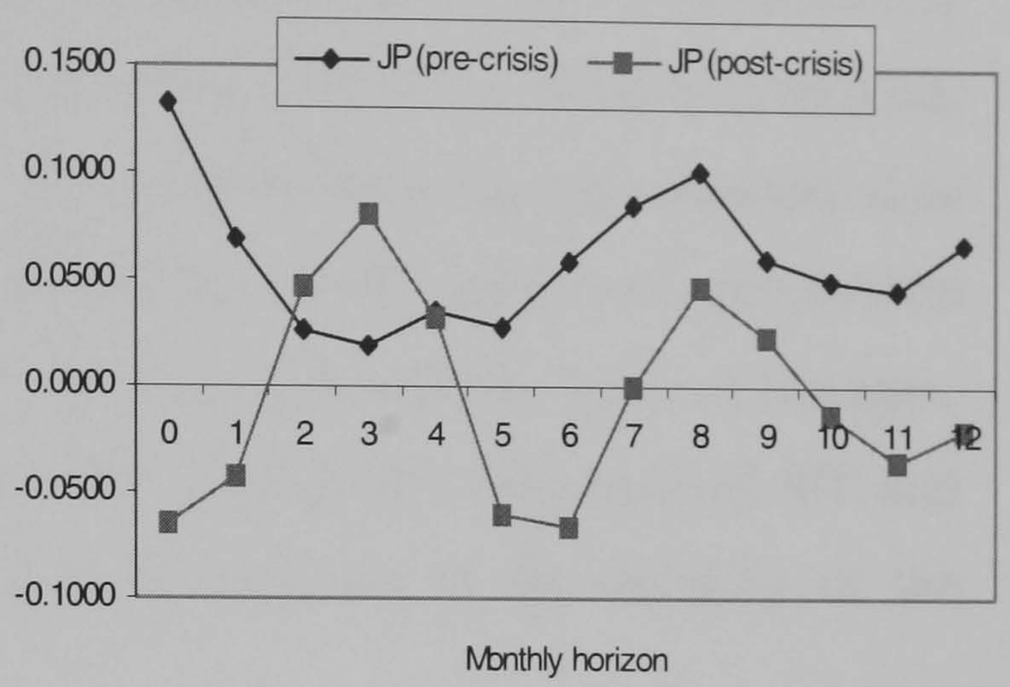
Figure 6.7: Generalised impulse responses to a shock in Singapore

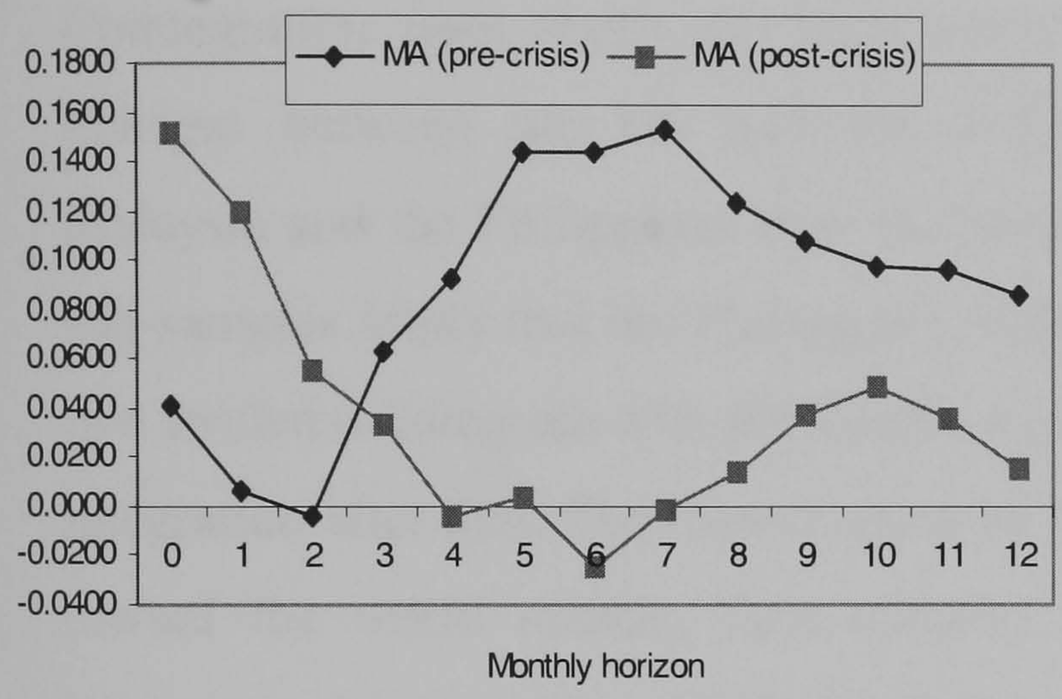


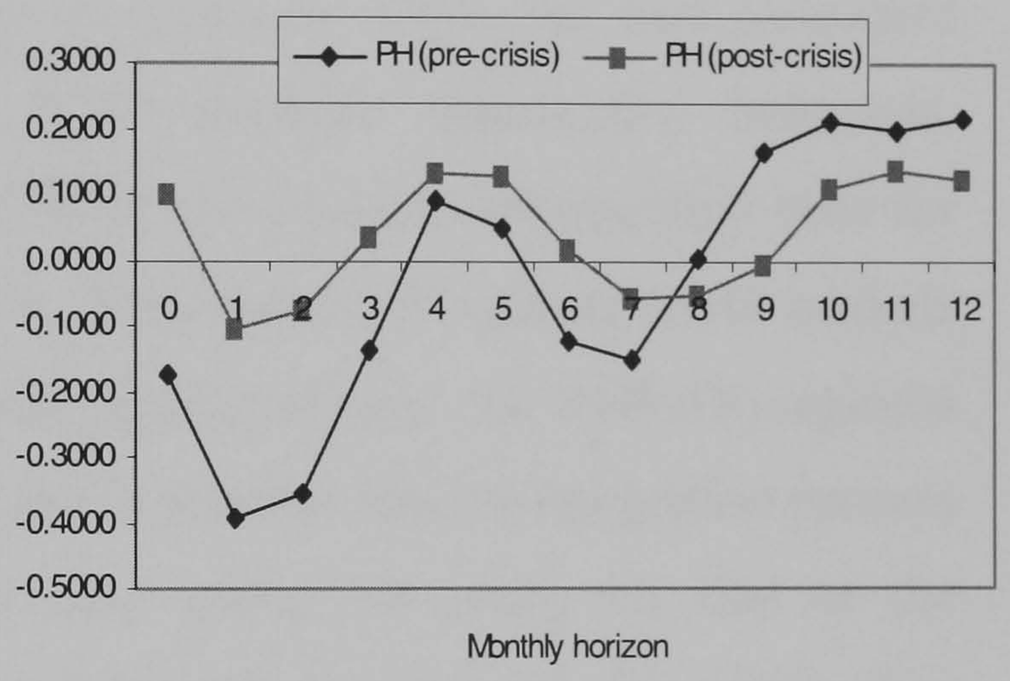
Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

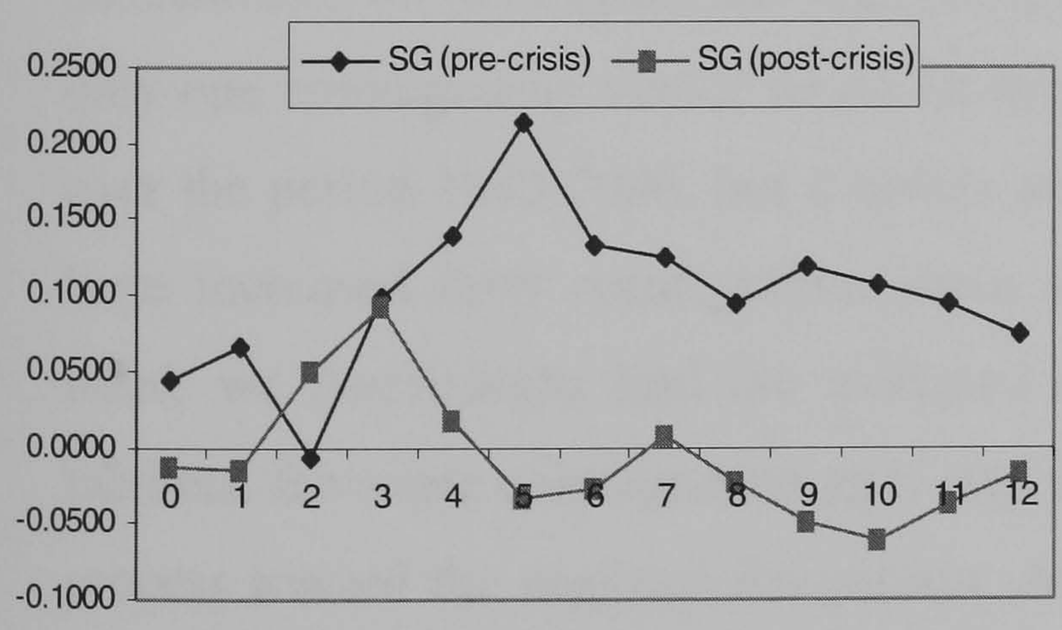
Figure 6.8: Generalised impulse responses to a shock in Thailand

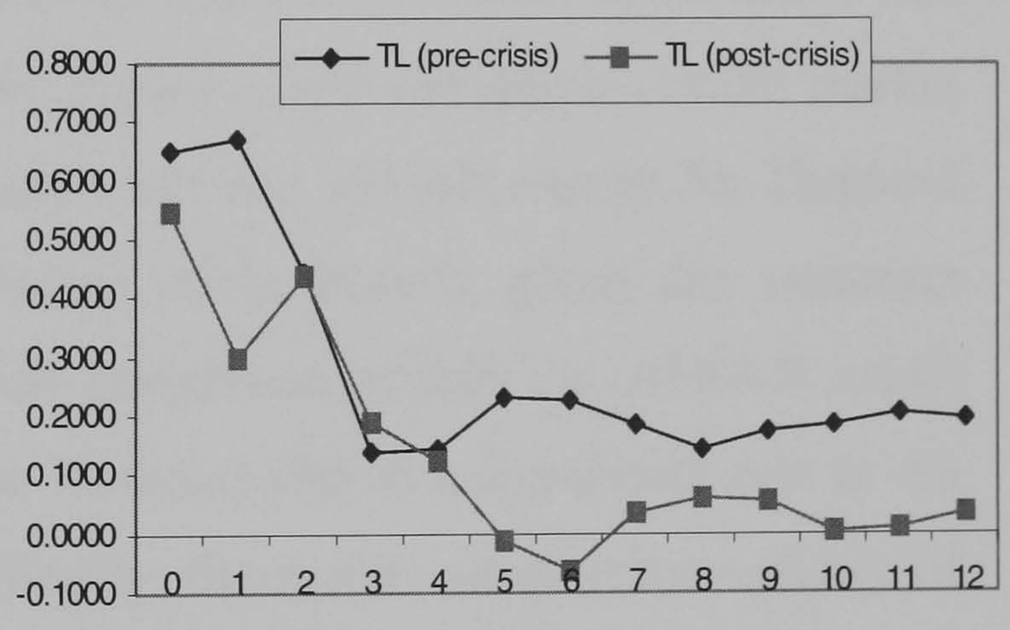


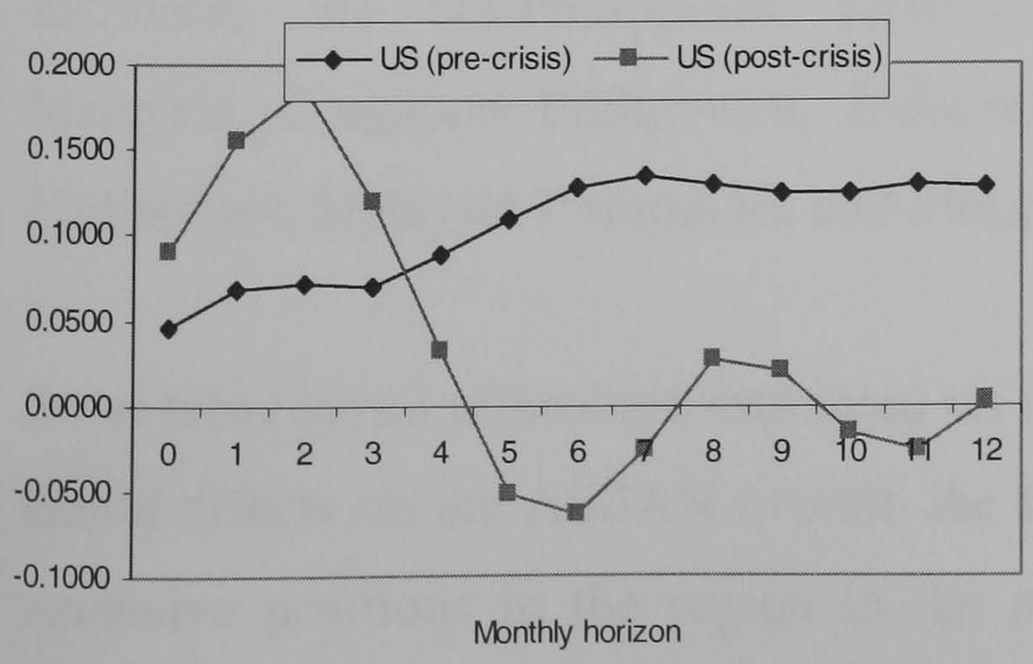












Note: HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

6.4 CONCLUSIONS

This study has applied the Johansen multivariate cointegration techniques to examine the state of long-run credit market integration in the ASEAN-5 area; namely Indonesia, Malaysia, Philippines, Singapore and Thailand. The US and Japan rates are considered as the world and regional rates, respectively. Additionally, VAR model and generalised impulse response functions (G-IRF) forecasts are also used to explore short-run linkages. It is noted that the G-IRF models overwhelm the shortcoming of orthogonalised IRF and orthogonalised VDC, having the advantage of being invariant to the ordering of the variables.

Cointegration tests result in many interesting implications. First, we find long-term linkages between the US and the ASEAN credit markets, specifically, Indonesia, Malaysia and the Philippines over the period 1983-2006. Second, cointegration tests for sub-samples imply that the Philippines, Indonesia, Thailand and Singapore credit markets first tended to integrate with the US for a particular period of time, but shifted to regional integration after that. The reason could be that after a specific time of integration process toward the world market, they realised they were really not ready for that or the international integration may harm their current financial development. Therefore, they concentrated on developing the regional and national financial systems. Third, there was only one cointegrating vector found between the Japanese and Philippines credit market over the period 1983-2006, but it seems that Japan and the ASEAN except for Thailand have increased their cointegration since the Asian crisis. Fourth, given one common trend, we surprisingly find the evidence of full integration within the ASEAN credit markets. Bivariate cointegration tests imply that Thailand played a significant role in the process toward the regional integration. And, finally, the results support the validity of real interest rate parity theory. Particularly, we find the [1-1] vector in the pairs of the US-Indonesia, the US-Philippines, Japan-Philippines, Singapore-Indonesia, Singapore-Malaysia, Singapore-Philippines, Indonesia-Malaysia, Indonesia-Thailand, Indonesia-Philippines, Malaysia-Philippines and Philippines-Thailand.

Short-term causal effects are estimated on the basis of VAR models. First, with one-way causal effects on the ASEAN overall, the US and Japanese credit markets confirm their exclusive positions in the region in the pre-crisis period. Second, the ASEAN credit

markets have increasingly linked to each other over time. In line with the results from bivariate cointegration tests, Thailand has had great impact on other regional markets all the time. Next, with strong and long lasting impact on other ASEAN, Japan and the US (in the post-crisis), Singapore - the only developed in the ASEAN - appears to take a significant position either in the regional or the world credit markets. And, finally, a common behaviour of real interest rates over the two periods is that they are positively related to and most explained by their last month changes.

The state of shock transmissions are also reported on the basis of G-IRF tests. First, all of credit markets were impacted most by their own shocks over the period 1983-2006. Especially, the response of Indonesia to its own shock reached the maximum rate at 195.76% after the Asian crisis. Second, a shock in the US credit market was highly transmitted to and long-lasting in the ASEAN and Japan credit markets before the Asian crisis. After that, the impact of the US was reduced. Third, the US and ASEAN-5 credit markets had weak linkages to a shock in Japan over the period 1983-2006. Among the ASEAN credit markets, although Thailand used to be impacted most by Japan in the pre-crisis, has had a divergent relationship after that. The US and Singapore also had divergent responses to the Japanese shock during the post-crisis. Fourth, although the ASEAN credit markets were significantly affected by the US shock, these effects were not as much as the regional ones. Besides, excluding Indonesia, it seems that the ASEAN credit markets have increased their impact on the US over time due to the fact that their impact was larger in the post-crisis than in the pre-crisis. In contrast, for Japan, their impact has decreased over the period 1983-2006. And finally, the Singaporean credit market significantly affected all other markets including the US and Japan, the two biggest ones in the world, implying the considerable role of Singapore not only in the region, but in the world as well. More interestingly, the Singapore credit market seems to influence the US and Japan more than being impacted by them

The results from this thesis could significantly contribute to investors' investment decisions. Indeed, the evidence of long-term integration and real interest rate parity in the ASEAN credit markets will make cross-border trading more flexible and efficient, giving the investors more opportunities to enlarge their investments. Besides, the results of short-run dynamics, shock transmissions and the considerable roles of Singapore and Thailand

may help international as well as regional investors manage risks in their portfolio investments better.

Several policy implications may be drawn based on these findings. First, policy makers in the ASEAN countries are interested in identifying the degree of integration of financial markets as part of negotiating and defining an agenda of reform and liberalisation in the region (Ghosh, 2006). Second, the considerably high level of regional cooperation and integration may provide the ASEAN with a stronger voice in global forums and greater influence on global policy making. Grenville (2000, 2003) argues that greater regional policy dialogue and cooperation are important because they provide the region with influence over global rules setting. Next, although a deeper level of financial market integration increases the tendency of capital flows to equalize real long-term interest rates between countries, a wider dispersion of short-term interest rates may persist, reflecting the business and financial conditions in each country. In this case, monetary policy will affect real economic activities by altering the spreads between long- and short-term interest rates. Thus, it seems to be the case that increased financial market integration will change the transmission mechanism of monetary policy. And, finally, the strongly on-going process of regional integration is premising a common currency area in future. Estimates of regional and global integration indicate that the ASEAN common currency is unlikely to be the US dollar or Japanese yen. Besides, Okina et al (1999) suggest that the target zone arrangement will be a realistic option for a group of small countries with a high dependency on foreign trade.

Credit market and stock market are two main players in financial markets overall. This chapter has exclusively focused on the ASEAN-5 credit market integration. We will look at the ASEAN-5 stock market integration in the next chapter in order to have a deep understanding of the state of financial integration in the ASEAN-5 markets.

CHAPTER VII

ASEAN-5 TIME-VARYING STOCK MARKET INTEGRATION AND CORRELATIONS: EMPIRICAL TESTS AND RESULTS

7.1 INTRODUCTION

This chapter reports empirical findings of stock market integration focusing on Indonesia, Malaysia, Philippines, Singapore and Thailand (called ASEAN-5 area or ASEAN). Similar to the credit market integration study conducted in the previous chapter, global integration and regional integration are two main topics throughout this chapter. Empirical tests are conducted on the basis of the CAPM (capital asset pricing model) framework suggested by Bekaert and Harvey (1997) and modified by Fratzscher (2001) and Bekaert et al (2005). The main advantages of this model are not only applying an advanced econometric model (GARCH) to estimate time-varying parameters of global and regional integration, but clearly distinguish estimates of market integration and market efficiency as well.

This chapter also takes a further step in estimating conditional correlations in the US, Japan and ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore and Thailand) stock markets based on the Asymmetric Dynamic Conditional Correlation (ADCC) proposed by Cappiello et al (2004). It has been argued and generally accepted that the multivariate generalised autoregressive conditional heteroskedasticity (MGARCH) models are best for studying the transmission mechanism and correlation dynamics. However, the model which is employed to capture the interrelationships among the markets can play a crucial role in the final results. A brief review in the literature leads to the following well-known MGARCH models: VECH model (Bollerslev, Engle and Wooldridge, 1988), Constant Conditional Correlation (Bollerslev, 1990), BEKK model (Engle and Kroner, 1995), Factor-GARCH (Alexander and Chibumbu, 1997), Orthogonal-GARCH (Alexander, 2001) and Dynamic Conditional Correlation (Engle, 2001). Although each of these

models has its own advantages and disadvantages, it will be very beneficial to have a model that encompasses at least the major multivariate models. The Asymmetric Dynamic Conditional Correlation (ADCC) is able to meet this requirement.

All of data for the US, Japan and the ASEAN-5 are index price returns covering from January 1991 to December 2006. While weekly data are used for the estimates of market integration in order to balance between information and noise (see sub-section 5.3.3.1), daily data are used for the estimates of market conditional correlations mainly because the ADCC requires a lot of observations. This chapter is structured as follows. Section 7.2 reports and discusses the state of regional and international integration in the ASEAN-5 stock markets. Section 7.3 draws the findings of time-varying conditional correlations across the US, Japan and ASEAN stock markets. And, finally, conclusions are given in section 7.4.

7.2 TIME-VARYING STOCK MARKET INTEGRATION

This section reports the findings of stock market integration based on the CAPM-TGARCH model (see sub-section 5.3.1.1). This approach allows estimating the degree of market integration over time. Weekly data cover from January 1991 to December 2006 (see sub-section 5.3.3.1). The purpose of this section is to answer the following main research questions. How do local volatilities respond to volatility-spillovers from the world and region? To what extent can changes in the global and regional returns affect local returns? How much are local stock returns explained by the world and regional factors? And, what are the patterns of market integration? The results of specification tests are also reported to assess whether the CAPM-TGARCH model appropriately capture the data generating process.

7.2.1 Descriptive Statistics

The series of price indices are plotted in Figure 7.1. It seems that the US stock market did not have strong linkages to the ASEAN before 2001. It was not affected much by the

Asian crisis. In fact, while the ASEAN price indices were sharply declining during this period of time, the US price index was still going up. The down trend of the US market did really happen from the 15th January 2000, and then lasted to the ninth September 2002. The crisis 2000-2002 is considered the 10th worst crash in the US stock market history[40]. Comparing the patterns of the US and ASEAN price indices, we find that they have been connected – especially, the similar behaviour of the US and Singaporean price indices – since 2001.

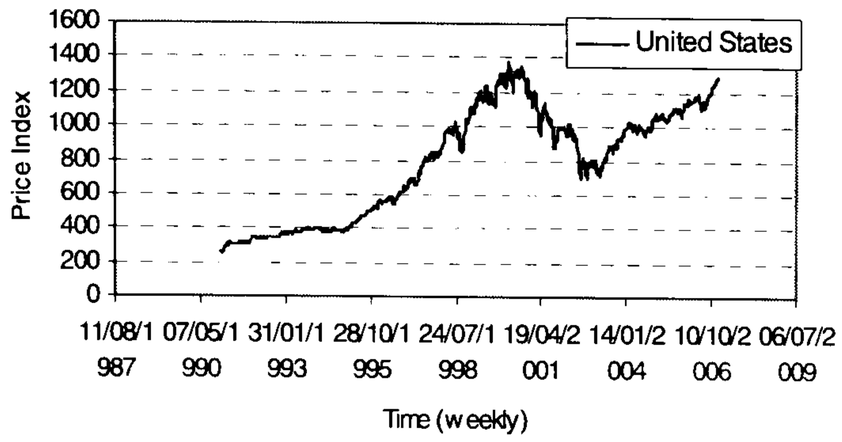
Generally, the patterns of price indices in the ASEAN are quite similar. "Similar patterns" mean similar periods of up and down trends rather than similar levels of fluctuations. The ASEAN stock markets were all heavily affected by the 1997 financial crisis. Compared to the period of 1992-1997, excluding Singapore, they have not been recovered so far. Indonesia, Malaysia, Philippines and Thailand reached their peaks of price indices at 105.14 points on 26/02/1997, 747.12 points on 26/03/1997, 870.06 points on 26/03/1997 and 1075.29 points on 03/04/1996, respectively. Although the 1997 financial crisis did impact the Singaporean stock market, it did not last long. The Singaporean stock market quickly recovered, continuously developed and reached its peak of price index at 803.53 on 27/12/2006. More interestingly, Singapore appears to be not only close to the other ASEAN, but strongly connected to the US as well.

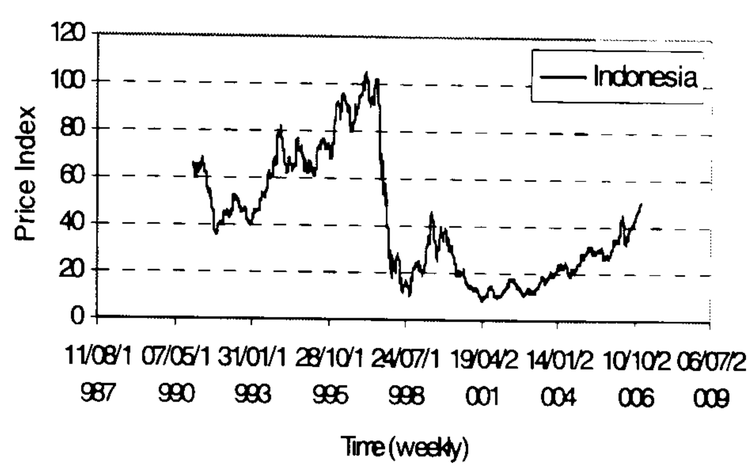
Table 7.1 reports the correlation matrix of weekly returns covering from January 1991 to December 2006 and also looking at three sub-periods: before the 1997 financial crisis, in the crisis (July 1997 to December 2000) and after the crisis (from January 2001 till December 2006). Particularly, for the relationship between the US and ASEAN stock markets, correlations were positive in all cases, but much smaller compared to those between the ASEAN markets. In fact, the mean of correlations was 0.2168 for the former and 0.4443 for the latter over the period 1991-2006. While the Filipino, Indonesian and Malaysian stock markets had their lowest correlations with the US in the Asian crisis period, it is opposite in the case of Thailand. Actually, given the correlation of 0.3185, Thailand had its highest correlation with the US during this period of time. Generally, excluding Thailand, the ASEAN stock markets tended to increase their correlations with

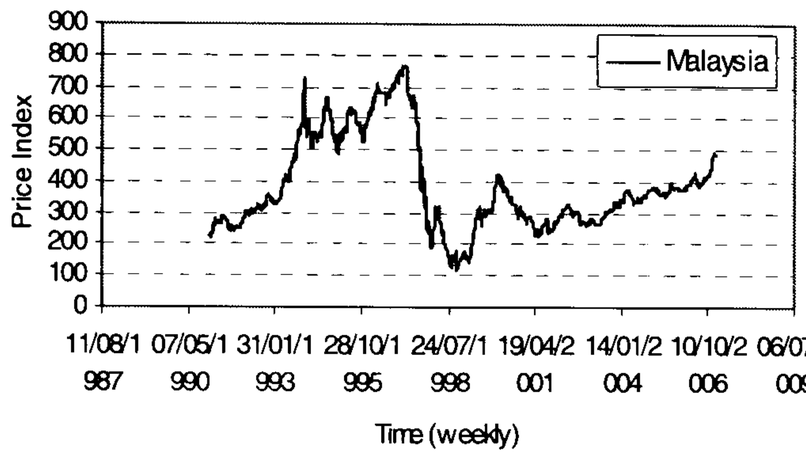
[40] *http://mutualfunds.about.com/cs/history/p/crash10.htm*

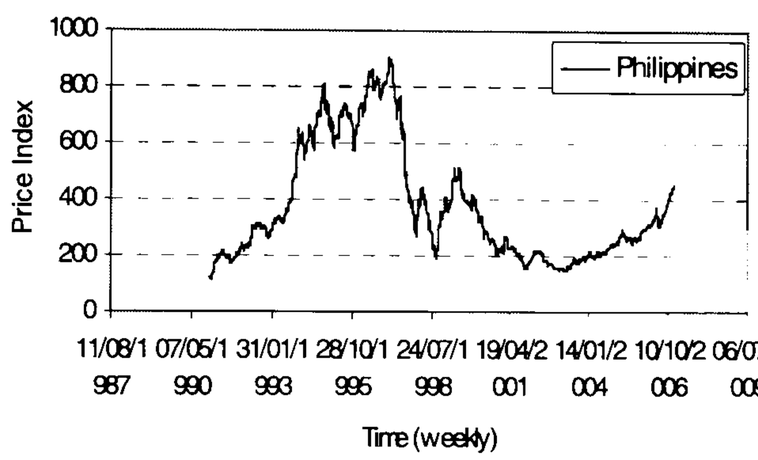
the US in the post-crisis period. Among the ASEAN-5 stock markets, it is evident that Singapore had the strongest linkage to the US and their correlations have increased over time.

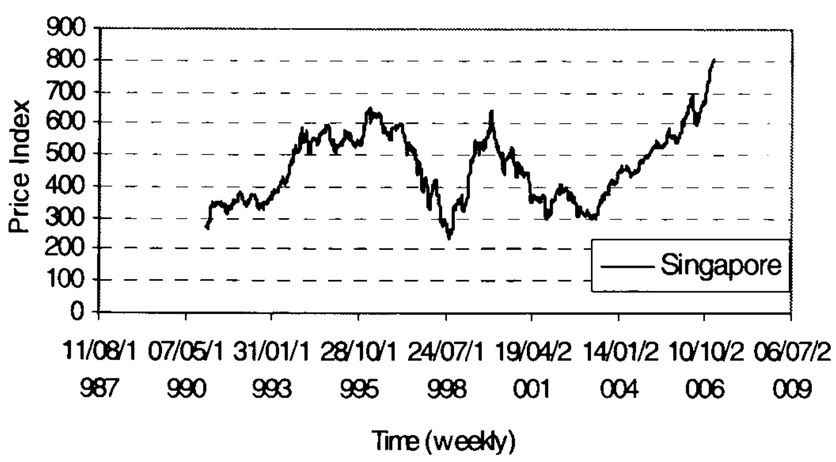
Figure 7.1: Plots of the indices for the period of January 1991 – December 2006

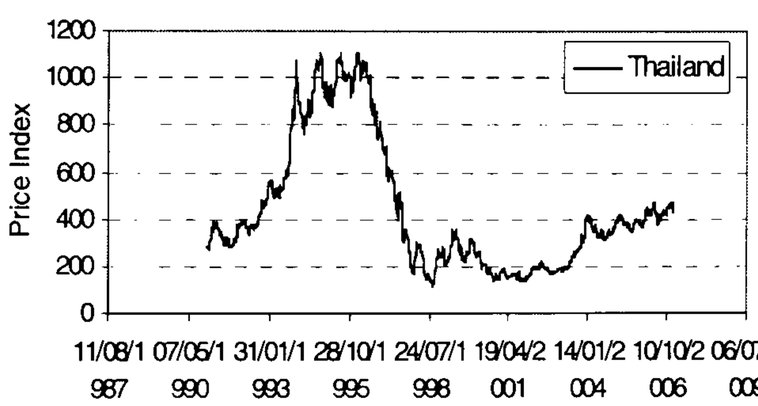












As illustrated in Table 7.1, the ASEAN-5 stock markets were highly correlated with each other over the period 1991-2006. The two most noticeable linkages are the linkages of Singapore-Malaysia and Singapore-Thailand. In fact, the mean of correlations was 0.5032 for the former and 0.5298 for the latter. Generally, the correlations of weekly returns within the ASEAN-5 were highest in the period of Asian crisis. It is evident that the mean of correlations within the ASEAN was 0.3682, 0.4960 and 0.4157 in the pre-crisis, in the

crisis and in the post-crisis periods, respectively. After the Asian crisis, the mean of correlations slightly declined since the Filipino stock market less correlated with the others. The Singaporean stock market plays a considerable role in the region. Among the ASEAN-5 stock markets, Singapore had the highest correlations with the others. The mean of correlations between Singapore and other ASEAN was 0.4723 over the period 1991-2006.

Table 7.1: Correlation matrix of weekly returns

	United States	Indonesia	Malaysia	Philippines	Singapore	Thailand
09/01/1991-27/12/2006						
United States	1					
Indonesia	0.1389	1				
Malaysia	0.1724	0.4128	1			
Philippines	0.2005	0.4509	0.3612	1		
Singapore	0.3402	0.4154	0.5032	0.4409	1	
Thailand	0.2320	0.4282	0.4423	0.4587	0.5298	1
09/01/1991-25/06/1997						
United States	1					
Indonesia	0.1479	1				
Malaysia	0.1646	0.3510	1			
Philippines	0.1618	0.3248	0.2774	1		
Singapore	0.2210	0.3418	0.6311	0.3039	1	
Thailand	0.0936	0.2990	0.4449	0.3212	0.3864	1
02/07/1997-27/12/2000						
United States	1					
Indonesia	0.1324	1				
Malaysia	0.1557	0.4318	1			
Philippines	0.1436	0.5318	0.4199	1		
Singapore	0.3488	0.4430	0.4646	0.5509	1	
Thailand	0.3185	0.4789	0.4466	0.5949	0.5979	1
03/01/2001-27/12/2006						
United States	1					
Indonesia	0.1847	1				
Malaysia	0.2954	0.4092	1			
Philippines	0.2939	0.3965	0.3152	1		
Singapore	0.4281	0.4173	0.5548	0.3703	1	
Thailand	0.2561	0.4140	0.4539	0.3206	0.5324	1

Table 7.2 contains summary statistics for the excess returns of the six countries indices. The average weekly excess returns fall in a wide range of: from -011393% (Indonesia) to 0.11071% (the US). The standard errors of the weekly excess returns fall in the interval

between 0.195851% (Indonesia) and 0.073892% (the US). All the excess return distributions except for Thailand are skewed to the left and all show excess kurtosis. This means that negative shocks are more frequent than positive shocks (negatively skewed); and large shocks are more common than expected statistically (excess kurtosis). All of the series are significantly auto-correlated (Ljung and Box (1978) tests for twelfth order autocorrelation). This indicates that the AR specification is useful. The squared excess return series are, in all cases, several times greater than that calculated for returns implying the existence of high heteroskedasticity, which motivates the GARCH specification.

Table 7.2: Descriptive statistics of weekly excess returns (1991-2006)

LB(12) implies the Ljung and Box (1978) test for twelfth order autocorrelation. *, ** and *** indicate the significant level of 10%, 5% and 1%, respectively.

Statistics	United States	Indonesia	Malaysia	Philippines	Singapore	Thailand
Mean	0.1107	-0.1139	0.0109	0.0803	0.0474	-0.0293
Min	9.2752	-36.7180	-39.1255	-20.4842	-12.6928	-17.9525
Max	9.9503	27.1405	27.5212	24.4889	10.1876	24.0941
Range	19.2256	63.8579	66.6467	44.9730	22.8804	42.0466
Standard error	0.0739	0.1959	0.1453	0.1384	0.0932	0.1669
Skewness	-0.2089	-0.6000	-1.1028	-0.0445	-0.2486	0.0625
Kurtosis	5.2119	10.4661	21.2417	8.0125	5.1079	5.2283
LB(12)	32.3457***	32.6329***	47.2433***	37.9041***	31.8993***	27.7744***
LB(12) squared	250.8581***	513.4466***	237.3129***	132.3311***	249.0605***	444.5601***

7.2.2 Regional and Global Integration

Table 7.3 presents the results for estimating the time-invariant degree of world and regional integration in the ASEAN-5 stock markets over the period from the 2nd January 1991 to the 27th December 2006 based on the CAPM-TGARCH model (see equations 5.3, 5.4, 5.5 and 5.8 in sub-section 5.3.1.2). γ_{iU} and γ_{iA} are the indicators of world and regional integration. Regarding the world integration, γ_{iU} is significantly positive for the Singaporean stock market, negative for the Philippines and negligible for the others. This implies that 1) Singapore is the only ASEAN stock market having a statistically significant degree of integration toward the world, but the magnitude of integration was moderate, approximately 20% over the period 1991-2006; 2) the Philippines had a strong

divergent relationship with the world market, indicating opportunities for portfolio diversifications between the world and the Philippines markets; and 3) Indonesia, Malaysia and Thailand were inconsiderably affected by the world stock market during this period of time. In contrast, regarding the regional integration, γ_{iA} is significantly positive for all the ASEAN stock markets. Especially, Thailand with its coefficient γ_{iA} of 1 implies that the Thai stock market was fully integrated with the ASEAN over the period 1991-2006. Right behind Thailand, Indonesia with its coefficient γ_{iA} of 0.87 confirmed its substantial degree of regional integration during this period of time. It is noted that Singapore had the lowest degree of regional integration compared to the others over the same period. This may be resulted from the fact that the Singaporean stock market is much more developed than the other ASEAN.

Fratzscher (2001) considers past information effects as the indicators of market efficiency. Specifically, the hypothesis is that the more past information effects are, the less efficient the market is. As illustrated in Table 7.3, β_{i1} and β_{i2} are used to measure the effects of the country *i*'s weekly excess return and dividend yield on the stock market *i*, standing for the local past information effects. β_{iU} and β_{iA} measure the effects of world and regional past conditional excess returns on each of the ASEAN markets, also called the world and regional past information effects, respectively. The effects of past information can be summarised as follows. First, Indonesia and the Philippines are impacted heavily by their local past information, especially their own past excess returns. In fact, β_{i2} was approximately 14.37 and 20.81 for Indonesia and the Philippines, respectively. Second, the regional past information does have strong positive impact on all of the ASEAN markets. Even though Singapore and Malaysia are the two most developed stock markets in the region, both are still significantly affected by the regional past conditional excess returns. And, finally, given the significantly negative value of β_{iU}, Indonesia and Thailand have divergent linkages with the world market. Generally, there was no existence of full market efficiency in the ASEAN in the period 1991-2006. Among the ASEAN, it appears that Indonesia has the lowest degree of market efficiency.

Table 7.3 also reports the estimates of volatility effects. Our results indicate that the persistence in volatility, as measured by the sum of α_{i1} and α_{i2} and in the CAPM-TGARCH model, ranging from 0.88 (the Philippines) to 1.00 (Thailand) with an average of 0.93, is closer to one, suggesting a stronger presence of ARCH and GARCH effects. Excluding Malaysia, the value of η_i is significantly negative in all of the cases, implying the existence of asymmetric local news effects. Particularly, bad news appears to make more impact on the conditional volatilities than good news could do. However, for Malaysia, η_i is not significantly different from zero, indicating that the asymmetric local news effects are negligible.

Considering the volatility spillover effects from the ASEAN to individual stock markets, we find that ς_{iA} is significantly positive in the cases of Indonesia, Malaysia and the Philippines. This implies that a shock in the region would be significantly transmitted to the Indonesian, Malaysian and Filipino stock markets. Additionally, φ_{iA} of Malaysia and the Philippine is positive at 5% level of significance implying that regional positive innovations have more impact on these markets than negative shocks do, which is opposite to the behaviour of local asymmetric volatility spillover effects discussed in the above paragraph. ς_{iA} is not different from zero at any level of significance in the cases of Thailand and Singapore indicating that these stock markets are not significantly impacted by a regional shock. It is reminded that the ASEAN market index is a weighted average of ASEAN countries. Therefore, the results of Thailand and Singapore do not mean these markets are completely isolated from shocks in any individual market. Regarding volatility spillover effects from the world market, only Malaysia and Thailand have significantly positive ς_{iU} and φ_{iU}, indicating these markets are significantly affected by shocks from the world; and the world innovations would have more effects than negative shocks would do. To some extent, the different behaviours of asymmetric volatility spillover effects from the local, regional and world markets imply that investors respond to the regional and global news (even bad or good) more optimistically than they do to the local.

Table 7.3: Summary results of regional and global integration (1991-2006)

The CAPM-TGARCH model for country *i* (see sub-section 5.3.1.2) is defined as follows:

$$r_{i,t} = \beta_{i0} + \beta_{i1} DY_{i,t-1} + \beta_{i2} r_{i,t-1} + \beta_{iU} \omega_{U,t-1} + \beta_{iA} \omega_{A,t-1} + \gamma_{iU} \varepsilon_{U,t-1} + \gamma_{iA} \varepsilon_{A,t} + \varepsilon_{i,t}$$

$$\sigma^2_{\varepsilon,i,t} = \alpha_{i0} + \alpha_{i1} \varepsilon^2_{i,t-1} + \alpha_{i2} \sigma^2_{\varepsilon,i,t-1} + \varsigma_{iU} \varepsilon^2_{U,t-1} + \varsigma_{iA} \varepsilon^2_{A,t} + \eta_i \varepsilon^2_{i,t-1} I[\varepsilon_{i,t-1} > 0] + \varphi_{iU} \varepsilon^2_{U,t-1} I[\varepsilon_{U,t-1} > 0] + \varphi_{iA} \varepsilon^2_{A,t} I[\varepsilon_{A,t} > 0]$$

$$\omega_{U,t} = \beta_{U0} + \beta_U X_{U,t-1}; \qquad \omega_{A,t} = \beta_{A0} + \beta_{AA} X_{A,t-1} + \beta_{AU} \omega_{U,t-1}$$

Where $r_{i,t}$ is the country *i*'s weekly excess return, *DY* is the dividend yield, ω_U is the world conditional mean excess return that is a function of past information on global fundamentals (X_U): its own excess return, world dividend yield, the spread between the 90-day Eurodollar rate and the 3-month Treasury-bill yield, the difference between the US 10-year Treasury bond yield and the 3-month bill yield and the change in the 90-day Treasury-bill yield. ω_A is the regional conditional mean excess return that is a function of past information on regional fundamentals (X_A): its own excess return and regional (South East Asian market) dividend yield. ε_U and ε_A are the global and regional shocks, respectively. The measures of world integration and regional integration are the coefficients γ_{iU} and γ_{iA}, respectively. ς_{iU} and ς_{iA} measure world and regional volatility spillover effects. φ_{iU} and φ_{iA} measure asymmetry effects of volatility spillover. If they are negative, negative shocks are more strongly transmitted than positive ones. ** and *** indicate the significant level of 5% and 1%, respectively.

Markets	Symmetric and asymmetric volatility effects							Past information effects				Measures of integration	
	Local			Regional		World		Local		Regional	World	Regional	World
	α_{i1}	α_{i2}	η_i	ς_{iA}	φ_{iA}	ς_{iU}	φ_{iU}	β_{i1}	β_{i2}	β_{iA}	β_{iU}	γ_{iA}	γ_{iU}
Indonesia	0.118***	0.819***	-0.061**	0.188**	-0.022	0.153	0.030	0.071**	14.365**	1.151***	-0.625**	0.866***	-0.023
Malaysia	0.111***	0.792***	0.024	0.092***	0.080**	0.079***	0.109***	0.026	-2.387	0.564***	0.149	0.574***	0.111
Philippines	0.242***	0.641***	-0.241***	0.182***	0.199**	0.002	0.092	-0.032	20.81***	2.137***	0.413	0.639***	-0.569***
Singapore	0.070***	0.840***	-0.047**	0.015	0.016	0.039	0.015	-0.013	4.385	0.843***	0.319	0.474***	0.125**
Thailand	0.116***	0.894***	-0.059***	-0.007	0.055	0.038***	0.076***	-0.020	6.023	1.261***	-0.783***	1.008***	0.051

Figure 7.2 illustrates time-varying degrees of integration between the ASEAN-5 and the regional as well as the world markets. Obviously, the level of integration within the region is substantially higher than that with the world. In fact, the degrees of integration toward the world are below zero in the cases of Indonesia, Philippines and Thailand. Table 7.4 shows that the average degrees of global integration for these markets are -11.73%, -55.80% and -7.98%, respectively. For the Philippines, its divergent relationship with the world market appears to have increased after the event of the Asian crisis, specifically, since March 2000. Compared to other regional stock markets, Malaysia always has the highest level of global integration during the period of 1991-2006. Although, less integration to the world compared to Malaysia, Singapore's stock market has steadily increased its level as the flow of time, especially since the beginning of 2000.

All countries have positive regional integration degrees. The order from the highest level of regional integration is from Indonesia, then Malaysia, Philippines, Singapore and Thailand. In fact, the average degrees of regional integration for these markets are 92.11%, 66.98%, 63.84%, 47.13% and 45.74%, respectively. Surprisingly, while the results from constant models (Table 7.3) indicate the Thai stock market has the highest level of regional integration, the findings from time-varying models report Thailand has had the lowest regional integration degree on average and has been continuously decreased throughout the sample period. For Singapore, the degree of regional integration was highest in the period 1991-1995; has rather kept stable later on, fluctuating around 47% approximately. The degree of regional integration has been steadily increased in the situations of Philippines, Malaysia and, especially, Indonesia markets.

Comparing to the constant model, the results of time-varying integration on the Thai market are surprising. In fact, for Thailand, while the constant model reports a full regional integration, the time-varying model find an average degree of 45.74%, the lowest compared to the other ASEAN stock markets. This should be resulted from the way we build up time-varying parameters of financial integration ($\gamma_{iA,t-1}$). We have followed Bekaert, Harvey and Ng (2005) to calculate time-varying parameters on the basis of trade variables. Chen and

Zhang (1997) also emphasise that countries with heavier external trade to a region tend to have higher return correlations with that region. In the case of Thailand, the average degree of regional integration is critically small due to the small amount of bilateral trades between Thailand and other ASEAN since the Asian crisis.

Figure 7.2: Time-varying integration, individual countries (1991-2006)

The CAPM-TGARCH model for country *i* (see sub-section 5.3.1.2) is defined as follows:

$$r_{i,t} = \beta_{i0} + \beta_{i1} DY_{i,t-1} + \beta_{i2} r_{i,t-1} + \beta_{iU} \omega_{U,t-1} + \beta_{iA} \omega_{A,t-1} + \gamma_{iU,t-1} \varepsilon_{U,t-1} + \gamma_{iA,t-1} \varepsilon_{A,t} + \varepsilon_{i,t}$$

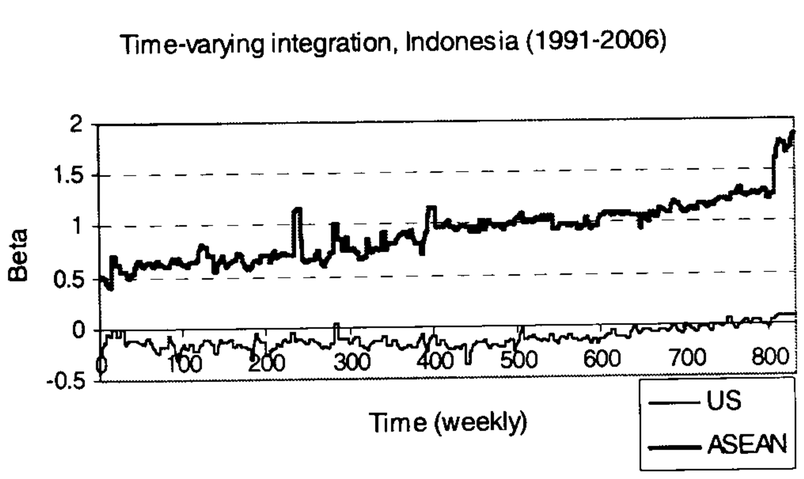
$$\sigma^2_{\varepsilon,i,t} = \alpha_{i0} + \alpha_{i1} \varepsilon^2_{i,t-1} + \alpha_{i2} \sigma^2_{\varepsilon,i,t-1} + \varsigma_{iU} \varepsilon^2_{U,t-1} + \varsigma_{iA} \varepsilon^2_{A,t} + \eta_i \varepsilon^2_{i,t-1} I[\varepsilon_{i,t-1} > 0] +$$

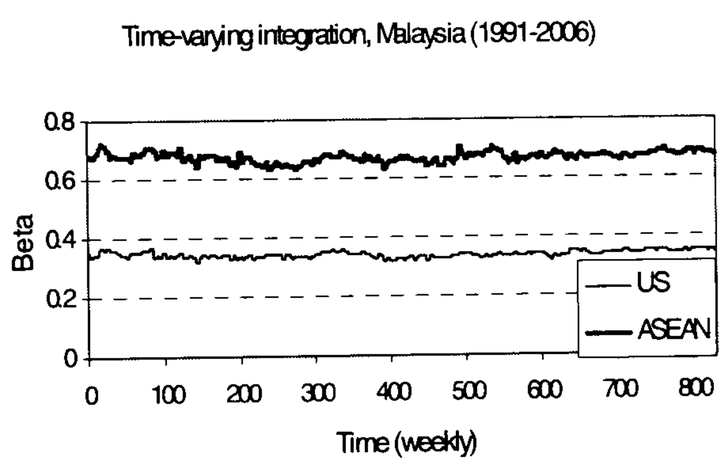
$$\varphi_{iU} \varepsilon^2_{U,t-1} I[\varepsilon_{U,t-1} > 0] + \varphi_{iA} \varepsilon^2_{A,t} I[\varepsilon_{A,t} > 0]$$

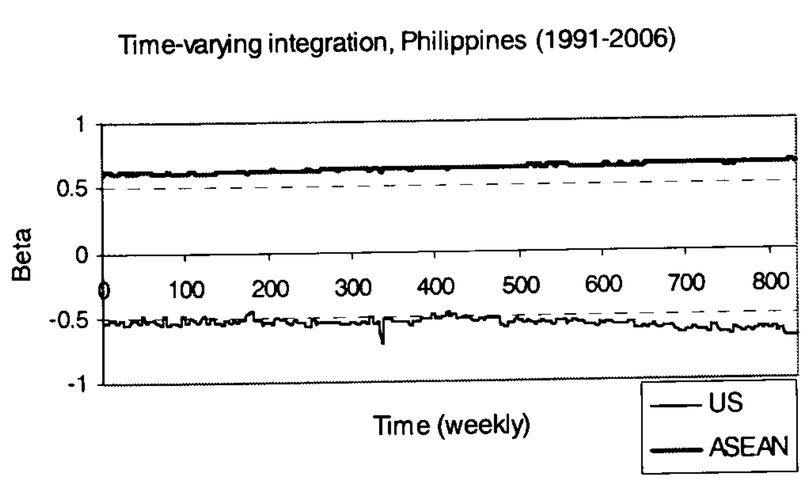
$$\omega_{U,t} = \beta_{U0} + \beta_U X_{U,t-1}; \qquad \omega_{A,t} = \beta_{A0} + \beta_{AA} X_{A,t-1} + \beta_{AU} \omega_{U,t-1}$$

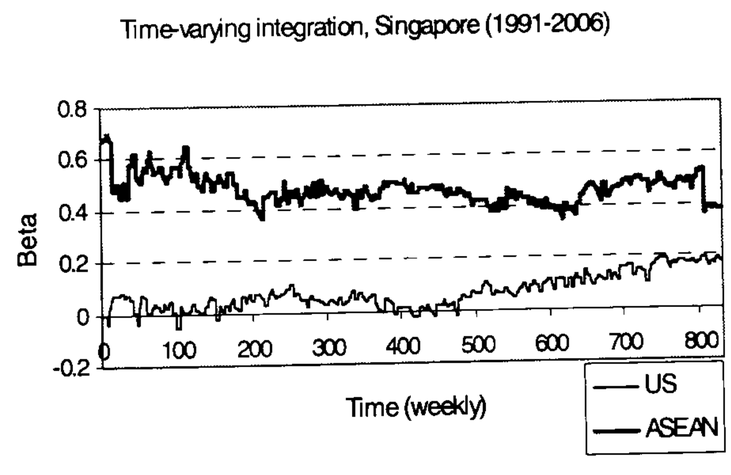
$$\gamma_{iA,t-1} = \psi_{iA,0} + \psi_{iA,1} Z_{iA,t-1}; \qquad \gamma_{iU,t-1} = \psi_{iU,0} + \psi_{iU,1} Z_{iU,t-1}$$

Where ε_U and ε_A are the global and regional shocks, respectively. The measures of world and regional integration are the coefficients $\gamma_{iU,t-1}$ and $\gamma_{iA,t-1}$, respectively. The set $Z_{iU,t-1}(Z_{iA,t-1})$ consists of information variables that capture the covariance risk of market *i* with the United States (the region). We use the sum of exports to and imports from the United States (the region) divided by the sum of total exports and total imports.









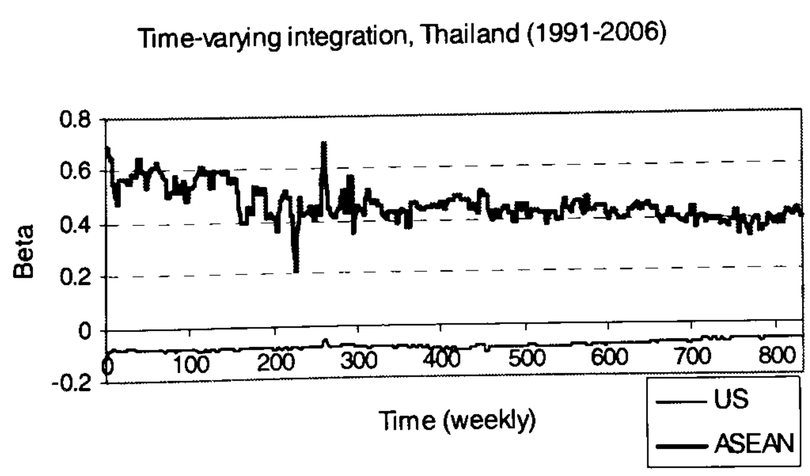


Table 7.4: Average of time-varying and constant integration measures (1991-2006)

$\gamma_{iU,t-1}$ and $\gamma_{iA,t-1}$ are the indicators of global and regional integration in the time-varying model, respectively. γ_{iU} and γ_{iA} are the indicators of global and regional integration in the constant model, respectively. ** and *** indicate the significant level of, 5% and 1%, respectively.

	Indonesia	Malaysia	Philippines	Singapore	Thailand
Average of time-varying integration measures					
$\gamma_{iU,t-1}$	-0.1174	0.3414***	-0.5581***	0.1113**	-0.0799
$\gamma_{iA,t-1}$	0.9221***	0.6699***	0.6384***	0.4713***	0.4574***
$\gamma_{iU,t-1}+\gamma_{iA,t-1}$	0.8047***	1.0113***	0.0803***	0.5826***	0.3775***
Constant integration measures					
γ_{iU}	-0.0230	0.1111	-0.5691***	0.1250**	0.0509
γ_{iA}	0.8862***	0.5737***	0.6388***	0.4743***	1.0081***
γ_{iU} γ_{iA}	0.8632***	0.6848***	0.0697***	0.5993***	1.0590***

7.2.3 Patterns in Global and Regional Integration

Following Bekaert et al (2005), we investigate patterns in regional and global integration by examining how the estimated gamma changes during particular periods. We consider four sample periods: (A) the period in the second half of the sample, (B) the Asian crisis period from July 1997 to December 1998, (C) the abnormal shock period in the US, and (D) the abnormal shock period in the ASEAN. "Abnormal" is defined as more than one standard deviation below zero. We run panel regressions of each of our measures on a constant and on a dummy variable that takes a value of one during these designated periods. The following time-series cross-section regression model is estimated:

$$S_{i,t} = \phi_i + \theta_i D_{i,t} + u_{i,t}$$

$S_{i,t}$ denotes the estimated degrees of regional ($\gamma_{iA,t-1}$) and global ($\gamma_{iU,t-1}$) integration. $D_{i,t}$ is a dummy variable that describes the degree of integration in the above designated periods. The results are presented in Table 7.5.

Panel A in Table 7.5 reports effects of the Asian crisis on the regional and global integration. Regarding the global integration, the dummy coefficients are significantly negative, except for the Philippines, implying that the ASEAN stock markets reduced their integration toward the world during the crisis. Particularly, the world integration in Singapore, Indonesia, Thailand and Malaysia was decreased by 4.76%, 4.64%, 0.74% and 0.46%, respectively. In contrast, with the estimated dummy coefficient of 3.6%, the Filipino stock market significantly increased its integration toward the world during the crisis. Regarding the regional integration, the dummy coefficients are negative in all the cases, but statistically significant for Malaysia and Thailand only. This implies that the Asian crisis appears to reduce the stock market integration within the ASEAN, especially for Malaysia and Thailand.

Panel B compares the degree of market integration in the first half of the sample to that in the second half (from January 1999 to December 2006). With respect to the world integration, all of the ASEAN are significantly responded to the time dummy. However, the behaviour of responses are different between the Philippines stock market and the rest. Specifically, the Philippines have a dummy coefficient of -5.15%, generally implying that its integration toward the world was declined over the period 1999-2006. In contrast, with positive dummy coefficients, Singapore, Indonesia, Malaysia and Thailand increased their world integration over the same period of time. With respect to the regional integration, while Singapore and Thailand have decreased their integration, the others, especially Indonesia with its striking dummy coefficient of 39.64%, have increased over time.

Panel C reports effects of the US abnormal (negative) shocks on the regional and world integration. Most of these shocks happened during the US stock market crash in the period 2000-2002. Generally all of significant responses are negative. With respect to the world integration, negative responses are significant in the cases of Thailand and Malaysia only, which implies the US abnormal shocks would reduce the world integration in these stock markets. With respect to the regional integration, negative responses are significant in the cases of the Philippines and Singapore indicating abnormal shocks would lower the regional integration in these stock markets. It seems that the ASEAN markets tend to self-protect and

cut off their financial linkages to the outside (regional as well as global) markets in facing of negative unstable circumstances in the US stock market.

Table 7.5: Patterns in regional and global integration (1991-2006)

The following time-series cross-section regression model is estimated:

$$S_{i,t} = \phi_i + \theta_i D_{i,t} + u_{i,t}$$

$S_{i,t}$ denotes the implied statistic being examined, such as $\gamma_{iU,t-1}$ and $\gamma_{iA,t-1}$. $\gamma_{iU,t-1}$ and $\gamma_{iA,t-1}$ are the indicators of time-varying global and regional integration respectively. $D_{i,t}$ is a dummy variable that describes the degree of integration in the following four periods: (A) the Asian crisis period from July 1997 to December 1998, (B) the second sub-sample period (from January 1999 to December 2006), (C) the period of abnormal shocks (one standard deviation below zero) in the US, and (D) the period of abnormal shock in the ASEAN. The estimation results correct with Newey-West for serial correlation (with one lag). The parameter estimates of θ_i are reported, with standard errors given in parentheses. ** and *** indicate the significant level of, 5% and 1%, respectively.

Measures of integration	Indonesia	Malaysia	Philippines	Singapore	Thailand
Panel A: Asian crisis dummy					
$\gamma_{iU,t-1}$	-0.0464*** (0.0083)	-0.0046*** (0.0017)	0.0360*** (0.0038)	-0.0476*** (0.0049)	-0.0074*** (0.0009)
$\gamma_{iA,t-1}$	-0.0168 (0.0228)	-0.0079*** (0.0021)	-0.0003 (0.0009)	-0.0007 (0.0054)	-0.0151*** (0.0057)
Panel B: Time (second sub-sample, from January 1999 to December 2006) dummy					
$\gamma_{iU,t-1}$	0.0642*** (0.0072)	0.0019** (0.0009)	-0.0515*** (0.0035)	0.0670*** (0.0045)	0.0038*** (0.0008)
$\gamma_{iA,t-1}$	0.3964*** (0.0166)	0.0035** (0.0015)	0.0245*** (0.0008)	-0.0511*** (0.0051)	-0.0771*** (0.0059)
Panel C: US abnormal shock dummy					
$\gamma_{iU,t-1}$	-0.0125 (0.0067)	-0.0021** (0.0009)	0.0055 (0.0037)	-0.0007 (0.0052)	-0.0032*** (0.0008)
$\gamma_{iA,t-1}$	0.0379 (0.0205)	-0.0007 (0.0017)	-0.0040*** (0.0013)	-0.0218*** (0.0053)	-0.0102 (0.0064)
Panel D: Regional abnormal shock dummy					
$\gamma_{iU,t-1}$	-0.0240*** (0.0084)	-0.0015 (0.0011)	0.0075 (0.0050)	-0.0097 (0.0068)	-0.0038*** (0.0011)
$\gamma_{iA,t-1}$	0.0026 (0.0258)	-0.0026 (0.0016)	-0.0033** (0.0014)	-0.0106** (0.0052)	-0.0199** (0.0066)

Panel D presents effects of the regional abnormal (negative) shocks on the state of regional and world integration in the ASEAN stock markets. Similar to the case of the US shock, all of significant responses to the regional shocks are negative. Specifically, only Indonesia and Thailand have significant negative thetas (θ_i) regarding the world integration; the Philippines, Singapore and Thailand have significant negative thetas with respect to the regional integration. These results mean the regional abnormal shock would lower the world

integration in the Thai and Indonesian stock markets and the regional integration in the Philippines, Singapore and Thailand. Combining with the results from Panel C, we find that the fact the ASEAN stock markets have negative responses to abnormal shocks from the US as well as within the region would reduce their vulnerability to shocks from abroad.

7.2.5 Specification Tests

We follow Fratzscher (2001) to test the specification of GARCH models applied in this chapter. A correct specification of the benchmark GARCH model requires that the following orthogonal conditions hold:

$$E[\varepsilon_{k,t}\varepsilon_{l,t} \mid \Omega_{t-1}] = 0 \quad , \qquad k,l = i, ASEAN, US \quad , \qquad \forall k \neq l$$

which implies that idiosyncratic shocks of the three markets are independent. Moreover, if the unexpected share $\mu_{i,t}$ of the returns in country i is solely explained by regional global shocks, then the idiosyncratic innovations $\varepsilon_{i,t}$ in country i should also be independent from shocks occurring in other local markets n

$$E[\varepsilon_{i,t}\varepsilon_{n,t} \mid \Omega_{t-1}] = 0 \quad , \qquad \forall i \neq n$$

Table 7.6 presents results of testing for independence and omitted common factors. In general, the results of specification tests for the constant model and time-varying model contain quite similar implications. The first two columns of Table 7.6 confirm that the residuals of the local markets orthogonal to those of the ASEAN-5 and the US markets. However, Table 7.6 also indicates that the residual correlations is significant across most local markets, suggesting that there are some other factors that explain the return correlations across local markets that are not included in the model. However, given that the correlation of the returns is considerably higher than the correlation of the residuals, the models have indeed substantial explanatory power.

Table 7.6: Testing for independence and omitted common factors

	US	ASEAN	Indonesia	Malaysia	Philippines	Singapore	Thailand
Constant models (16/01/1991-27/12/2006) 16/01/1991-27/12/2006							
Indonesia	-0.01345	0.093273	1				
Malaysia	0.028057	0.195967	-0.08156	1			
Philippines	0.014111	0.021382	0.104204	-0.18421	1		
Singapore	-0.0033	-0.07099	-0.20651	-0.28304	-0.13295	1	
Thailand	-0.00822	-0.02636	-0.05635	-0.24507	0.01885	-0.1512	1
Time-varying models (16/01/1991-27/12/2006)							
Indonesia	-0.00828	0.089567	1				
Malaysia	0.029301	0.12789	-0.09863	1			
Philippines	0.019924	0.027663	0.104071	-0.19813	1		
Singapore	0.015038	-0.04729	-0.20714	-0.30147	-0.12094	1	
Thailand	-0.00367	0.053196	0.046932	-0.05176	0.074861	-0.04068	1

How well does the model explain the data of the time-variation of integration? The variance ratio tests of equations 5.44 and 5.45 provide a goodness-of-fit test for the estimated models. Table 7.7 shows that, except Thailand, the variance ratios are mostly over 0.25, indicating that the time-varying model manages to explain about 25% of the time variation of local returns for the period of 1991-2006. Although this might seem small, it is quite similar to the results reported by Bekaert et al (2005) who studied financial integration in East Asia from 1986 to 1998.

Table 7.7: Average of time-varying variance ratios (1991-2006)

$$h_{i,t} = E[\mu_{i,t}^2 \mid \Omega_{i-1}] = \gamma_{iA,t-1}^2 \sigma_{T,t}^2 + \gamma_{iU,t-1}^2 \sigma_{U,t}^2 + \sigma_{\varepsilon,i,t}^2$$

$$VR_{iU,t} = \frac{\gamma_{iU,t-1}^2 \sigma_{U,t}^2}{h_{i,t}}; \qquad VR_{iA,t} = \frac{\gamma_{iA,t-1}^2 \sigma_{A,t}^2}{h_{i,t}}$$

VR denotes the variance ratios. These relations provide a goodness-of-fit measure, a test for how much of the local return variance is explained by regional factors and by world factors (see equations 5.42-5.45 in sub-sections 5.3.1.3). ** and *** indicate the significant level of, 5% and 1%, respectively.

	Indonesia	Malaysia	Philippines	Singapore	Thailand
$VR_{iU,t}$	0.0049	0.0439	0.1035**	0.0089	0.0017
$VR_{iA,t}$	0.2308***	0.2150***	0.1659***	0.3159***	0.0598**
$VR_{iU,t} + VR_{iA,t}$	0.2357***	0.2589***	0.2695***	0.3249***	0.0615**

So far, we have only discussed the sign and significance of the integration parameters. The relatively size of the parameters are not particularly relevant to evaluate the quantitative influence of the US and ASEAN-5 stock markets on the local return variance. Generally, the ASEAN market was the dominant one over the period 1991-2006. In fact, $VR_{iU,t}$ is significant for the Philippines only while $VR_{iA,t}$ is significant for all, especially for Singapore. The model explains about 32%, 26%, 23%, 21% and 6% of the variation of returns in the Singaporean, Filipino, Indonesian, Malaysian and Thai stock markets, respectively.

The results for Thailand are out of expectation. The model only explains about 6% of the variation of returns in the Thai stock market, which should result from the way we build up time-varying parameters of financial integration ($\gamma_{iU,t-1}$ and $\gamma_{iA,t-1}$). We have followed Bekaert, Harvey and Ng (2005) to calculate time-varying parameters on the basis of trade variables. Chen and Zhang (1997) also emphasise that countries with heavier external trade to a region tend to have higher return correlations with that region. In the case of Thailand, the variance ratios are substantially small due to the small amount of bilateral trades between Thailand and the other ASEAN as well as the US compared to others in the world since the Asian crisis.

7.3 ASYMMETRIC CONDITIONAL CORRELATIONS

This section reports the results of time-varying correlations in the US, Japanese and ASEAN-5 stock markets. Estimates are based on the asymmetric dynamic conditional correlations – multivariate GARCH model (ADCC-MVGARCH) proposed by Cappiello et al (2004). The purpose of this section is to answer the following main research questions. How are the return spillovers across the US, Japan and the ASEAN equity markets? What is the nature of time-varying correlation structure across the equity markets of the US, Japan and ASEAN-5? Furthermore, we visually examine the affects of negative and positive innovations on conditional volatilities and correlations occurring in these equity markets through the *news impact curves* (Engle and Ng, 1993) and *news impact surfaces* (Cappiello et al, 2004). Daily index returns cover from the 3rd January 1991 to the 29th December 2006. The main reason

daily data are employed instead of weekly data is that the ADCC-MVGARCH model (7 variables) requires a lot of observations in order to estimate dynamic linkages of stock markets.

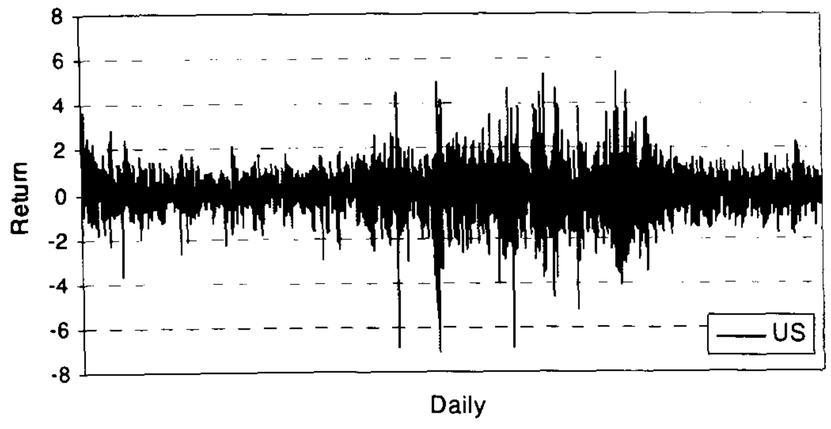
7.3.1 Descriptive Statistics

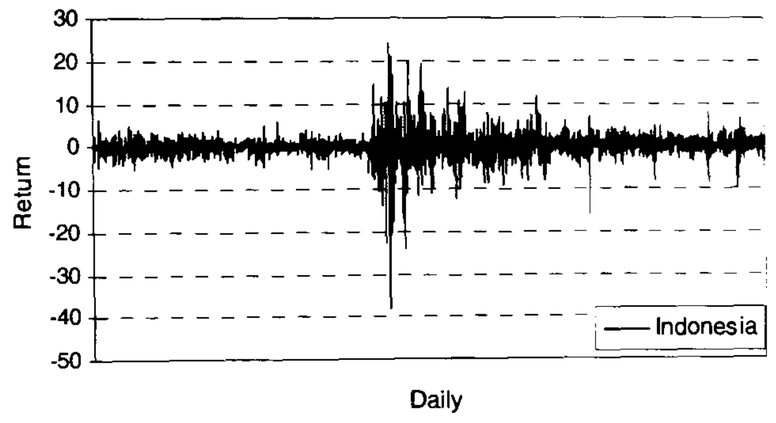
Figure 7.3 plots time series of daily index returns covering from 03/01/1991 to 29/12/2006. It is evident that developing markets (Indonesia, Malaysia, Philippines) have lower returns and higher volatilities compared to developed markets (the US, Japan and Singapore). However, the mean of price returns in all markets are not significantly different from zero. Clearly, all of return series were fluctuated around zero throughout the period. All market returns are heavily influenced by the 1997 financial crisis. Indeed, the level of risk of returns except for the US is highest during this period of time. The US returns were fluctuated most in the period 2000-2002. Although all of the Asian market returns have been getting more stable after the crisis, market volatility has not reverted back to its initial low-volatility state that was observed up to the summer 1997.

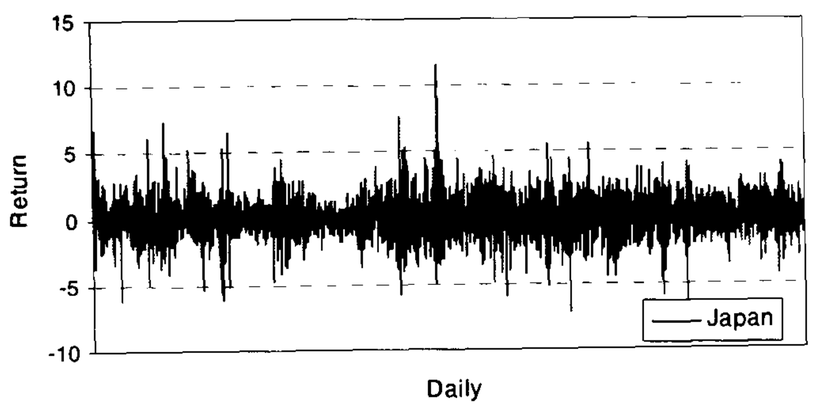
For the whole sample period, as presented in Table 7.8, the average returns fall in a wide range of: from -0.0064% (Indonesia) to 0.0381% (the US). The standard errors of returns fall in the interval between 0.9778% (the US) and 2.5252% (Indonesia). Clearly, Indonesia is the market with the lowest mean of returns and highest level of risk. Among the Asian stock markets including Japan, Singapore is the most stable market. In fact, the standard error of price returns in the Singaporean stock market is 1.21%, smallest in the region.

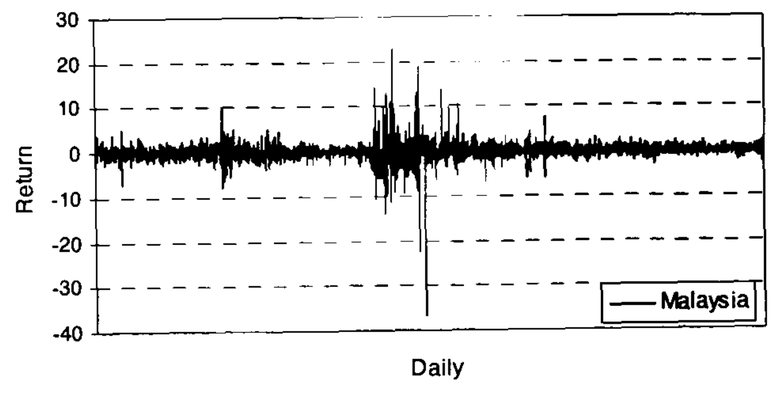
Excess kurtosis indicates that there are more large shocks than expected statistically. Ljung and Box (1978) tests for twelfth order autocorrelation show that all of the series are significantly auto-correlated indicating that the AR specification is suited. The same tests are conducted for the squared return series. As a result, the test statistics are several times greater than that calculated for returns (not squared) in all cases, implying the existence of high heteroskedasticity. The attractiveness and empirical success of GARCH models is that they are able to explain to a large extent the heteroskedasticity behaviour and the excess kurtosis of the empirical distribution of returns (Goeij and Marquering, 2004).

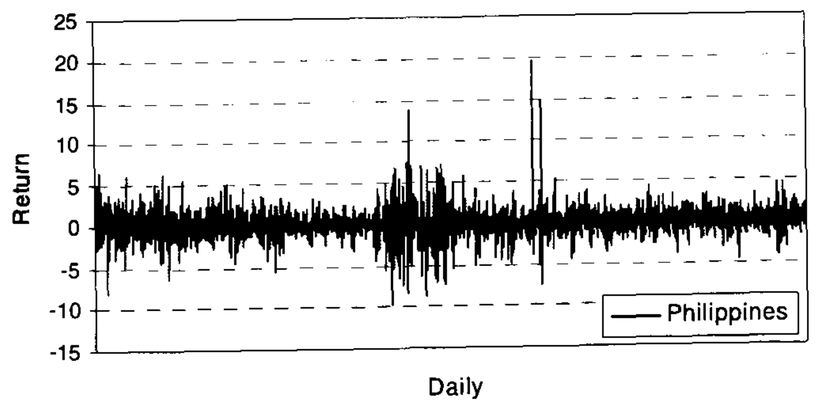
Figure 7.3: Time series of daily index returns (1991-2006)

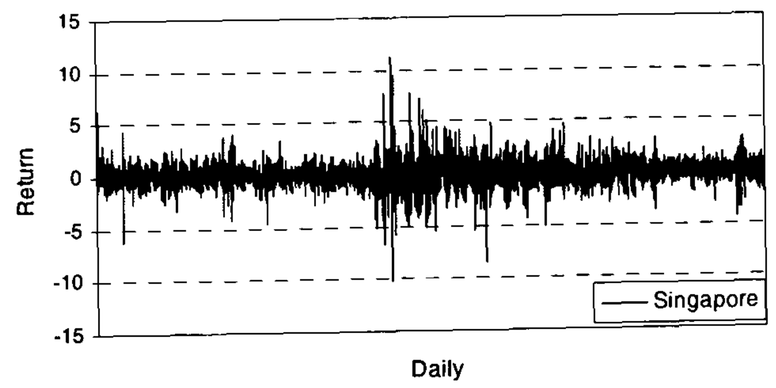












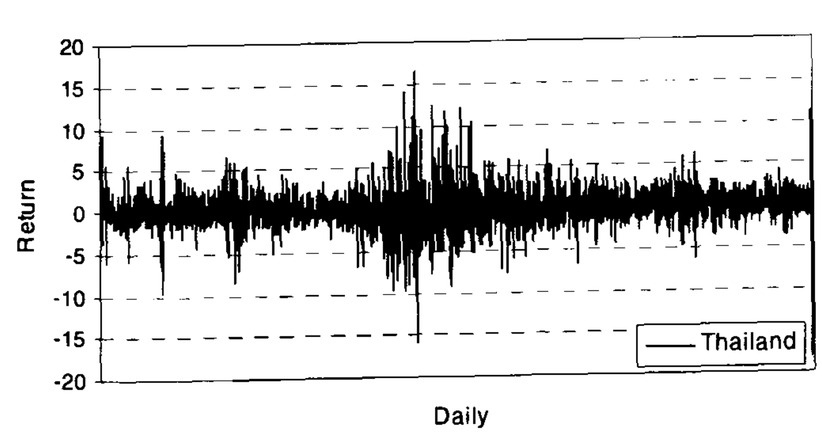


Table 7.8: Descriptive statistics of daily index returns (03/01/1991-29/12/2006)

LB(12) implies the Ljung and Box (1978) test for twelfth order autocorrelation. *, ** and *** indicate the significant level of 10%, 5% and 1%, respectively.

Statistics	The US	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Mean	0.0381	-0.0064	0.0051	0.0188	0.0330	0.0261	0.0098
Min	-7.0264	-37.8446	-7.4926	-36.7680	-9.7124	-9.5464	-17.8017
Max	5.3666	23.2345	11.5330	22.9868	19.5485	10.6184	16.3520
Standard error	0.9778	2.5252	1.3771	1.7474	1.5487	1.2046	2.0315
Skewness	-0.1180	-1.0803	0.1658	-1.4793	0.7571	0.0171	0.3392
Kurtosis	7.5585	32.5634	6.3012	75.9188	16.1079	10.4441	11.3824
LB(12)	26.1342***	181.110***	30.8857***	105.760***	192.497***	35.8854***	84.6871***
LB(12) squared	1326.92***	1987.31***	372.399***	212.815***	334.682***	1217.15***	1320.18***

Table 7.9 shows the correlation matrix of index returns. Particular attention is given to three sub-periods: pre-crisis period (from 03/01/1991 to 30/06/1997), crisis period (from 01/01/1997 to 31/12/1998) and post-crisis period (from 01/01/1999 to 29/12/2006). Looking at the relationship between the US and ASEAN, we find that the correlations between them are low over the whole period 1991-2006. In fact, the range of correlations is from 15.56% (US-Indonesia) to 28.69% (US-Singapore). Singapore, Japan and the Philippines are three markets correlated most with the US. Interestingly, compared to the Singaporean stock market, Japan, one of the biggest financial markets in the world, has less correlation with the US. The results in three sub-periods show that the correlations between the US and ASEAN have increased over time, implying a globalisation trend in the ASEAN. Particularly, the average of correlations is 17.16%, 22.53% and 23.41% in the pre-crisis, crisis and post-crisis periods, respectively. Most evidently, Singapore has been increasing its connection to the world market, from 23.85% in the pre-crisis, 26.52% during the crisis and up to 33.11% in the post-crisis. Among the ASEAN, Malaysia appears to have the most stable correlation to the US, 20.20%, 23.24% and 20.42% over three sub-periods. For Japan, its correlation with the US was unchanged in the first two sub-periods, but double to 33.21% in the post-crisis.

With respect to linkages between the Japanese and ASEAN stock markets, their correlations are a bit higher than the correlations between the US and ASEAN overall. Indeed, the average correlation in the former was 22.40% while that in the latter was 20.36%

over the whole period 1991-2006. The strongest linkage is between Japan and Singapore, which is evident throughout three sub-periods. Particularly, among the ASEAN, the correlation between the Japanese stock market and the Singaporean stock market is always highest, 25.14% in the pre-crisis, 42.08% in the crisis and 41.25% in the post-crisis. Generally, the linkage between the Japanese and ASEAN stock markets was rather low before the Asian crisis. However, they were much closer in facing of the crisis and after that. The close relationship between Japan and the ASEAN during the crisis may be considered a phenomenon of financial contagion, but the strong linkage in the post-crisis should be appreciated as a signal of financial integration between Japan and the ASEAN.

Table 7.9: Correlations of country-index returns

	US	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Whole sample (03/01/1991-29/12/2006)							
US	1	0.1556	0.2594	0.1813	0.2113	0.2869	0.1827
Indonesia	0.1556	1	0.1874	0.3163	0.3298	0.3836	0.3171
Japan	0.2594	0.1874	1	0.1918	0.1639	0.3631	0.2139
Malaysia	0.1813	0.3163	0.1918	1	0.2463	0.4201	0.3236
Philippines	0.2113	0.3298	0.1639	0.2463	1	0.3352	0.3072
Singapore	0.2869	0.3836	0.3631	0.4201	0.3352	1	0.4338
Thailand	0.1827	0.3171	0.2139	0.3236	0.3072	0.4338	1
Pre-crisis period (03/01/1991-30/06/1997)							
US	1	0.1219	0.1682	0.2020	0.1606	0.2385	0.1348
Indonesia	0.1219	1	0.0909	0.2524	0.2680	0.2891	0.1394
Japan	0.1682	0.0909	1	0.1914	0.0411	0.2514	0.0853
Malaysia	0.2020	0.2524	0.1914	1	0.2074	0.6132	0.3337
Philippines	0.1606	0.2680	0.0411	0.2074	1	0.2280	0.1504
Singapore	0.2385	0.2891	0.2514	0.6132	0.2280	1	0.3116
Thailand	0.1348	0.1394	0.0853	0.3337	0.1504	0.3116	1
Crisis period (01/07/1997-31/12/1998)							
US	1	0.1892	0.1682	0.2324	0.2530	0.2652	0.1868
Indonesia	0.1892	1	0.2591	0.4086	0.4647	0.5079	0.4297
Japan	0.1682	0.2591	1	0.2527	0.4208	0.4208	0.2947
Malaysia	0.2324	0.4086	0.2527	1	0.3256	0.4469	0.3901
Philippines	0.2530	0.4647	0.2707	0.3256	1	0.5329	0.4962
Singapore	0.2652	0.5079	0.4208	0.4469	0.5329	1	0.5484
Thailand	0.1868	0.4297	0.2947	0.3901	0.4962	0.5484	1
Post crisis period (01/01/1999-29/12/2006)							
US	1	0.1773	0.3321	0.2042	0.2390	0.3311	0.2190
Indonesia	0.1773	1	0.2167	0.1667	0.2457	0.3145	0.2802
Japan	0.3321	0.2167	1	0.1949	0.2047	0.4125	0.2643
Malaysia	0.2042	0.1667	0.1949	1	0.1862	0.3107	0.2392
Philippines	0.2390	0.2457	0.2047	0.1862	1	0.2531	0.2571
Singapore	0.3311	0.3145	0.4125	0.3107	0.2531	1	0.4109
Thailand	0.2190	0.2802	0.2643	0.2392	0.2571	0.4109	1

Generally, ASEAN-5 market returns tend to be correlated within the region. The range of their correlations is from 24.63% (Malaysia-Philippines) to 43.38% (Singapore-Thailand) over the period 1991-2006. The most considerable linkages in the region are the pairs of Singapore-Malaysia with its correlation of 42.01% and Singapore-Thailand with its correlation of 43.38%. Compared to their correlations with the US and Japan, local markets are correlated much more with each other. Singapore confirms its position as a financial centre within the region instead of Japan. Indeed, the average correlations of local markets with Singapore, Japan and US are 39.32%, 18.93% and 18.27%, respectively. Considering correlation changes in sub-periods, we find that the correlation level is highest during the 1997-1998 period compared to the pre- and post- crisis periods. Besides, the average correlation level is higher in the post-crisis period than that in the pre-crisis period indicates that the level of financial integration has been increasing.

7.3.2 Time-varying Conditional Correlations

Time-varying conditional correlations are calculated on the basis of the Asymmetric Dynamic Conditional Correlation – Multivariate GARCH (ADCC-MVGARCH) model recently introduced by Engle (2002) and developed by Cappiello et al (2004). The ADCC-MVGARCH model was designed to allow for two-stage estimation of the conditional covariance matrix H_t. In the first stage, univariate volatility models are fitted for each of the assets and estimates of $h_{i,t}$ are obtained; these models with one lag of innovation and one lag of volatility are selected using the Schwartz Information Criterion. Besides, the GARCH (1, 1) specification should be enough since it has been shown to be a parsimonious representation of conditional variance that adequately fits many high-frequency time series (Bollerslev 1987 and Engle 1993). In the second stage, asset returns, transformed by their estimated standard deviations resulting from the first state, are used to estimate the parameters of the conditional correlation. More details of this model have been specified in sub-section 5.3.2.

Table 7.10 presents the results of mean conditional equations. Obviously, excluding the US, all markets exhibit a significant own mean spillover from their own lagged returns. It is noted that the mean spillovers (within the country or across border) are positive in all cases which report statistically significant results. Regarding cross-border effects, one-way causal effect from the US to Japanese market implies the US past price returns have significant impact on the Japanese current price returns, but not vice versa. As the two biggest financial markets in the world, but the US and Japanese lagged market returns do not affect much the ASEAN-5 current market returns. Particularly, both of the US and Japanese past returns have significant effects on the Philippines only.

Table 7.10: GARCH modeling of the conditional mean equations

The conditional mean equations are estimated on the basis of GJR-GARCH model (see equations 5.46 and 5.48 in sub-section 5.3.2.2) as follows:

$$r_t = \alpha_0 + \sum_{i=1}^{n} \alpha_i r_{i,t-1} + \varepsilon_t$$

$$h_t = \omega + \psi \varepsilon_{t-1}^2 + \gamma I[\varepsilon_{t-1} > 0]\varepsilon_{t-1}^2 + \beta h_{t-1}$$

All GARCH models have one lag of innovation and one lag of volatility based on the Schwartz Information Criterion. The conditional mean in each market (r_t) is a function of own past returns and cross-market past returns ($r_{i,t-1}$). ε_t is the innovation for each market at time *t* with $\varepsilon_t | I_{t-1} \sim N(0, H_t)$. *, * and *** indicate the significant levels of 10%, 5% and 1%, respectively.

	US	Japan	Indonesia	Malaysia	Philippines	Singapore	Thailand
α_{US}	0.0051	0.0916***	0.0346	-0.0146	0.0753***	0.0226	0.0109
α_{JP}	-0.0002	0.1024***	-0.0068	0.0079	0.0335***	0.0078	0.0238
α_{IN}	0.0249**	-0.0243	0.0319*	-0.0014	-0.0035	-0.0096	-0.0161
α_{MA}	-0.0082	0.0709***	0.0124	0.1194***	0.0488***	0.0201	0.0537**
α_{PH}	0.0057	0.0182	0.0127	-0.0105	0.0975***	-0.0054	0.0231
α_{SG}	0.0665***	0.0763***	0.0902***	0.0516***	0.1081***	0.0313*	0.1269***
α_{TL}	0.0089	0.0489***	-0.0129	0.0270***	0.0743***	0.0282***	0.0673***
ψ	0.1060***	0.1821***	0.1048***	0.0872***	0.1256***	0.1045***	0.1580***
β	0.8342***	0.8011***	0.8983***	0.9038***	0.8034***	0.8800***	0.8396***
γ	-0.1002***	-0.0732***	-0.0770***	-0.0562***	-0.0552***	-0.0885***	-0.0831***

Clearly, the ASEAN-5 stock markets tend to interact regionally rather than they are impacted by the two biggest stock markets in the world, such as the US and Japan. Singapore and Thailand play as leaders within the region. Indeed, their lagged returns considerably affect all other regional current market returns. And, all of these significant effects are positive implying regional stock markets have strong direct linkages to changes in Singapore and Thailand. For the Philippines and Indonesia, their stock markets play inconsiderable roles in the region. They significantly depend on changes in the Singaporean, Thai and Malaysian price returns, but they have little reversal effects on these markets. A special attention is given to Singapore. It is interesting that the Singaporean stock market not only impacts regional stock markets, but also affects the US and Japan. Indeed, both of the US and Japan price returns are significantly influenced by the Singapore lagged returns. In addition to Singapore, the US returns are influenced by Indonesian past returns; the Japanese returns are affected by Malaysian and Thai past returns. Obviously, changes in the ASEAN stock markets could make significant impact on international markets.

Table 7.10 also show the results of conditional variance equations. The conditional variance equations are based on the GJR- GARCH model (see sub-section 5.3.2) which is useful in detecting the asymmetric behaviour in volatilities (Glosten et al, 1993). First, the coefficients of the conditional variance equations are significant at 1% level for own innovations and volatilities in all the cases, indicating the presence of strong ARCH and GARCH effects. Second, large GARCH lag coefficients, β, ranging from 0.80 in the case of Japan to 0.89 in the case of Indonesia indicates that shocks to conditional variance take a long time to die out, so volatility is persistent. Third, the sum of ψ and β is close to but less than unity implying that the model is strictly mean reverting. And, finally, the coefficients γ are significantly negative in all cases mean that, given the same magnitude, negative shocks would make more effects on conditional volatilities than positive innovations would do. Overall, the GJR-GARCH (1, 1) models are quite successful in taking into account the autocorrelation and asymmetric behaviour in volatilities in return series.

Daily conditional correlations among the US, Japan and ASEAN-5 are reported in Appendix 3. In order to reduce noise from daily results and make the analysis process more convenient, this section shows graphs of monthly conditional correlations in Figure 7.4. Monthly conditional correlations are calculated on the basis of the average of estimated daily conditional correlations. Besides, for the purpose of comparing the results of conditional and unconditional correlations, the average of conditional correlations is calculated in three sub-periods: the pre-crisis (from January 1991 to June 1997), crisis (from July 1997 to December 1998) and post-crisis (from January 1999 to December 2006) (see Table 7.11).

First, we consider conditional correlations among three developed financial markets in the sample: the US, Japan and Singapore. Generally, their conditional correlations have increased over time. The Japanese and Singaporean stock markets had moderate correlations with the US in the period 1991-1998, but significantly strengthened their linkages with the US after the Asian crisis. Particularly, for the US and Japan, the average of correlations were moderately 24.55% and 25% in the pre-crisis and crisis periods, respectively. However, the average of their correlations sharply increased to 37.82% over the post-crisis. For the US and Singapore, the average of correlations were 26.78% in the pre-crisis, 31.85% in the crisis and considerably up to 40.52% in the post-crisis. Although the US and Japan are two biggest financial markets in the world, given the average of correlations of 33.05%, the US stock market appears to have a close relationship with the Singaporean stock market rather than with the Japanese over the period 1991-2006. Among these three developed markets, two Asian stock markets - Japan and Singapore – seem to have the highest and most stable linkage. Indeed, the average of their correlations was 31.76%, 39.855 and 39.62% in the pre-crisis, crisis and post-crisis, respectively.

Second, we consider conditional correlations between the US and ASEAN stock markets. The average of conditional correlations is varied from 15.53% (US-Indonesia) to 33.05% (US-Singapore) over the period 1991-2006. Obviously, Singapore, the only developed financial market in the region, has the most robust linkage to the US throughout all sub-

periods. Regarding regional developing markets, the Philippines have the highest average of conditional correlations with the US while Indonesia has the lowest. Indeed, the average of conditional correlations for the US-Indonesia, US-Malaysia, US-Thailand and US-Philippines was 15.53%, 23%, 26.16% and 27.67% over the period 1991-2006, respectively. While the Philippines, Indonesia and Malaysia had their strongest conditional correlations with the US during the Asian crisis, Thailand appears to have steadily increased its linkage to the US over time. Indeed, the average of correlations between the Thai and US stock markets was 23.32%, 25.12% and 29.03% in the pre-crisis, crisis and post-crisis, respectively. Evidently, Thailand has got the highest correlations with the US after the Asian crisis compared to other regional developing markets.

Next, we look at the linkage between the Japanese and ASEAN stock markets. Generally, the order of countries (from the highest to lowest correlations with Japan) is Singapore, Thailand, the Philippines, Malaysia and Indonesia over the period 1991-2006. The average of conditional correlations is fluctuated from 21.76% in the case of Japan-Indonesia to 37.08% in the case of Japan-Singapore over the period 1991-2006. All of these markets had their strongest conditional correlations with Japan over the Asian crisis period. In fact, the average conditional correlations between the ASEAN and Japanese stock markets were 22.75%, 30.03% and 26.81% in the pre-crisis, crisis and post-crisis, respectively. The event markets substantially increase their correlations over the crisis period and decline right after that should be considered a phenomenon of financial contagion instead of financial integration (Khalid and Kawai 2003, Bekaert and Harvey 2003 and Bekaert et al 2005). Contagion in equity markets refers to the notion that markets move more closely together during periods of crisis. In spite of the low level of conditional correlations, compared to the pre-crisis period, the increase of correlations in the post-crisis and, especially, the average correlation of 30.11% in year 2006 may imply that the ASEAN and Japan have increased their financial linkage and been toward the process of financial integration over time.

Finally, we discuss dynamic correlations within the ASEAN-5. As illustrated in Table 7.11, the average of conditional is varied from 25.41% (Malaysia-Philippines) to 51.34% (Singapore-Thailand) over the period 1991-2006. Evidently, the Singaporean stock market has the greatest impact in the region. Indeed, all of the highest conditional correlations within the region are the ones between regional markets and Singapore throughout all sub-periods. The two most striking correlations are 50.97% for the Singapore-Malaysia and 51.34% for the Singapore-Thailand over the period 1991-2006. However, the conditional correlations of Singapore-Malaysia and Singapore-Thailand have different behaviours over time. While the former tends to be farther away from each other, the latter is getting closer. Generally, all of the ASEAN markets had their highest correlations during the Asian crisis, which is regarded as a phenomenon of financial contagion as discussed in the previous paragraph. The conditional correlations sharply declined right after the Asian crisis. Indeed, the average of correlations in the post-crisis is much lower than that in the crisis, and, for Malaysia, even lower than in the pre-crisis. However, paying more attention to the behaviour of conditional correlations during the post-crisis period, we find that regional correlations tend to increase over time. We conduct a simple test to examine whether the level of increase is significant in the post-crisis period. Specifically, we test the following linear regression:

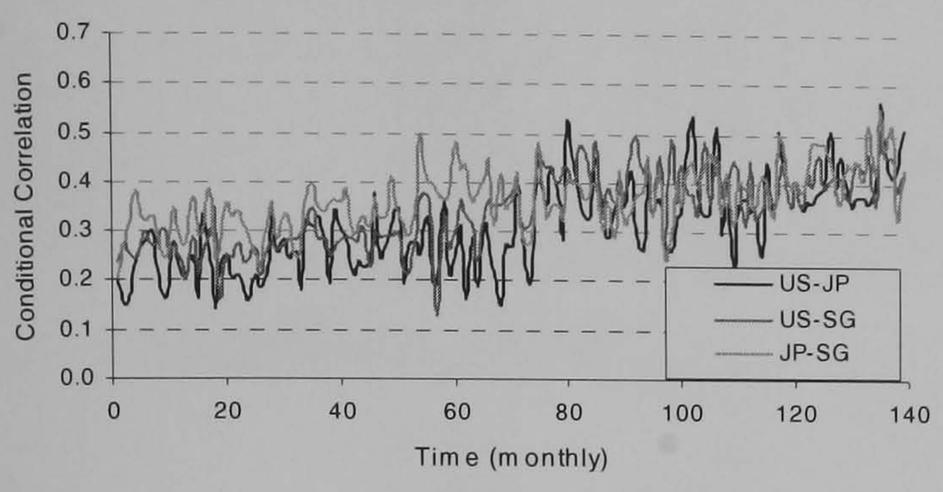
$$CCOR_i = \phi_i + \theta_i t_i + u_i$$

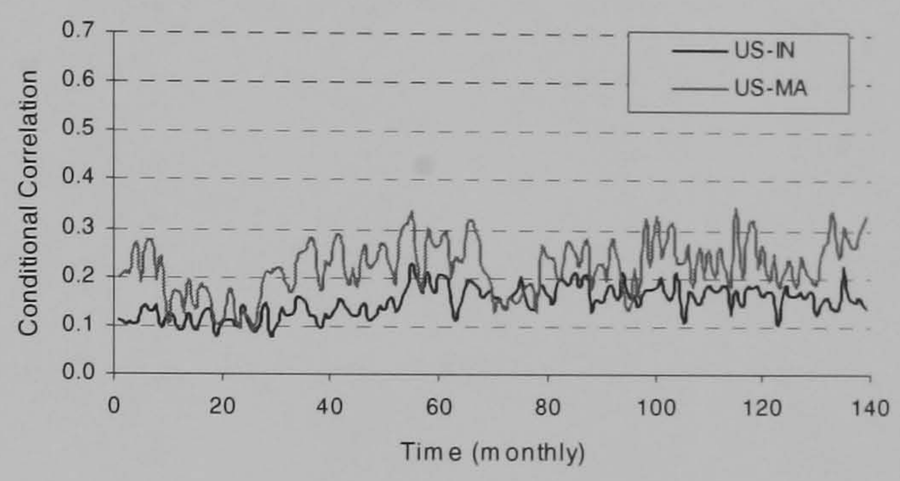
$CCOR_i$ denotes the conditional correlation in the post-crisis period. t_i stands for the independent variable of time from January 1999 to December 2006.

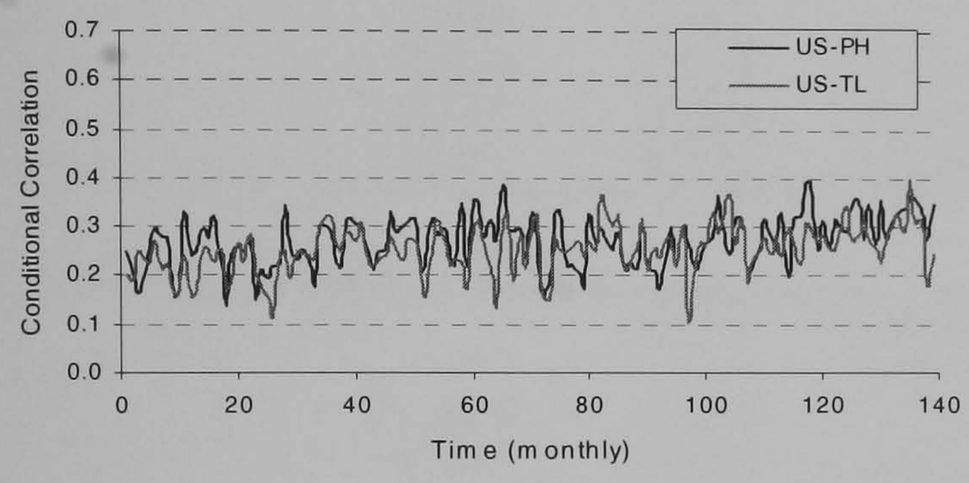
Evidently, except for the Indonesia-Philippines, the coefficients of time variable are significantly positive in all the cases implying that regional stock markets have been more connected and toward the process of regional integration over time (see Table 7.12). Besides, regarding the linkage between Singapore and others, the comparably big slopes of linear trends indicate that Singapore has been increasing its considerably important role in the region over time.

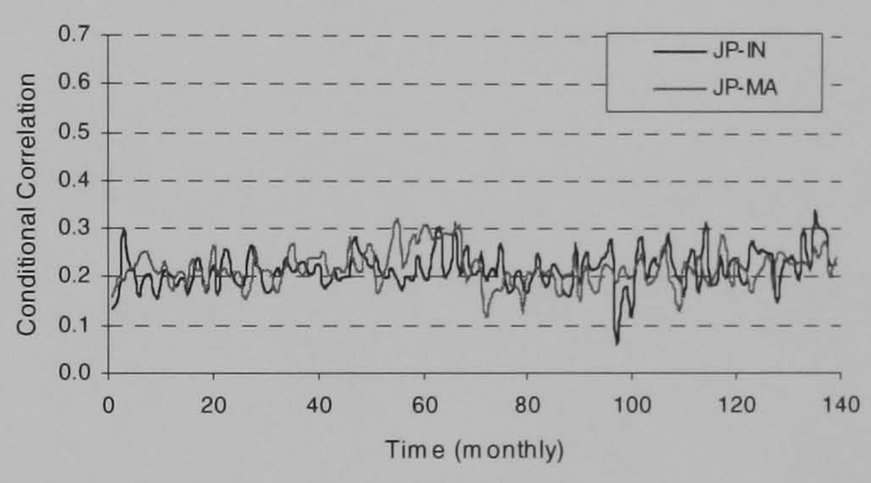
Figure 7.4: Time-varying conditional correlations in the US, Japan and ASEAN (1991-2006)

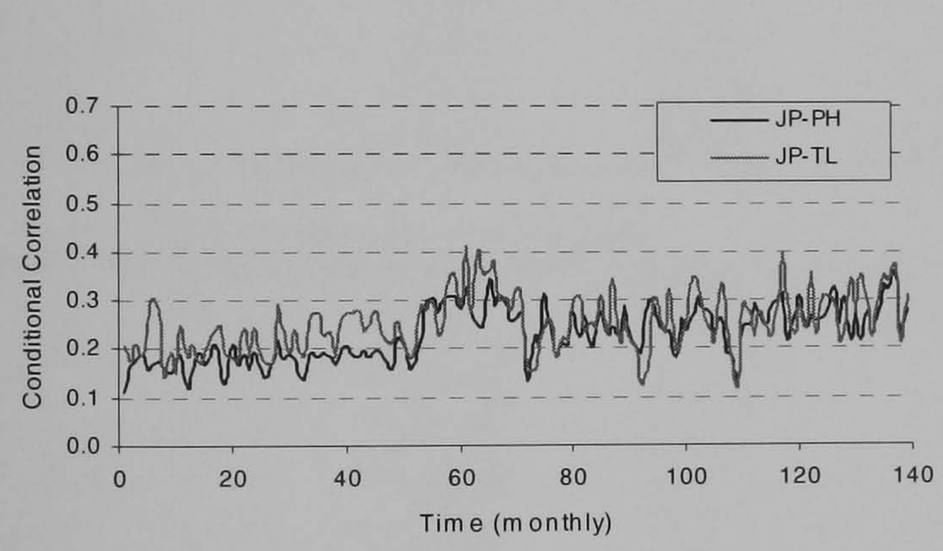
US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figure shows average monthly conditional correlations based on daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2

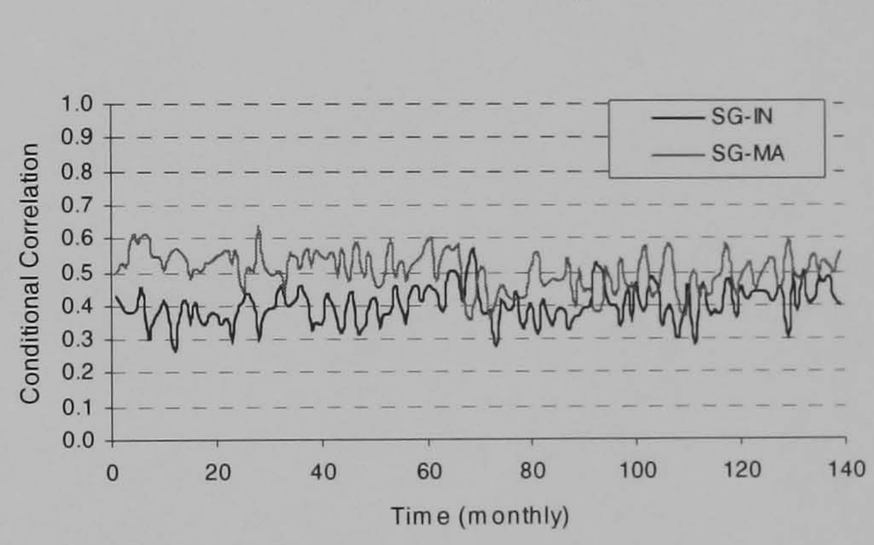


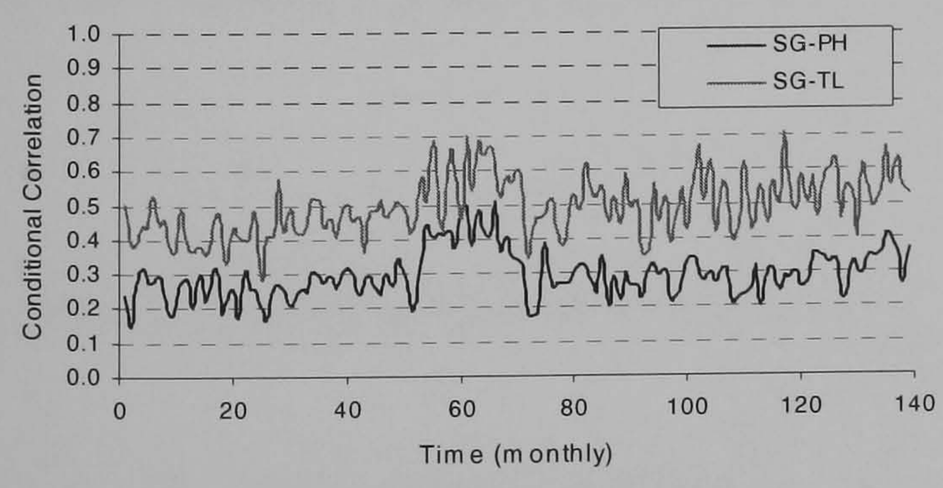


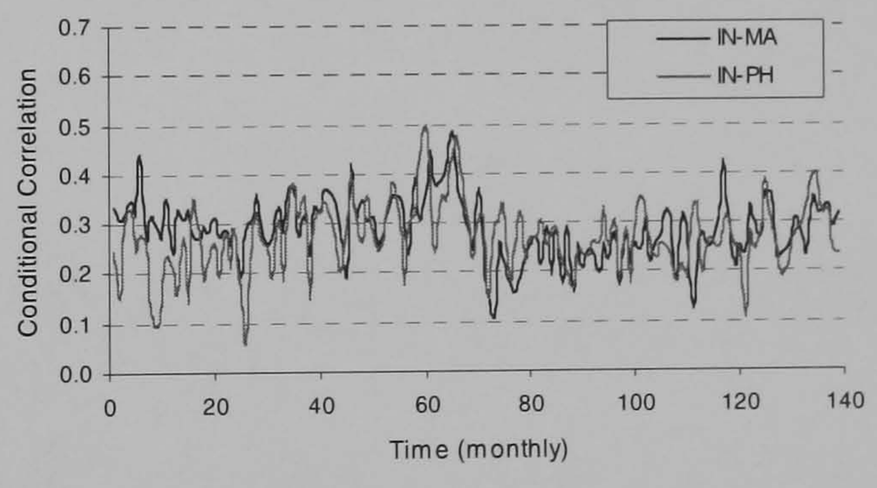


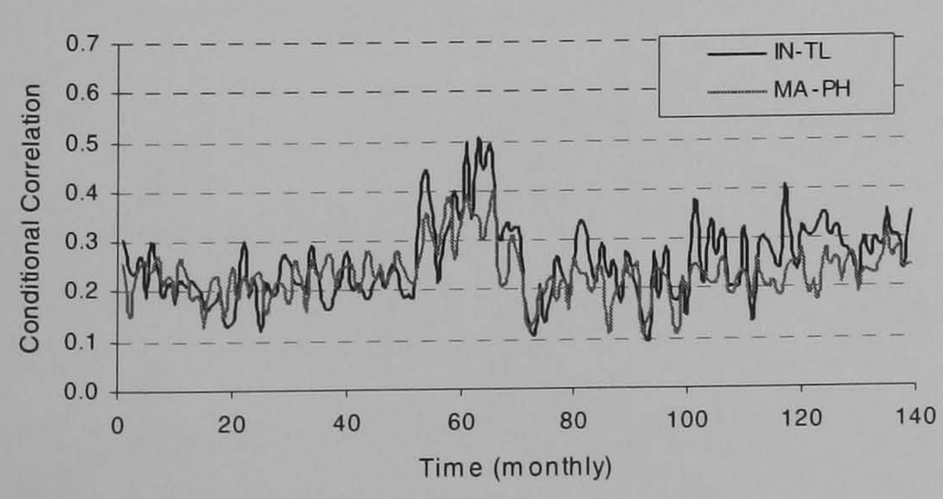












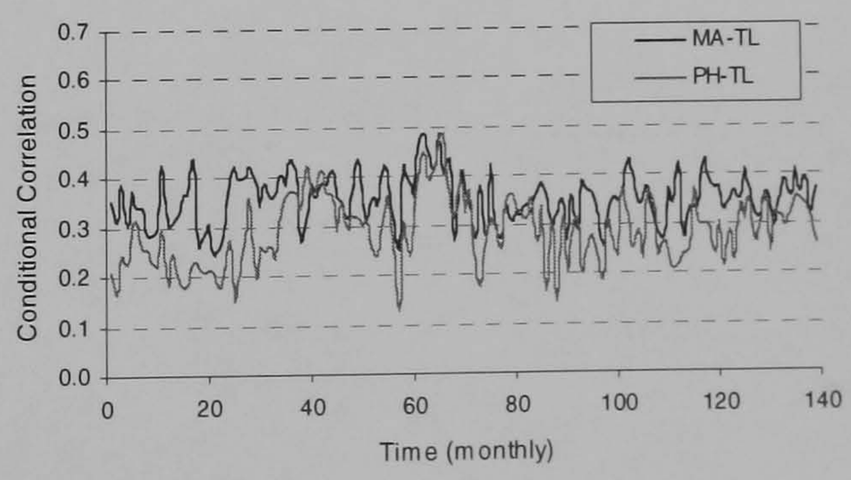


Table 7.11: Matrix of average conditional correlations (1991-2006)

	US	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Whole sample (03/01/1991-29/12/2006)							
US	1	0.1553	0.2912	0.2300	0.2767	0.3305	0.2616
Indonesia	0.1553	1	0.2176	0.3065	0.2892	0.4106	0.2822
Japan	0.2912	0.2176	1	0.2321	0.2385	0.3708	0.2675
Malaysia	0.2300	0.3065	0.2321	1	0.2541	0.5097	0.3649
Philippines	0.2767	0.2892	0.2385	0.2541	1	0.3226	0.3116
Singapore	0.3305	0.4106	0.3708	0.5097	0.3226	1	0.5134
Thailand	0.2616	0.2822	0.2675	0.3649	0.3116	0.5134	1
Pre-crisis period (03/01/1991-30/06/1997)							
US	1	0.1202	0.2455	0.1981	0.2525	0.2678	0.2332
Indonesia	0.1202	1	0.2076	0.3062	0.2543	0.3794	0.2137
Japan	0.2455	0.2076	1	0.2153	0.1756	0.3176	0.2213
Malaysia	0.1981	0.3062	0.2153	1	0.2224	0.5318	0.3533
Philippines	0.2525	0.2543	0.1756	0.2224	1	0.2573	0.2652
Singapore	0.2678	0.3794	0.3176	0.5318	0.2573	1	0.4380
Thailand	0.2332	0.2137	0.2213	0.3533	0.2652	0.4380	1
Crisis period (01/07/1997-31/12/1998)							
US	1	0.1788	0.2500	0.2597	0.2970	0.3185	0.2512
Indonesia	0.1788	1	0.2240	0.3573	0.3489	0.4474	0.3786
Japan	0.2500	0.2240	1	0.2725	0.2878	0.3985	0.3188
Malaysia	0.2597	0.3573	0.2725	1	0.3221	0.5176	0.3962
Philippines	0.2970	0.3489	0.2878	0.3221	1	0.4207	0.3890
Singapore	0.3185	0.4474	0.3985	0.5176	0.4207	1	0.5905
Thailand	0.2512	0.3786	0.3188	0.3962	0.3890	0.5905	1
Post crisis period (01/01/1999-29/12/2006)							
US	1	0.1668	0.3782	0.2322	0.2806	0.4052	0.2903
Indonesia	0.1668	1	0.2212	0.2559	0.2644	0.4051	0.2542
Japan	0.3782	0.2212	1	0.2085	0.2522	0.3962	0.2625
Malaysia	0.2322	0.2559	0.2085	1	0.2177	0.4795	0.3452
Philippines	0.2806	0.2644	0.2522	0.2177	1	0.2898	0.2807
Singapore	0.4052	0.4051	0.3962	0.4795	0.2898	1	0.5118
Thailand	0.2903	0.2542	0.2625	0.3452	0.2807	0.5118	1

Table 7.12: The behaviour of conditional correlations over the post-crisis period (January 1999 – December 2006)

IN, MA, PH, SG, TL stand for Indonesia, Malaysia, Philippines, Singapore and Thailand, respectively. *, ** and *** denote the significant levels of 10%, 5% and 1%, respectively.

	SG-IN	SG-MA	SG-PH	SG-TL	IN-MA
θ_i	0.0010***	0.0012***	0.0010***	0.0013**	0.0014***
	IN-PH	IN-TL	MA-PH	MA-TL	PH-TL
θ_i	0.0004	0.0015***	0.0008***	0.0005**	0.0006*

7.3.3 News Impact on Conditional Dynamics

In recent years the evidence for predictability has led to a variety of approaches, some of which are theoretically motivated, while others are simply empirical suggestions. The most interesting of these approaches are the "asymmetric" or "leverage" volatility and correlation models, in which good news and bad news have different predictability for future volatilities and correlations. This section aims to answer the following research question (see section 1.2.1): What are the effects of bad news and good news on conditional volatilities and correlations within the US, Japan and ASEAN-5?

7.3.3.1 News impact on conditional variance

Pagan and Schwert (1990) provide the first systematic comparison of volatility models. Engle and Ng (1993) suggest "News Impact Curve" to measure and test the impact of news on volatility. This section is going to apply the approach of "News Impact Curve" by Engle and Ng (1993) to explore the impact of news on volatilities of the US, Japan and ASEAN-5 markets (see equations 5.52 and 5.53 in sub-section 5.3.2.2). It is noted that our volatility model is built on the basis of GJR-GARCH model (see equation 5.48 in sub-section 5.3.2.2):

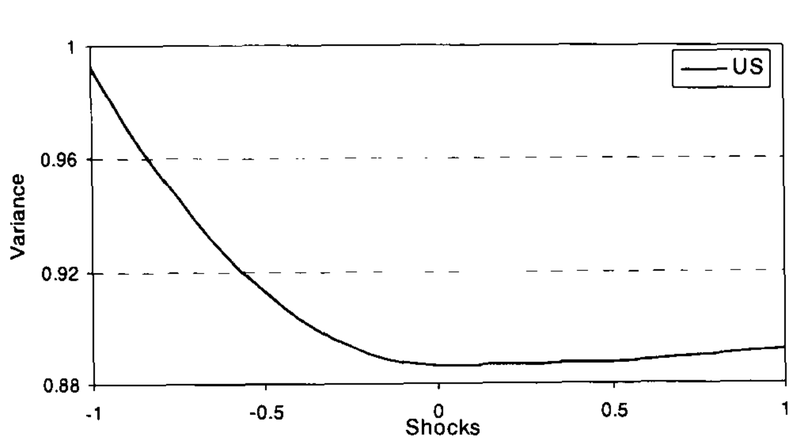
$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \gamma I[\varepsilon_{t-1} > 0]\varepsilon_{t-1}^2 + \beta h_{t-1}$$

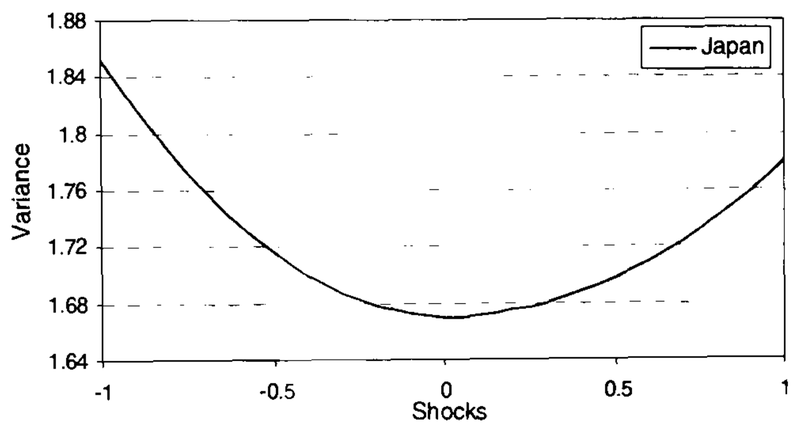
Figure 7.5 plots News Impact Curves for the US, Japan and ASEAN-5 markets. With the smallest conditional variance compared to others, the US is considered the most stable stock market. Indeed, given a shock fluctuated from -1 to 1, the US's conditional variance is approximately varied from 0.89 to 0.99. Next to the US, Singapore has its market stability ranked the second. Indonesia is the most fluctuated stock market, varying from 5.63 to 5.76 for shocks from -1 to 1. Generally, the rank of market stability based on conditional volatilities is in line with the results of unconditional volatilities (standard errors) reported in Table 7.8. Figure 7.5 also shows that bad news and good news obviously have different effects on volatility. In fact, the bad news or negative shocks in all cases make the market returns considerably more volatility than the good news or positive shocks do. It is reminded that the difference of news effects is statistically significant in all cases as presented in Table

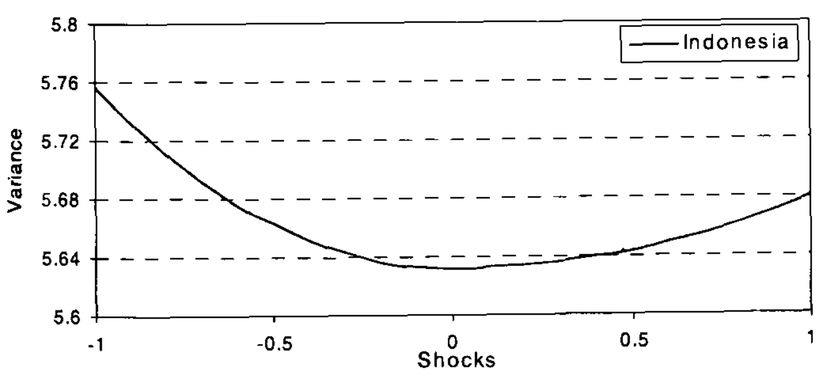
7.10. The asymmetric effects of news are most evident in the case of the US. In particular, the good news has very little impact on the US conditional variance, much smaller compared to the bad news does. For the ASEAN, the effects of good news on conditional variances are approximately just about half of the effects of bad news. The difference of news effects in the Japanese stock market is relatively smallest compared to others. Obviously, the GJR-GARCH model could detect asymmetric effects of news on conditional variances more efficiently than a normal GARCH could do.

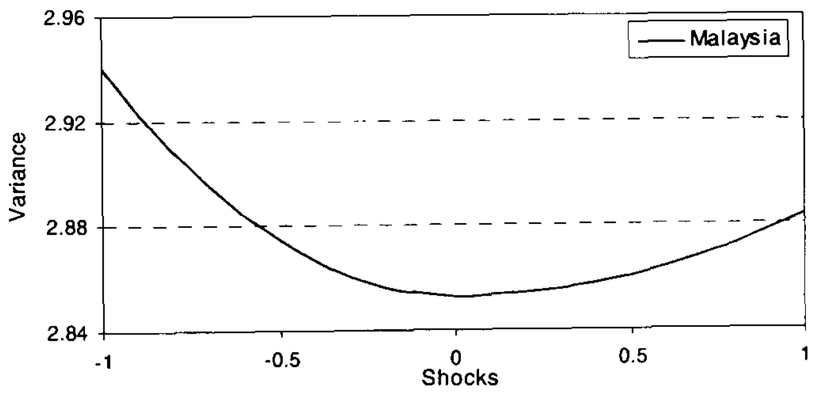
Figure 7.5: News Impact Curve on the conditional variance

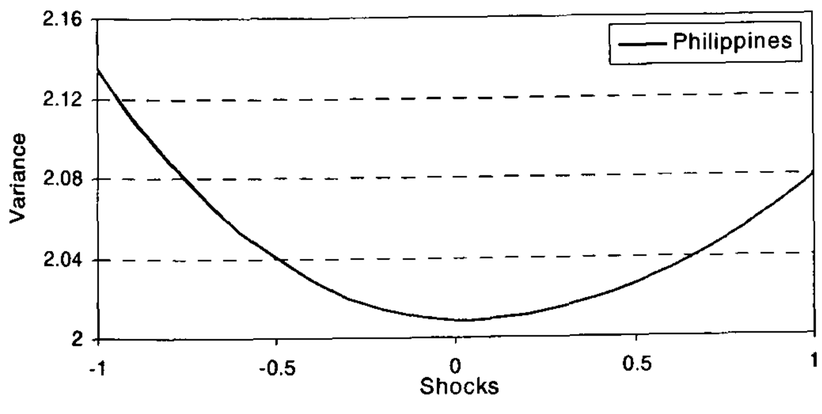
IN, MA, PH, SG, TL stand for Indonesia, Malaysia, Philippines, Singapore and Thailand, respectively

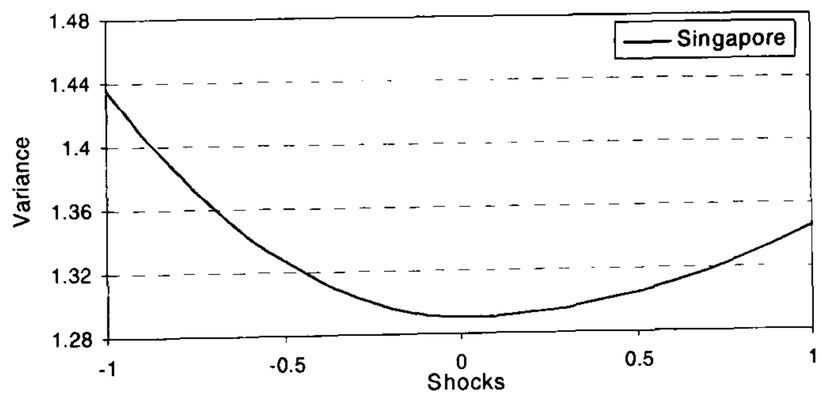


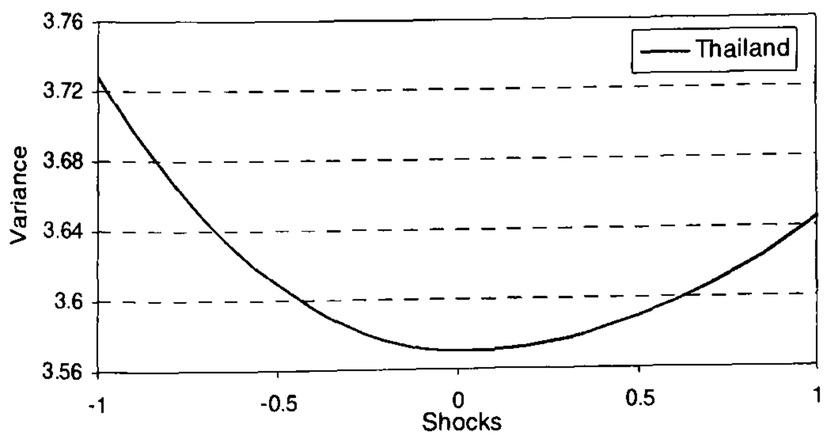












7.3.3.2 News impact on conditional correlation

Kroner and Ng (1998) introduced a multivariate generalisation of the graphical news impact curve from Engle and Ng (1993). The multivariate generalisation plots the conditional correlation and covariance against shocks from the last period. They call these "***News Impact Surfaces***" (see equations 5.54 and 5.55 in sub-section 5.3.2.2). The correlation news impact surface for the ADCC-GARCH model is given by

$$f(e_1, e_2) \approx \tilde{c}_{ij} + (a_i a_j + g_i g_j) e_i e_j, \quad \text{for } e_1, e_2 < 0$$

$$f(e_1, e_2) \approx \tilde{c}_{ij} + a_i a_j e_i e_j, \qquad \text{otherwise}$$

$e_i, i = 1,2$ are the standardized residuals, $e_{i,t} = \varepsilon_{i,t} / \sqrt{h_{i,t}}$. c, a and g are parameters estimated by ADCC-MVGARCH model. This section aims to investigate how the behaviour of conditional correlations changes corresponding to good news (+) and bad news (-). Joint positive news is when $\varepsilon_1 > 0$ and $\varepsilon_2 > 0$; and joint negative news is when $\varepsilon_1 < 0$ and $\varepsilon_2 < 0$ (Chandra, 2005). Generally, the results of twenty-one pairs of conditional correlations are categorised into four groups as follows (see Appendix 4 for visual evidence on each pair of conditional correlations):

<u>The 1st group</u>: ++ > -- > +-. Figure 7.6 illustrates the 1st group results. These results imply that the responses of conditional correlations to the joint good news (++) are larger than those to the joint bad news (--); and the responses to the joint bad news are larger than those to the combination of good news and bad news (+-). The pairs of US-Japan, US-Thailand, Indonesia-Philippines, Indonesia-Singapore, Japan-Malaysia, Japan-Thailand, Malaysia-Philippines, Malaysia-Singapore, Philippines-Thailand and Singapore-Thailand exhibit the above behaviour.

The 2nd group: ++ > +- > --. Figure 7.7 shows the 2nd group results. Particularly, these results mean that the responses of conditional correlations to the joint good news (++) are larger than those to the combination of good news and bad news (+-); and the responses to the combination of good news and bad news are larger than those to the joint bad news (--). The pairs are US-Malaysia, US-Singapore, Japan-Indonesia, Japan-Philippines and Japan-Singapore.

The 3rd group: +- > ++ > --. Figure 7.8 visually presents the 3rd group results. Specifically, these results indicate that the responses of conditional correlations to the combination of good news and bad news (+-) are larger than those to the joint good news (++); and the responses to the joint good news are larger than those to the joint bad news (--). The pairs are US-Philippines, Indonesia-Malaysia, Malaysia-Thailand, Philippines-Singapore and Indonesia-Thailand.

The 4th group: +- > -- > ++. Figure 7.9 plots the 4th group results. In particular, these results imply that the responses of conditional correlations to the combination of good news and bad news (+-) are larger than those to the joint bad news (--); and the responses to the joint bad news are larger than those to the joint good news (++). Only the pair of US-Indonesia shows this behaviour.

Generally, most of correlations within the US, Japan and the ASEAN-5 are impacted by good news and bad news in a way similar to the way reported in the 1st group where the joint good news (++) and joint bad news (--) contribute most to correlations. Besides, compared to the others ways of news combination, the joint good news provides the biggest contribution to correlations in fifteen cases out of twenty-one through out four groups of results. This indicates that the market development is an essential factor for increasing the stock market connection and motivating the process of financial integration. Focusing on the Asian markets (including the ASEAN-5 and Japan), we find regional correlations are affected most by the joint good news in eleven cases out of fifteen in total. These impressive impact of the

joint good news imply that the synchronous development of local markets plays a key role in building up an integrated financial region.

Obviously, compared to the symmetric DCC-MVGARCH, the ADCC-MVGARCH is more sophisticated, producing results with more detail of correlation behaviour. Indeed, for the symmetric DCC-MVGARCH model, the impact of joint good news and joint bad news on conditional correlations are the same by design. However, for the ADCC-MVGARCH, it allows these impacts to be investigated separately. Consequently, as illustrated in Figures 7.6-7.9, these impacts are clearly different from each other. Indeed, the impact of joint good news on conditional correlations is greater than the impact of joint bad news in all cases except for the US-Indonesia. In short, the ADCC-MVGARCH models do well-detect the asymmetric effects of news on conditional correlations.

Figure 7.6: News impact surface for the 1st group

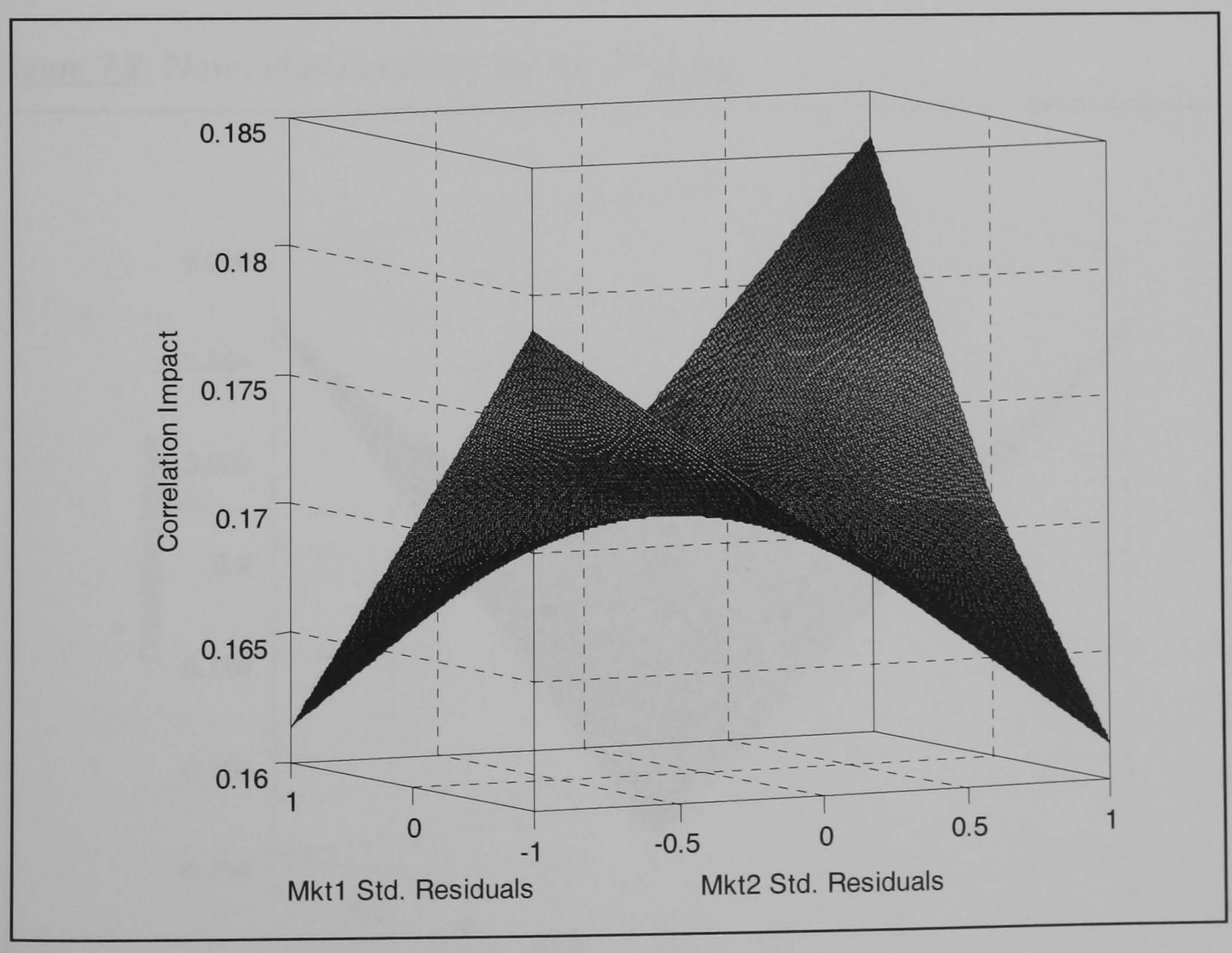


Figure 7.7: News impact surface for the 2nd group

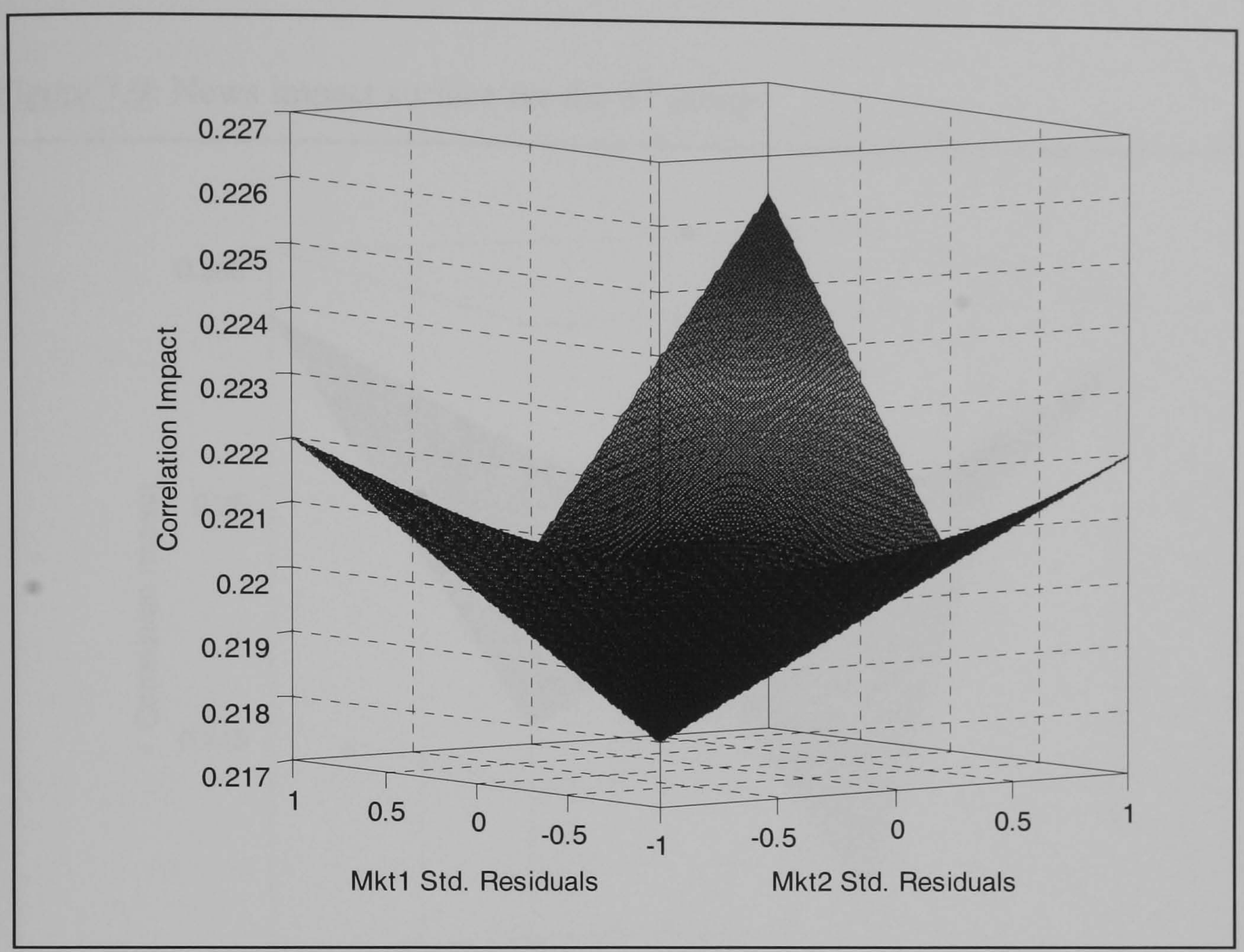


Figure 7.8: News impact surface for the 3rd group

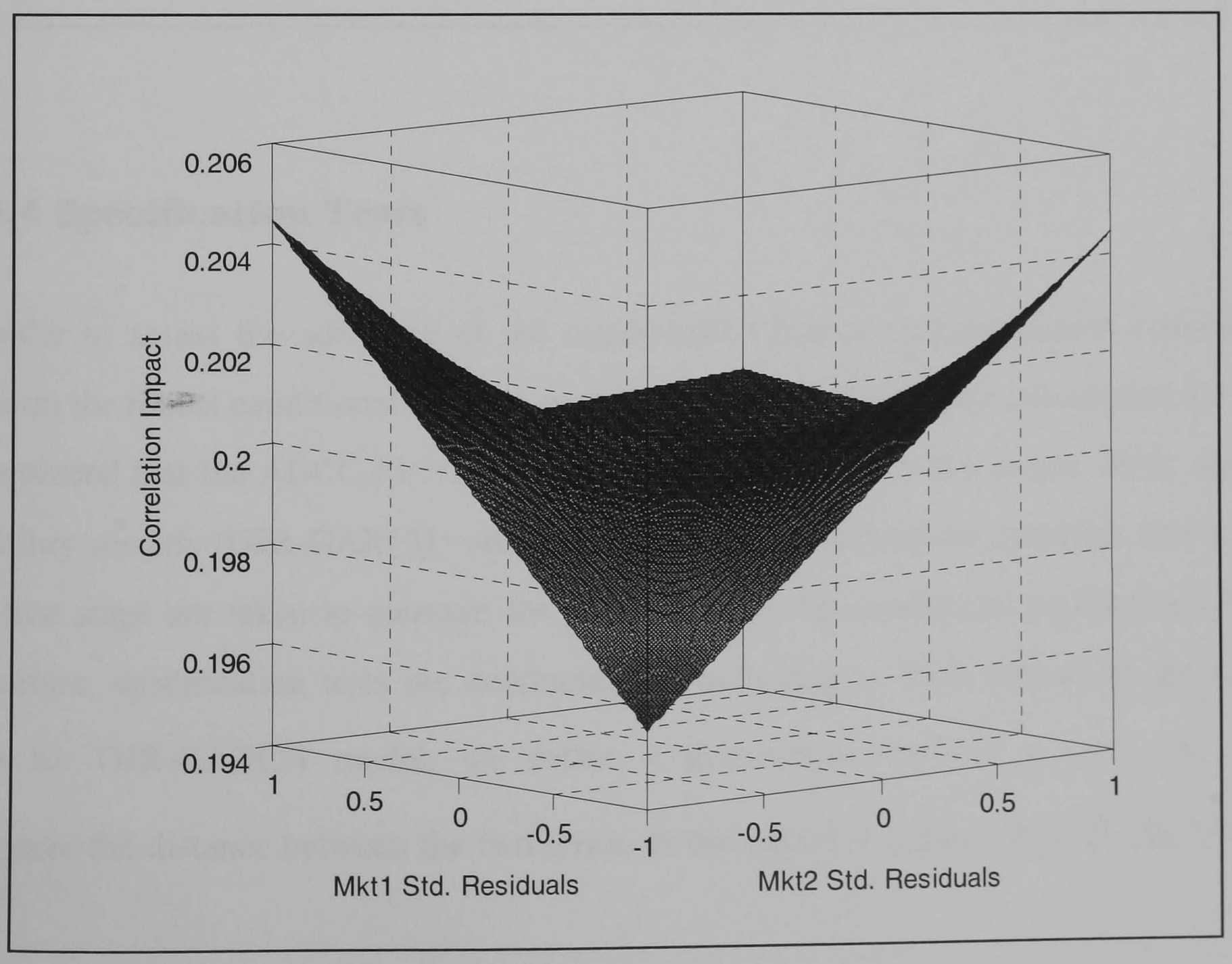
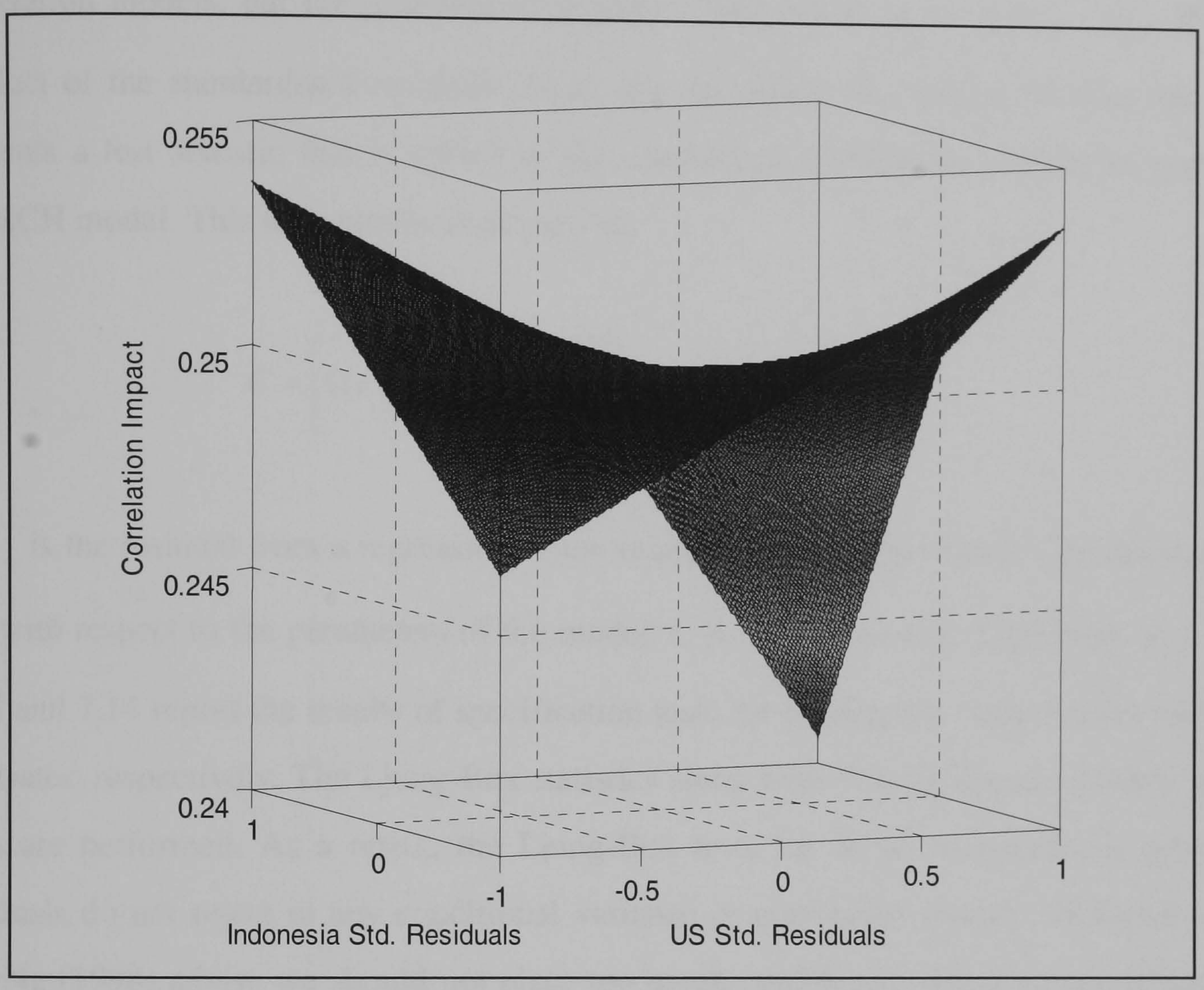


Figure 7.9: News impact surface for the 4th group



7.3.4 Specification Tests

In order to assess the adequacy of the conditional variance and correlation estimates, we perform the robust conditional moment test of Wooldridge (1990) (see sub-section 5.3.2.4). It is reminded that the ADCC-MVGARCH model is conducted in two stages. First, univariate volatility models (GJR-GARCH) are applied. Second, standardised residuals derived from the first stage are taken to measure the parameters of the conditional correlation (ADCC). Therefore, specification tests are conducted for both stages. With respect to specification tests for GJR-GARCH model, we define a generalised residual $u_t = \varepsilon_{i,t}^2 - h_{i,t}$, which measures the distance between the two terms. If the model is correct, then $E_{t-1}\{u_t\} = 0$, thus

u_t should be uncorrelated with any of variable known at time *t-1* (x_{t-1}). These variables are referred as misspecification indicators. Similar procedures are applied for testing conditional correlation models, but the generalised residual is defined as $u_{ij,t} = e_{i,t}e_{j,t} - \rho_{ij,t}$ (the outer product of the standardized residuals minus the estimated correlation). Wooldridge (1990) presents a test statistic that is robust to the conditional distribution used when testing the GARCH model. This test statistic is defined as:

$$C = \left[(1/T) \sum_{t=1}^{T} u_t \lambda_{g,t-1} \right]^2 \left[(1/T) \sum_{t=1}^{T} u_t^2 \lambda_{g,t-1}^2 \right]^{-1}$$

$\lambda_{g,t-1}$ is the residual from a regression of the misspecification indicator on the derivatives of $h_{i,t}$ with respect to the parameters of the model; C is asymptotically distributed $\chi_{(1)}$. Tables 7.13 and 7.14 report the results of specification tests for conditional variance and correlation estimates, respectively. The Ljung-Box statistics along with Wooldridge conditional moment tests are performed. As a result, the Ljung-Box tests for serial correlation in generalised residuals do not reject in any conditional variance or correlation models. However, Kroner and Ng (1998) advise we should not place too much confidence in statistically insignificant Ljung-Box statistics when evaluating GARCH models. For examining Wooldridge conditional moments, 196 tests were conducted for conditional variance models and 168 tests for conditional correlation models. The overall rejection rate in Table 7.13 is close to 13%, which means 87% of the tests report the adequacy of the GJR-GARCH model for estimating conditional variances. The overall rejection rate in Table 7.14 is close to 27%, which means 73% of the tests report the adequacy of the ADCC model for estimating conditional correlation.

Table 7.13: Specification tests for conditional variance estimates

Mispecification Indicators		$u_{i,t} = \varepsilon_{i,t}^2 - h_{i,t}$						
		US	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
x_{1t-1}	US	0.037	0.333	1.325	0.037	0.253	0.249	0.149
	Indonesia	0.013*	3.634*	0.001**	0.180	0.001**	0.001**	0.935
	Japan	0.120	2.560	2.304	0.275	2.176	0.189	0.225
	Malaysia	0.065	1.797	0.957	2.404	0.020	0.018	1.588
	Philippines	0.199	0.872	0.050	0.355	5.211**	0.042	0.240
	Singapore	0.205	0.685	0.156	0.007*	0.499	0.508	1.598
	Thailand	0.453	0.018	0.035	0.004**	0.040	0.131	0.526
x_{2t-1}	US	1.983	2.372	0.050	0.033	0.827	0.248	1.932
	Indonesia	1.267	1.430	1.840	0.341	1.590	0.000***	0.509
	Japan	0.242	0.527	0.001**	0.467	0.134	1.238	1.509
	Malaysia	1.354	1.254	0.197	0.935	1.375	0.124	0.191
	Philippines	1.654	2.011	1.382	0.174	0.208	0.241	1.301
	Singapore	1.777	3.743*	1.060	0.001**	0.585	5.973**	0.250
	Thailand	0.036	6.531**	2.086	0.003**	1.288	0.373	0.649
x_{3t-1}	US	1.867	0.371	0.697	0.898	0.704	1.048	0.021
	Indonesia	0.216	4.194**	0.472	0.049	0.298	0.657	1.696
	Japan	0.733	0.769	2.684	0.171	0.647	0.622	0.025
	Malaysia	0.557	1.405	0.215	1.693	1.365	0.018	0.251
	Philippines	0.082	2.537	1.547	0.716	0.050	0.274	0.116
	Singapore	3.972**	0.791	0.099	0.000***	2.521	0.910	1.758
	Thailand	1.073	0.039	0.118	0.020	0.237	0.818	0.650
x_{4t-1}	US	2.925*	0.686	0.119	1.247	0.064	0.077	0.134
	Indonesia	2.922*	1.079	2.520	1.466	2.930*	0.368	1.427
	Japan	0.285	0.099	0.251	0.495	0.130	0.019	1.860
	Malaysia	4.991**	0.449	0.405	1.238	0.479	0.026	1.915
	Philippines	2.916*	2.076	2.694	1.078	0.240	0.352	0.604
	Singapore	1.748	0.221	4.051**	2.141	0.769	3.595*	2.546
	Thailand	0.284	0.657	2.631	0.901	1.554	0.642	0.194
Ljung-Box Statistics	Q(6)	3.496	1.905	8.287	5.784	1.153	8.550	9.053
	Q(12)	6.646	5.336	9.325	8.210	3.501	13.349	11.977
	Q(18)	10.378	13.518	24.785	10.067	4.495	19.621	15.690
	Q(24)	15.705	22.478	28.864	12.583	8.233	27.473	17.214

Note:

- For Q(6), the 5% and 1% critical values are 12.592 and 16.812, respectively.
- For Q(12), the 5% and 1% critical values are 21.026 and 26.217, respectively.
- For Q(18), the 5% and 1% critical values are 28.869 and 34.808, respectively.
- For Q(24), the 5% and 1% critical values are 36.415 and 42.980, respectively.

Table 7.14: Specification tests for conditional correlation estimates

Countries	$u_{i,t} = e_{i,t}e_{j,t} - \rho_{ij,t}$								Ljung-Box Statistics			
	x_{5t-1}	x_{6t-1}	x_{7t-1}	x_{8t-1}	x_{9t-1}	x_{10t-1}	x_{11t-1}	x_{12t-1}	Q(6)	Q(12)	Q(18)	Q(24)
US-IN	1.066	1.052	3.171*	4.931**	3.402*	1.947	1.384	1.589	0.0013	0.0026	0.0041	0.0053
US-JP	6.268**	12.653***	0.861	18.276***	1.974	6.225**	0.595	1.636	0.3537	0.5080	1.0566	1.3370
US-MA	0.378	0.052	0.466	0.860	0.025	0.328	0.087	0.268	0.0036	0.0042	0.0046	0.0048
US-PH	2.666	11.277***	0.215	7.741***	1.689	11.173***	0.532	0.267	1.7416	2.8861	6.2709	23.2039
US-SG	0.154	1.153	0.416	6.366**	0.678	5.580**	0.298	1.347	0.0243	0.0288	1.6103	1.6220
US-TL	0.529	4.790**	0.489	3.215*	0.004**	9.766***	0.797	0.164	0.0232	1.0348	1.0392	1.0473
IN-JP	0.083	0.039	0.654	0.307	0.281	0.384	1.477	0.986	0.0139	0.0396	1.5706	1.5913
IN-MA	1.717	2.807*	5.663**	11.138***	2.060	0.810	0.926	0.062	0.0476	0.0577	0.0603	0.0662
IN-PH	0.570	0.239	0.289	0.173	0.844	0.652	0.876	0.777	0.0015	0.0038	0.0049	0.0063
IN-SG	0.009*	0.230	0.526	0.737	0.052	0.640	1.155	17.720***	0.4404	0.4864	1.0046	1.2492
IN-TL	6.061**	4.359**	0.288	5.293**	0.998	0.939	0.621	0.007*	0.1041	3.8844	4.5859	5.1272
JP-MA	12.502***	0.000***	2.703	0.020	12.402***	1.128	13.940***	0.480	0.7620	5.9382	7.6190	10.1602
JP-PH	0.624	0.391	0.103	0.079	0.761	0.498	0.828	0.203	0.3153	2.1408	5.1714	21.3179
JP-SG	1.607	3.401*	0.856	1.238	0.363	1.951	0.881	0.030	0.0689	0.0932	0.1188	0.1817
JP-TL	0.556	0.142	4.111**	1.006	0.974	0.046	3.92**	0.500	0.4825	1.4276	7.4003	10.3627
MA-PH	0.106	7.160***	2.274	9.865***	0.918	0.396	0.338	7.255***	0.0571	0.0580	0.0783	0.0801
MA-SG	1.762	2.212	0.920	6.263**	2.645	0.161	4.633**	9.135***	0.0013	0.0023	0.0036	0.0056
MA-TL	1.082	4.349**	0.492	7.106***	0.362	1.238	2.599	0.408	1.5506	2.5505	3.4030	3.7435
PH-SG	0.150	0.003**	0.329	7.025**	4.524**	1.977	1.565	0.021	0.0259	0.0445	0.0876	0.1196
PH-TL	2.208	1.766	1.259	2.780*	0.011*	0.648	1.587	1.088	0.0762	0.3675	0.3789	0.3891
SG-TL	0.485	1.669	0.043	5.242**	2.380	0.078	2.075	1.523	2.7280	3.2783	10.8040	11.7368

Note:

- For Q(6), the 5% and 1% critical values are 12.592 and 16.812, respectively.
- For Q(12), the 5% and 1% critical values are 21.026 and 26.217, respectively.
- For Q(18), the 5% and 1% critical values are 28.869 and 34.808, respectively.
- For Q(24), the 5% and 1% critical values are 36.415 and 42.980, respectively.

7.4 CONCLUSIONS

There are two main research themes examined and reported in this chapter. First, we investigate the time-varying degree and nature of integration in the ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore and Thailand) stock markets based on the CAPM framework suggested by Bekaert and Harvey (1997) and modified by Fratzscher (2001) and Bekaert et al (2005). The findings relate to three main issues: market integration, market efficiency and volatility-spillover spread. Second, we estimate the time-varying correlation dynamics in the US, Japan and ASEAN-5 stock markets based on the asymmetric dynamic conditional correlation - multivariate GARCH (ADCC-MVGARCH) model suggested by Cappiello et al (2004). Data for national indices cover from the 3rd January 1991 to the 29th December 2006.

Tests of integration based on the CAPM model result in five main conclusions. First, the level of integration within the region is substantially higher than that with the world over the period 1991-2006. In fact, the significant level of regional integration is documented in all of the ASEAN stock markets, but world integration only in the case of Singapore. Thailand and Indonesia are the two markets with the highest levels of regional integration over the period 1991-2006. Second, findings from testing patterns in global and regional integration strongly indicate that the Asian crisis and abnormal (regional as well as global) shocks tend to challenge the process of financial regionalisation and globalisation. Third, changes in ASEAN-5 market returns are heavily dependent on past information, especially from the region, which reflects a low degree of market efficiency. Among the ASEAN, given its market returns are considerably explained by the global, regional and local past information, Indonesia seems to have the lowest degree of market efficiency. Next, regarding volatility-spillover spread, Indonesia, Malaysia and the Philippines seem to be most impacted by regional shock while Thailand is most influenced by global market fluctuations. And, finally, the different behaviour of asymmetric volatility spillover effects from the local, regional and world markets imply that investors respond to regional and global news more optimistically than they do to local news.

Tests of integration based on the ADCC-MVGARCH model also result in five main conclusions. First, the ASEAN market returns seem to interact regionally rather than they are impacted by the US and Japanese markets. More specifically, regional market returns have strong direct linkages to changes in the Singaporean and Thai market returns. Second, changes in the ASEAN stock markets could make statistically significant impact on international markets. Indeed, both the US and Japanese market returns are significantly influenced by the Singapore lagged returns. In addition to Singapore, the US returns are influenced by Indonesian past returns; the Japanese returns are affected by Malaysian and Thai past returns. Third, results of conditional correlations indicate that the ASEAN markets have considerably higher correlations to each other than with the US and Japan over the period 1991-2006. These strong linkages seem to be enhanced over time, especially in the post-crisis period. The two most notable correlations are 50.97% for the Singapore-Malaysia and 51.34% for the Singapore-Thailand over the period 1991-2006. It is noted that a phenomenon of financial contagion is documented during the Asian crisis. Next, correlations among the three developed markets, the US, Japan and Singapore seem to increase over time. Indeed, the Japanese and Singaporean stock markets had moderate correlations with the US in the period 1991-1998, but significantly strengthened their linkages with the US after the Asian crisis. And, finally, through News Impact Curve and New Impact Surfaces we have found strong evidence of asymmetries in conditional variances and correlations of all seven markets, although the asymmetries are presented in markedly different manners. News Impact Curves show that negative shocks make market returns considerably more volatile than positive shocks. News Impact Surfaces illustrate different impacts of joint news on market correlations. A special attention is given to the joint good news. In fact, the join good news contributes most to correlations in most of cases. These impressive impacts of the joint good news imply that the synchronous development of individual markets plays a key role in building up an integrated financial region

The results from the analysis of stock market integration and dynamic linkage could help investors in their investment decisions. First, the significant level of regional integration and increase in conditional correlations may reduce benefits of portfolio diversification within the region. However, the level of integration is relatively low, although increasing over time, which implies there are still opportunities for investors to diversify portfolio investment. Second, the finding of low market efficiency in the ASEAN stock markets

will help the investors assess the price trend and predict expected returns more accurately. Next, the asymmetric effects of news on conditional variances and correlations in stockmarket returns is of importance for international and domestic investors, helping them evaluate risks in their investment portfolios. And, finally, it should be emphasised that financial regionalisation will, through promoting the monitoring of government behaviour by participants in regionalised financial markets, provide the government with discipline for macroeconomic policy management and, hence, contribute to stability of the financial system. The results show that regional stockmarket correlations are highest on days when good news emanates from stock markets. Generally speaking, the evidence on stock market integration indicates that the synchronous development of individual stock markets would play a key role to build up an integrated financial region.

In conclusion, the ASEAN-5 markets tend to integrate and correlate together rather than with the Japanese or the world market (the US). Although Japan is the biggest financial market in Asia, it is neither quite close nor affects much the group of ASEAN. In fact, the country playing the most considerable role in the region is Singapore. The Singaporean stock market not only has a great impact on regional markets, but also significantly influences the Japanese and US markets. Looking at both credit and equity markets, Chapters 6 and 7 have provided a comprehensive view of the state of financial integration in the ASEAN-5. The next chapter, also the final chapter, will give a summary of this thesis, present policy implications based on thesis findings and raise recommendations for further research.

CHAPTER VIII

CONCLUSIONS, CONTRIBUTIONS AND SUGGESTIONS FOR FURTHER RESEARCH

8.1 CONCLUSIONS

This dissertation aims to fill a gap in the existing literature by attempting to answer questions relative to the state of financial integration in East Asia, with a special focus on the ASEAN-5 area. The US and Japan are considered reference markets. Based on the availability and the reliability of data, two main financial markets are investigated: credit markets and stock markets. The study purposes and objectives, literature reviews, methodologies and empirical findings are all sequentially specified, discussed and reported throughout Chapters I-VII. Based on what has been done in the previous chapters, this final chapter is going to present some conclusions for the whole research.

For ***credit market integration***, empirical tests are employed on the basis of Johansen's multivariate cointegration techniques. An unrestricted VAR model is conducted to investigate short-run linkages. The generalised impulse response function (G-IRF) forecasts by Pesaran and Shin (1998) are also utilised in order to draw a clear picture of dynamic linkages. Real short-term money market rates are used for empirical tests because long-term interest rates, such as government bond yields, are unavailable for most of the ASEAN economies. Data are all collected from Datastream. Monthly observations cover from January 1983 to May 2006, which comprises 281 observations. The US and Japanese rates are considered the global and regional rates, respectively.

All results relative to credit market integration are reported in Chapter VI. The main conclusions are drawn as follows. In the first place, although long-term integration is found between the US and the group of Indonesia, Malaysia and the Philippines based on cointegration tests, the full global integration or a common trend with the world market has not happened for the ASEAN over the period 1983-2006. There is also no evidence

that the ASEAN credit markets tend to integrate with the Japanese market. However, the evidence of full integration or one common trend is surprisingly found within the ASEAN markets.

Second, the results support the validity of real interest rate parity theory. Specifically, the [1-1] vectors are found in the pairs of the US-Indonesia, the US-Philippines, Japan-Philippines, Singapore-Indonesia, Singapore-Malaysia, Singapore-Philippines, Indonesia-Malaysia, Indonesia-Thailand, Indonesia-Philippines, Malaysia-Philippines and Philippines-Thailand. Indeed, the evidence for real interest rate parity in the Pacific Basin countries is partially documented in Phylaktis (1999).

Next, with respect to causal effects, a common behaviour of real interest rates is that they are positively related to and most explained by their last month changes. Given one-direction effects on the ASEAN, the US and Japanese credit markets used to be dominant players in the region before the Asian crisis. The ASEAN credit markets have increasingly connected to each other over time. Especially, Thailand has great impact on other regional markets all the time. Besides, with strong and long lasting impact on other ASEAN, Japan and the US (in the post-crisis), Singapore appears to play a considerable position either in the regional or in the world credit markets, serving to mediate the interest rate linkages between the US and the Asian region. These findings are in line with Anoruo et al (2002).

Finally, regarding the state of shock transmission, it is common that credit markets were impacted most by their own shocks over the period 1983-2006. The US shocks were highly transmitted to and long-lasting in the ASEAN and Japanese credit markets over the pre-crisis; but the US impact was reduced during the post-crisis. It is surprising that a shock from Japan, considered the regional market, generally has little impact on the ASEAN. Notably, the ASEAN credit markets were affected by each other more than by the world market. It seems that the ASEAN except for Indonesia have increased their impact on the US in post-crisis. In contrast, for Japan, their impact has declined over time. The Singaporean credit market significantly affected all other markets including the US and Japan, the two biggest ones in the world, implying the considerable role of

Singapore not only in the region, but in the world as well. More interestingly, Singapore appears to affect the US and Japan more than being impacted by them.

For ***stock market integration***, empirical tests are conducted on the basis of the CAPM-TGARCH (capital asset pricing model – trivariate GARCH) and ADCC-MVGARCH (asymmetric dynamic conditional correlation – multivariate GARHC). The CAPM framework was suggested by Bekaert and Harvey (1997) and then sequentially modified by Fratzscher (2001) and Bekaert et al (2005). This model is used to investigate the state of stock market integration for the ASEAN. The ADCC-MVGARCH model was proposed by Cappiello et al (2004). This model is applied to estimate time-varying conditional correlations among the ASEAN, US and Japan. Data are all collected from Datastream covering from January 1991 to December 2006. While weekly data are used for the estimates of market integration in order to balance between information and noise, daily data are used for the estimates of market conditional correlations mainly because the MVGARCH model requires a lot of observations.

The results of stock market integration are reported in Chapter VII. The main conclusions are summarised as follows. First, findings from the CAPM-TGARCH model indicate that the ASEAN markets tend to integration within the ASEAN region rather than with the world over the period 1991-2006. In fact, a significant level of regional integration is documented in all ASEAN stock markets (especially Thailand and Indonesia), but world integration is only in the case of Singapore. Besides, it seems that the Asian crisis and abnormal (regional as well as global) shocks impede the regional and global integration processes.

Second, ASEAN-5 market returns are significantly influenced by past information, especially from the region, which reflects a low degree of market efficiency. Among the ASEAN, given its market returns sizably accounted by the global, regional and local past information, Indonesia appears to be the least efficient market.

Third, regarding volatility-spillover spread, neither regional nor global volatilities have significant effects on the Singaporean stock market. While Indonesia, Malaysia and the

Philippines' volatilities are significantly impacted by the volatilities spread from regional markets, Thailand is affected by shocks from the world market. Besides, the behaviour of local variances in facing negative and positive shocks is different depending on the originality of shocks. Specifically, for local shocks, the negative shocks have more effects than positive. In contrast, for regional and global shocks, the positive has more. To some extent, these results may indicate that investors respond to regional and global shocks more optimistically than they do to the local.

Fourth, results from the ADCC-MVGARCH model imply the ASEAN market returns seem to be impacted by the other regional market returns rather than by US and Japanese returns. Evidently, the Singaporean and Thai stock markets play considerable roles in the region. ASEAN stock markets could make statistically significant impact on international markets. Indeed, Singaporean past returns significantly affect both the US and Japan. In addition, Indonesian past returns may affect the US; the Malaysian and Thai past returns may affect Japan.

Next, the ASEAN are more strongly correlated to each other than with the US and Japan. These strong linkages seem to be enhanced over time, especially in the post-crisis period. The two most notable correlations are 50.97% for the Singapore-Malaysia and 51.34% for the Singapore-Thailand over the period 1991-2006. With respect to the dynamic linkages among the US, Japan and Singapore, the Japanese and Singaporean stock markets had moderate correlations with the US in the period 1991-1998, but significantly strengthened their linkages with the US afterward.

Finally, the asymmetric effects of news on conditional variances and correlations are clearly visualised through news impact curves and new impact surfaces. News impact curves show that bad news makes market returns considerably more volatile than good news. News impact surfaces illustrate different impacts of joint news on market correlations. A special attention is paid to impressive effects of the joint good news. For most of cases, the joint good news contributes most to correlations, which indicates that the synchronous development of local markets plays a key role in building up an integrated financial region.

8.2 IMPLICATIONS AND CONTRIBUTIONS

This dissertation makes several policy implications and contributions to the existing literature on integration, dynamic linkage and volatility transmission across financial markets.

Previous studies mostly look at the ASEAN markets in the periods of 1980s and 1990s. Our study enhances the literature by investing the ASEAN financial integration in an updated period, from 1983 to 2006. The considered period covers three remarkable phases: (1) financial deregulation, (2) financial crisis and (3) financial restructuring and co-operation.

Our methodologies constitute several advanced econometric techniques some of which have not used in previous studies on the ASEAN:

- *First*, we improve the quality of cointegration tests using the adjusted trace and maximum eigenvalue statistics introduced by Reinsel and Ahn (1988). Cheung and Lai (1993) report that using these trace and maximum eigenvalue statistics would lead to reduce the over-rejection problem of the null hypothesis of no cointegration.
- *Second*, we apply the generalised impulse response functions (G-IRF) forecasts to trace how a shock to a real interest rate affects the current or future values of itself and other real interest rates. The G-IRF developed by Pesaran and Shin (1998) overcomes the disadvantage of the traditional (orthogonalised) IRF and allow the results to be invariant to any ordering of variables.
- *Third*, we evaluate the state of international and regional integration in the ASEAN-5 equity markets on the basis of the CAPM with trivariate GARCH model (CAPM-TGARCH) sequentially developed by Fratzscher (2001) and Bekaert et al (2004). The CAPM-TGARCH is a two-factor model extended from the traditional CAPM, one-factor model. Specifically, the CAPM-TGARCH divides the world market into the US market and a particular regional market and then allows individual markets to be priced. Besides, compared to other CAPM models, the CAPM-TGARCH allows us to clearly distinguish indicators of market integration and market efficiency.

- *Fourth*, in order to explore dynamic linkages among the US, Japanese and ASEAN-5 equity markets, we employ the Asymmetric Dynamic Conditional Correlation Multivariate GARCH model (ADCC-MVGARCH) proposed by Cappiello et al (2004). This model does not only overcome disadvantages of other MVGARCH models, but also take into account the asymmetric effects of news on conditional second moments, such as variances and correlations.
- *Next*, news impact curves (Engle and Ng, 1993) and news impact surfaces (Kroner and Ng, 1998) are used to visualise the effects of positive and negative shocks on conditional volatilities and correlations. The new impact curves measure how new information is incorporated into volatility estimates; the new impact surfaces describe the way joint news from different markets affect their correlations.
- And, *finally*, along with the Ljung-Box statistics, Wooldridge conditional moment tests are conducted. In fact, Kroner and Ng (1998) advise we should not place too much confidence in statistically insignificant Ljung-Box statistics when evaluating GARCH models.

We extend the existing literature based on the reported results:

- *First*, cointegration tests indicate the existence of long-term full integration or a common trend in the ASEA-5 credit market over the period 1983-2006.
- *Second*, the theory of real interest rate parity is strongly supported. Specifically, the [1-1] vectors are found in the pairs of the US-Indonesia, the US-Philippines, Japan-Philippines, Singapore-Indonesia, Singapore-Malaysia, Singapore-Philippines, Indonesia-Malaysia, Indonesia-Thailand, Indonesia-Philippines, Malaysia-Philippines and Philippines-Thailand.
- *Third*, short-run dynamic tests imply that the Singaporean market has been increasing its role as a dominant player in the ASEAN instead of the Japanese. Indeed, changes in Singapore's credit and equity markets do considerably impact and have strongly positive correlations with other regional credit and equity markets.
- *Fourth*, tests of equity market integration indicate that the ASEAN tend to integrate with each other over time rather than integrate with the US.
- *Next*, tests of market efficiency imply that the ASEAN price returns positively rely on past regional and local information. Besides, the Thai and Indonesian

returns have significantly negative correlations with the past global information while the others do not at all.

- And, *finally*, good and bad news have different effects on the behaviour of conditional variances and correlations. Specifically, the bad news makes market returns considerably more volatility than good news; the joint good news generally contributes most to correlations.

The results from this thesis could significantly contribute to investors' investment decisions. First, the evidence of long-term integration and real interest rate parity in the ASEAN credit markets will make the cross-border trading more flexible and efficient, giving the investors more opportunities to enlarge their investments. Second, the increasing positive direction of regional and global correlations may reduce benefits of portfolio diversification. Next, the finding of low market efficiency in the ASEAN stock markets will help the investors assess the price trend and predict expected returns more accurately. And, finally, the asymmetric effects of news on conditional variances and correlations in the stock markets is of importance for international and domestic investors, helping them evaluate risks in their investment portfolios and improve their investment decisions.

Several policy implications are also drawn on the basis of the research findings. First, it should be pointed out that financial regionalisation will, through promoting the monitoring of government behaviour by participants in regionalised financial markets, provide the government with discipline for macroeconomic policy management and, hence contribute to stability of the financial system (Okina et al, 1999). Second, policy makers in the ASEAN countries are interested in identifying the degree of integration of financial markets as part of negotiating and defining an agenda of reform and liberalisation in the region (Ghosh, 2006). Third, the considerably high regional cooperation and integration may provide the ASEAN a stronger voice in global forums and greater influence on global policy making. Grenville (2000, 2003) argues that greater regional policy dialogue and cooperation are important because they provide the region with influence over global rules setting. Next, although a deeper level of financial market integration increases the tendency of capital flows to equalize real long-term interest rates between countries, a wider dispersion of short-term interest rates may persist, reflecting the business and financial conditions in each country. In this case, monetary policy will

affect real economic activities by altering the spreads between long- and short-term interest rates. Thus, it seems to be the case that increased financial market integration will change the transmission mechanism of monetary policy. And, finally, the strongly on-going process of regional integration is premising a common currency area in future. Estimates of regional and global integration indicate that the ASEAN common currency is unlikely the US dollar or Japanese yen. Besides, Okina et al (1999) suggest that the target zone arrangement will be a realistic option for a group of small countries with a high dependency on foreign trade.

8.3 LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Generally, the thesis provides an informative and new insight based on an updated data set and newly developed methodologies, from which certain tentative policy prescriptions and investment decisions can be drawn. The analysis, however, is not without its limitations. This section discusses these limitations and provides suggestions for future research.

In the first place, the limitation is related to the data set used in this study. The time scale and frequency of credit market data are not the same as those of equity market data due to the data unavailability. Particularly, while monthly data on credit market cover from January 1983 to August 2006, weekly and daily data on equity market cover from January 1991 to December 2006. Additionally, the sample countries are limited to the five ASEAN markets including Singapore, Thailand, Indonesia, Malaysia and the Philippines because data are not available in other East Asian markets, or, if available, they do not cover a sufficiently long period of time. We hope that future research can overcome these data disadvantages in order to achieve more comprehensive results of financial integration in the ASEAN in particular and in the East Asia in general.

The second point is related to the CAPM-TGARCH model, there are only trade variables (information variables) used to estimate time-varying degrees of integration. Although Chen and Zhang (1997) point out countries with heavier external trade to a region tend to have higher degree of financial integration with that region, this does not mean the degree of integration may be fully explained by the trade variables. Thus, further studies on the

ASEAN using other information variables, such as exchange rate (Fratzscher, 2001), are highly recommended.

Next, Wooldridge (1990) specification tests show that the ADCC-MVGARCH model does not completely capture the data dynamics. In fact, it is unable to determine there is surely a specific approach which generates better results. However, we may try other techniques and compare their results with those of the ADCC-MVGARCH model. One of the ways is to employ the multivariate GARCH model with time-varying correlations proposed by Tse and Tsui (2002). The point this model is different from the ADCC-MVGARCH is that it formulates the conditional correlations as a weighted sum of past correlations while the ADCC-MVGARCH does not. Another approach is to apply the dynamic conditional correlation model with asymmetric multivariate laplace innovations proposed by Cajigas and Urga (2007). This model follows an asymmetric multivariate laplace distribution which is able to capture leptokurtosis and asymmetry from financial assets. It preserves desirable properties such as finiteness of moments and stability under geometric summation.

With respect to the scope of investigation, this dissertation does not consider East Asian bond markets in investigating the state of financial integration. In fact, the bond market is an important component in the financial market in addition to the credit and equity markets. This suggests further research on bond market integration to have a comprehensive view of the financial integration in the East Asian economies.

The final limitation is that this thesis has focused on investigating financial integration based on the country-level data only. However, the theoretical definition of financial integration indicates that identical tradable assets should expect to receive the same level of return. Hence, in order to evaluate the process of financial integration, we need analyse the integration in not only country-level, but industry-level as well. Investigating market integration at the industry-level is important because of the increase in economic integration, industrial reorganisation and blurring of national boundaries. Indeed, it is possible that even if a country is integrated with the world capital market, some of its industries may not be integrated due to, for example, industry-specific foreign ownership restrictions, absence or low volume of exports. Therefore, identifying whether there is considerable industry integration could be a fruitful avenue for future research.

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Appendix 1: Generalised Impulse Responses across the US, Japan and the ASEAN.

Panel A: Generalised impulse response to a shock in the US.

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	0.1638*	0.0530*	-0.0166*	-0.0184	0.0525*	0.1319*	0.2297*	-0.4076*	-0.0152	0.0180*	0.0168	0.0444*	0.1762*	0.2822*
1	0.2713*	0.0619*	0.0632*	-0.1443*	0.1115*	0.1133*	0.2661*	-0.1672*	-0.0017	-0.0370*	-0.0203	0.0441*	0.1296*	0.3584*
2	0.2256*	0.0933*	0.0036	-0.2395*	0.0840*	0.0807*	0.2576*	-0.0346	0.0436*	-0.0265*	-0.0161	0.0589*	0.1838*	0.2788*
3	0.1639*	0.1819*	0.0678*	-0.1622*	0.1248*	0.1914*	0.1650*	-0.0048	0.0813*	-0.0670*	-0.0105	0.0520*	0.1402*	0.0869*
4	0.1926*	0.1917*	0.0312*	-0.1016*	0.0927*	0.2363*	0.1103*	-0.0920*	0.0589*	-0.0628*	0.0734*	-0.0177*	0.0920*	0.0243
5	0.2543*	0.1331*	0.0681*	0.0284	0.1005*	0.2661*	0.0854*	-0.1504*	0.0170*	-0.0706*	0.1819*	0.0396*	0.0057	0.0287
6	0.1848*	0.0544*	0.0353*	0.0446	0.0657*	0.2148*	0.0889*	-0.1386*	0.0174*	-0.0005	0.2423*	0.0800*	0.0011	0.0804*
7	0.0942*	0.0221	0.0316*	0.0824*	0.0812*	0.2269*	0.1094*	0.0359	0.0273*	0.0220*	0.1996*	0.1192*	0.0267*	0.0783*
8	0.0428	0.0753*	0.0180*	0.0494*	0.0827*	0.2379*	0.1222*	0.2635*	-0.0015	0.0476*	0.0800*	0.0701*	0.0191*	0.0344*
9	0.0881*	0.1200*	0.0363*	0.0614*	0.0931*	0.2348*	0.1252*	0.2137*	-0.0227*	0.0241*	-0.0004	0.0291*	0.0420*	-0.0223
10	0.1344*	0.1375*	0.0663*	0.1040*	0.0956*	0.1937*	0.1077*	0.0147	-0.0176*	0.0367*	0.0060	0.0220*	0.0084	-0.0178
11	0.1504*	0.0844*	0.0954*	0.1697*	0.1002*	0.1492*	0.0869*	-0.1680*	0.0241*	0.0368*	0.0157*	0.0417*	0.0417*	0.0383*
12	0.1514*	0.0452*	0.1047*	0.1990*	0.1058*	0.1398*	0.0766*	-0.0764*	0.0272*	0.0568*	0.0104	0.0525*	0.0113	0.1023*

Panel B: Generalised impulse response to a shock in Japan

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	-0.0145	0.4539*	0.0316*	-0.1624*	0.0210*	0.1903*	0.0268*	-0.6173*	0.2758*	-0.0201*	-0.0297	-0.0324*	-0.1286*	-0.0156
1	-0.0230	0.3913*	0.0222*	-0.2327*	0.1021*	0.2488*	0.0300*	-0.7543*	0.2040*	0.0063	0.1091*	-0.1361*	-0.1030*	-0.0537*
2	0.0053	0.2546*	-0.0005	-0.0678*	0.0919*	0.2025*	-0.0127	-0.2506*	0.0226	0.0574*	0.1580*	-0.2213*	-0.2749*	-0.1986*
3	-0.0189	-0.0235	0.0248*	-0.0058	0.0680*	0.0822*	-0.0402*	0.2504*	-0.1970*	0.0397*	0.0920*	-0.1605*	-0.2298*	-0.2547*
4	0.0538*	0.0266	0.0218*	0.1640*	0.0769*	0.1331*	-0.0013	0.5062*	-0.1487*	0.0213*	-0.1372*	-0.0600*	-0.1266*	-0.1961*
5	0.0868*	0.1217*	0.0333*	0.0618*	0.0732*	0.2071*	0.0514*	0.2947*	-0.0401	-0.0672*	-0.3253*	-0.0391*	-0.0629*	-0.0253
6	0.1261*	0.2522*	0.0154	-0.0214	0.0521*	0.2147*	0.0663*	0.1184*	0.0556*	-0.0818*	-0.3763*	-0.0972*	-0.1434*	0.0182
7	0.0955*	0.2242*	0.0139	-0.1699*	0.0508*	0.1238*	0.0364*	-0.2179*	0.0340	-0.0820*	-0.2405*	-0.1622*	-0.3026*	-0.0607*
8	0.0761*	0.1389*	0.0290*	-0.0732*	0.0716*	0.0652*	-0.0035	-0.4259*	-0.0222	-0.0462*	-0.1157*	-0.1741*	-0.3072*	-0.1712*
9	0.0864*	0.0181	0.0777*	0.0220	0.1035*	0.0751*	-0.0037	-0.4842*	-0.0789*	-0.0568*	-0.0461*	-0.1389*	-0.2115*	-0.1532*
10	0.1200*	0.0057	0.0609*	0.1014*	0.0815*	0.1246*	0.0257	-0.4874*	-0.0719*	-0.0675*	-0.1012*	-0.0814*	-0.0606*	-0.0395*
11	0.1416*	0.0678*	0.0426*	-0.0013	0.0547*	0.1520*	0.0688*	-0.4601*	-0.0049	-0.0779*	-0.1392*	-0.0320*	0.0076	0.0523*
12	0.1107*	0.1660*	0.0053	-0.0790*	0.0237*	0.1457*	0.0774*	-0.5151*	0.0586*	-0.0642*	-0.1768*	-0.0332*	-0.0144	0.0377*

HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

Appendix 1 (continued): Generalised impulse responses across the US, Japan and the ASEAN

Panel C: Generalised impulse response to a shock in Indonesia.

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	0.9864*	-0.0067	0.0772*	0.1387*	0.0334*	-0.0268	0.0381*	1.9576*	-0.0870*	0.0525*	0.0452*	-0.0567*	0.0225*	-0.0588*
1	1.0522*	-0.0176	0.0721*	0.2437*	0.0349*	-0.0226	0.0685*	1.8381*	-0.1097*	0.0743*	-0.0230	-0.0731*	-0.0710*	-0.0901*
2	0.6783*	-0.0225	0.0395*	0.1666*	0.0316*	0.0169	0.0892*	1.1257*	-0.0315*	0.0380*	-0.0192	0.0260*	-0.0756*	-0.0621*
3	0.1888*	0.0637*	0.0208*	0.0101	0.0556*	0.1156*	0.0936*	0.5434*	0.0704*	0.0157*	-0.0138	-0.0439*	-0.1103*	0.0290*
4	0.0971*	0.1343*	0.0249*	-0.0380	0.0679*	0.1384*	0.0944*	-0.0715*	0.0327*	-0.0189*	0.0547*	0.0025	-0.1628*	0.0510*
5	0.0910*	0.0966*	0.0382*	0.2276*	0.0394*	0.1389*	0.0837*	-0.0082	0.0011	0.0205*	0.1775*	-0.0435*	-0.1043*	0.0249*
6	0.0666	-0.0115	0.0636*	0.5246*	0.0111*	0.0894*	0.0642*	0.0216	-0.0240*	0.0157*	0.2235*	-0.0353*	-0.0195*	0.0084
7	0.0034	-0.0629*	0.0886*	0.6634*	0.0011	0.0654*	0.0512*	0.0321	0.0149*	0.0176*	0.1739*	-0.0102	0.0778*	0.0272*
8	0.0090	-0.0132	0.0961*	0.5378*	0.0250*	0.0630*	0.0496*	-0.0245	0.0672*	0.0013	0.1444*	-0.0145*	0.0625*	0.0759*
9	0.0252	0.0541*	0.0641*	0.3327*	0.0158*	0.0620*	0.0471*	-0.1069	0.0700*	0.0161*	0.1343*	0.0211*	0.0157	0.0680*
10	0.0343	0.0691*	0.0295*	0.1901*	0.0015	0.0441*	0.0365*	-0.0574	0.0392*	0.0334*	0.1341*	0.0120*	-0.0638*	0.0108
11	0.0163	0.0326*	0.0237*	0.1943*	-0.0106	0.0156	0.0265*	0.0234	-0.0267*	0.0350*	0.0924*	0.0029	-0.0826*	-0.0371*
12	0.0276	-0.0066	0.0484*	0.2769*	0.0149*	0.0181	0.0299*	0.1104	-0.0573*	0.0168*	0.0265	-0.0008	-0.0699*	-0.0422*

Panel D: Generalised impulse response to a shock in Malaysia

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	0.1881*	0.0354	0.4050*	-0.0091	0.1341*	0.0654*	-0.0094	0.2823*	-0.0152	0.3643*	0.1237*	0.0136	0.2286*	0.0140*
1	0.2262*	0.0195	0.3702*	0.0612	0.1203*	0.0637*	-0.0064	0.4702*	-0.0036	0.2891*	-0.0697*	-0.0182	0.2255*	0.0508*
2	0.1950*	-0.1052*	0.2644*	0.0927	0.0584*	0.0698*	0.0062	0.8991*	-0.0469*	0.2391*	0.0106	0.0447*	0.2568*	0.0984*
3	0.1200*	-0.0455*	0.0069	-0.0986*	-0.0978*	0.0648*	0.0108	0.7281*	-0.0015	0.0608*	0.0420*	0.0705*	0.1249*	0.0929*
4	0.1605*	0.0561*	-0.0344	-0.2659*	-0.0769*	0.0913*	0.0655*	0.6480*	0.0277*	0.0430*	0.1430*	0.0089	0.0521*	0.0958*
5	0.1247*	0.1445*	-0.0071	-0.1082*	-0.0292	0.1300*	0.0785*	0.7120*	0.0735*	-0.0482*	0.1127*	-0.0067	-0.0672*	0.0519*
6	0.0565*	0.0033	0.0923*	0.2121*	0.0574*	0.0954*	0.0669*	0.7155*	0.0580*	-0.0246	0.1127*	-0.0403*	-0.1048*	0.0104*
7	-0.0030	-0.0827*	0.1366*	0.5157*	0.0534*	0.0546*	0.0252*	0.5306*	0.0547*	-0.0296	0.1208*	-0.0188*	-0.0912*	-0.0442*
8	0.0329	-0.0977*	0.1388*	0.5054*	0.0396*	0.0365	0.0184*	0.3964*	0.0135	0.0223	0.1213*	-0.0437*	-0.0651*	-0.0483*
9	0.0737*	0.0281	0.0744*	0.3806*	-0.0148	0.0657*	0.0250*	-0.4842*	-0.0789*	-0.0568*	-0.0461*	-0.1389*	-0.2115*	-0.1532*
10	0.0694*	0.0785*	0.0236	0.1801*	-0.0364	0.0585*	0.0312*	-0.4874*	-0.0719*	-0.0675*	-0.1012*	-0.0814*	-0.0606*	-0.0395*
11	0.0163	0.0672*	0.0080	0.1737*	-0.0358	0.0146	0.0175*	-0.4601*	-0.0049	-0.0779*	-0.1392*	-0.0320*	0.0076	0.0523*
12	-0.0100	-0.0236	0.0499	0.2479*	0.0104	-0.0237	0.0084	-0.5151*	0.0586*	-0.0642*	-0.1768*	-0.0332*	-0.0144	0.0377*

HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

Appendix 1 (continued): Generalised impulse responses across the US, Japan and the ASEAN

Panel E: Generalised impulse response to a shock in the Philippines.

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	0.1194*	-0.0643*	-0.0032	1.1459*	0.0096	-0.1006*	-0.0037	0.1329*	-0.0123	0.0676*	0.6665*	-0.0258*	0.0813*	0.0071
1	0.2285*	-0.0658*	0.0874*	1.6753*	0.0744*	-0.1938*	-0.0059	0.2026*	0.0071	0.0545*	0.4084*	-0.0106	0.1168*	-0.0253*
2	0.1517*	0.0036	0.1213*	1.7089*	0.0648*	-0.2743*	-0.0148	0.2432*	0.0437*	0.0776*	0.3658*	-0.0082	0.0556*	0.0052
3	0.0671*	0.0861*	0.0930*	1.0812*	0.0631*	-0.1768*	-0.0301*	0.0388	0.0236*	0.0573*	0.0094*	0.0461*	0.0519*	0.0497*
4	-0.1369*	0.0600*	-0.0161	0.6558*	-0.0493*	-0.1610*	-0.0703*	0.1307*	0.0129*	0.1360*	0.0205	0.0707*	0.0406*	-0.0012
5	-0.1652*	-0.0172	-0.0777*	0.5067*	-0.1040*	-0.1437*	-0.0838*	0.0586*	-0.0319*	0.0951*	-0.1308*	0.0008	0.0227*	-0.0048
6	-0.1851*	-0.0672*	-0.0570*	0.6956*	-0.1094*	-0.1932*	-0.0644*	0.1726*	-0.0437*	0.0640*	-0.0311	-0.0253*	0.0277*	-0.0218*
7	-0.1034*	-0.0609*	-0.0175	0.7827*	-0.0526*	-0.1515*	-0.0224	0.1811*	-0.0363*	0.0334*	-0.0355	-0.0655*	0.0047	0.0478*
8	-0.1093*	-0.0122	-0.0045	0.6567*	-0.0256	-0.1181*	-0.0034	0.2190*	0.0265*	0.0023	0.0686	-0.0172*	0.0576*	0.0711*
9	-0.0938*	0.0451*	-0.0424*	0.3122*	-0.0473*	-0.0763*	-0.0182	0.2463*	0.0537*	0.0132	0.0396	-0.0312*	0.0607*	0.0977*
10	-0.1116*	0.0741*	-0.0683*	0.0660	-0.0690*	-0.0833*	-0.0483*	0.2350*	0.0558*	-0.0136	0.0367	-0.0112	0.0314*	0.0386*
11	-0.0898*	0.0500*	-0.0731*	0.0088	-0.0733*	-0.0838*	-0.0690*	0.2343*	0.0106	-0.0048	0.0054	-0.0209*	-0.0311*	-0.0111
12	-0.0775*	-0.0124	-0.0459*	0.1053	-0.0400*	-0.0826*	-0.0642*	0.1341*	-0.0032	-0.0301*	0.0305	-0.0066	-0.0796*	-0.0581*

Panel F: Generalised impulse response to a shock in Singapore

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	0.0933*	0.0270*	0.1539*	0.0313	0.3527*	0.0814*	0.0342*	-0.2917*	-0.0235*	0.0130*	-0.0451*	0.3806*	-0.0173	0.0329*
1	-0.0019	0.0436*	0.1376*	0.1493*	0.2621*	0.1472*	0.0692*	-0.0840*	0.0467*	0.0140*	-0.0821*	0.2230*	0.0809*	0.1165*
2	0.0878*	-0.0068	0.0537*	0.1447*	0.2221*	0.2071*	0.0971*	0.0246	-0.0449*	-0.0206*	0.0528*	0.2323*	-0.0006	0.1279*
3	0.0729*	0.0910*	-0.0304*	0.1021*	0.0124	0.1281*	0.1001*	0.0422	0.0010	-0.0351*	0.0664*	0.1180*	-0.0427*	0.0235*
4	0.1640*	0.1294*	-0.0297*	0.0955*	0.0542*	0.1519*	0.0922*	-0.2097*	0.0564*	-0.0141*	0.2102*	0.0682*	-0.0320*	0.0097
5	0.1196*	0.1199*	0.0208	0.1936*	0.0925*	0.0941*	0.0731*	-0.4115*	0.0886*	0.0090	0.2333*	0.1393*	0.1089*	0.0458*
6	0.1371*	-0.0177	0.0589*	0.2097*	0.1432*	0.0954*	0.0510*	-0.2731*	0.0767*	0.0686*	0.2796*	0.1263*	0.1599*	0.1249*
7	0.1058*	-0.0546*	0.0645*	0.1714*	0.1233*	0.0593*	0.0592*	-0.1217*	0.0262*	0.0911*	0.2561*	0.2015*	0.2132*	0.1379*
8	0.1232*	-0.0116	0.0317*	0.0480*	0.0672*	0.1119*	0.0828*	0.2225*	0.0147*	0.1056*	0.2081*	0.1927*	0.1798*	0.0871*
9	0.1094*	0.0921*	-0.0009	-0.0037	0.0453*	0.1342*	0.1071*	0.3131*	0.0093	0.0619*	0.1541*	0.1616*	0.1235*	0.0484*
10	0.1061*	0.1236*	-0.0016	-0.0230	0.0327*	0.1327*	0.0995*	0.4194*	0.0048	0.0395*	0.1486*	0.1331*	0.0696*	0.0309*
11	0.0942*	0.0798*	0.0285*	0.0504*	0.0736*	0.0903*	0.0768*	0.3393*	0.0183*	0.0364*	0.1662*	0.0940*	0.0256*	0.0579*
12	0.0934*	0.0062	0.0624*	0.1072*	0.0859*	0.0753*	0.0574*	0.2954*	0.0307*	0.0596*	0.1832*	0.1068*	0.0710*	0.0843*

HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

Appendix 1 (continued): Generalised impulse responses across the US, Japan and the ASEAN

Panel G: Generalised impulse response to a shock in Thailand

HZ	Pre-crisis period (January 1983 – June 1997)							Post-crisis period (July 1997 – May 2006)						
	IN	JP	MA	PH	SG	TL	US	IN	JP	MA	PH	SG	TL	US
0	-0.0405	0.1324*	0.0406*	-0.1767*	0.0440*	0.6525*	0.0464*	0.0803	-0.0646*	0.1519*	0.0988*	-0.0120	0.5486*	0.0906*
1	-0.0286	0.0697*	0.0067	-0.3950*	0.0666*	0.6730*	0.0674*	0.0140	-0.0427*	0.1200*	-0.1067*	-0.0149	0.3000*	0.1552*
2	0.1139*	0.0270*	-0.0037	-0.3570*	-0.0072	0.4448*	0.0719*	0.2213*	0.0467*	0.0553*	-0.0782*	0.0498*	0.4381*	0.1870*
3	0.1376*	0.0185*	0.0630*	-0.1352*	0.0976*	0.1365*	0.0691*	0.4963*	0.0802*	0.0329*	0.0349	0.0930*	0.1914*	0.1187*
4	0.1854*	0.0358*	0.0924*	0.0898*	0.1388*	0.1405*	0.0888*	0.4803*	0.0328*	-0.0037	0.1337*	0.0169	0.1228*	0.0328*
5	0.2670*	0.0285*	0.1442*	0.0498	0.2138*	0.2328*	0.1094*	1.0167*	-0.0605*	0.0035	0.1279*	-0.0323*	-0.0123	-0.0520*
6	0.3381*	0.0585*	0.1435*	-0.1247*	0.1322*	0.2248*	0.1273*	0.7813*	-0.0659*	-0.0240*	0.0163	-0.0264*	-0.0618	-0.0647*
7	0.3294*	0.0848*	0.1528*	-0.1519*	0.1250*	0.1857*	0.1351*	0.6153*	0.0000	-0.0016	-0.0576*	0.0064	0.0370	-0.0260*
8	0.2363*	0.1009*	0.1231*	0.0000	0.0934*	0.1435*	0.1301*	0.3563*	0.0476*	0.0146	-0.0531*	-0.0222*	0.0623*	0.0269*
9	0.2079*	0.0605*	0.1077*	0.1651*	0.1182*	0.1748*	0.1238*	0.2427*	0.0228*	0.0373*	-0.0056	-0.0489*	0.0537*	0.0203*
10	0.2132*	0.0498*	0.0982*	0.2139*	0.1059*	0.1837*	0.1245*	0.3047*	-0.0135	0.0489*	0.1098*	-0.0609*	0.0030	-0.0152
11	0.2201*	0.0452*	0.0968*	0.1973*	0.0942*	0.2031*	0.1299*	0.3055*	-0.0359*	0.0357*	0.1359*	-0.0379*	0.0088	-0.0258*
12	0.1626*	0.0683*	0.0867*	0.2175*	0.0746*	0.1943*	0.1284*	0.3848*	-0.0210*	0.0147	0.1218*	-0.0161	0.0340	0.0017

HZ, IN, JP, MA, PH, SG, TL and US stand for Horizon, Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and the US. * denotes the significance of 5% level.

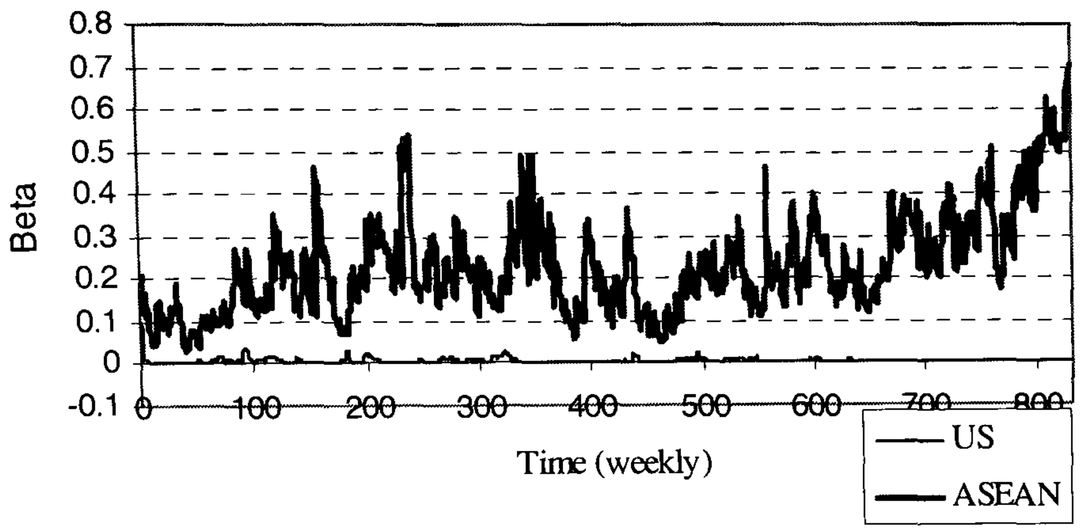
Appendix 2: Time-Varying Variance Decompositions for the ASEAN (January 1991- December 2006)

$$h_{i,t} = E[\mu_{i,t}^2 \mid \Omega_{i-1}] = \gamma_{iA,t-1}^2 \sigma_{T,t}^2 + \gamma_{iU,t-1}^2 \sigma_{U,t}^2 + \sigma_{\varepsilon,i,t}^2$$

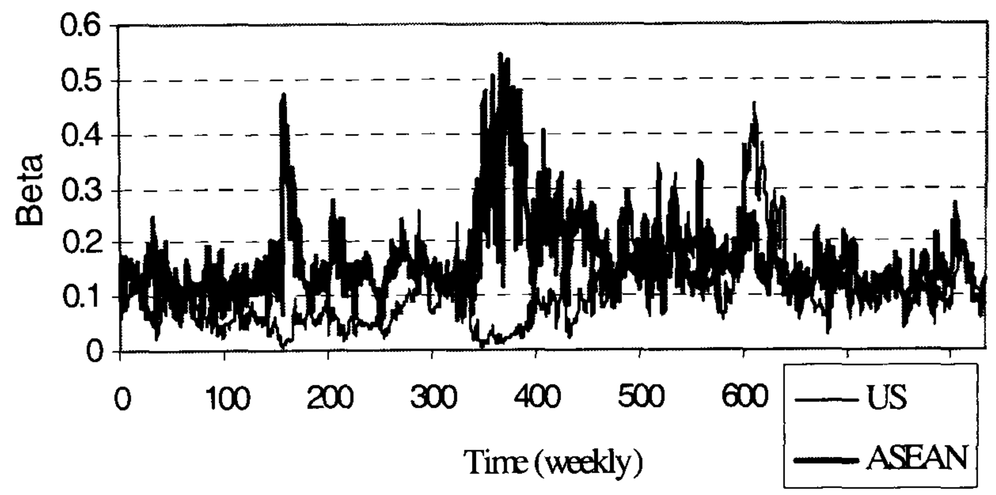
$$VR_{iU,t} = \frac{\gamma_{iU,t-1}^2 \sigma_{U,t}^2}{h_{i,t}}; \qquad VR_{iA,t} = \frac{\gamma_{iA,t-1}^2 \sigma_{A,t}^2}{h_{i,t}}$$

VR denotes the variance ratios. These relations provide a goodness-of-fit measure, a test for how much of the local return variance is explained by regional factors and by world factors (see equations 5.42-5.45 in sub-sections 5.3.1.3).

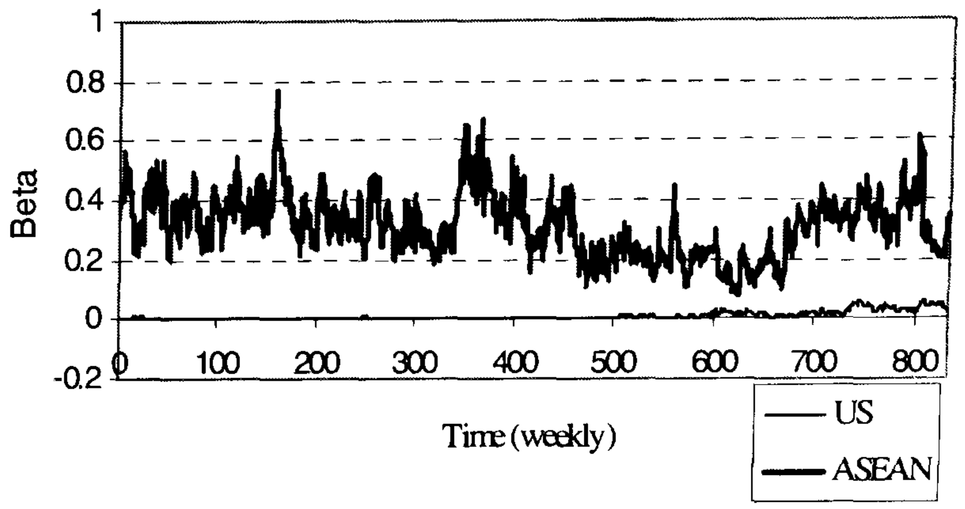
Time-varying variance ratio decompostion, Indonesia



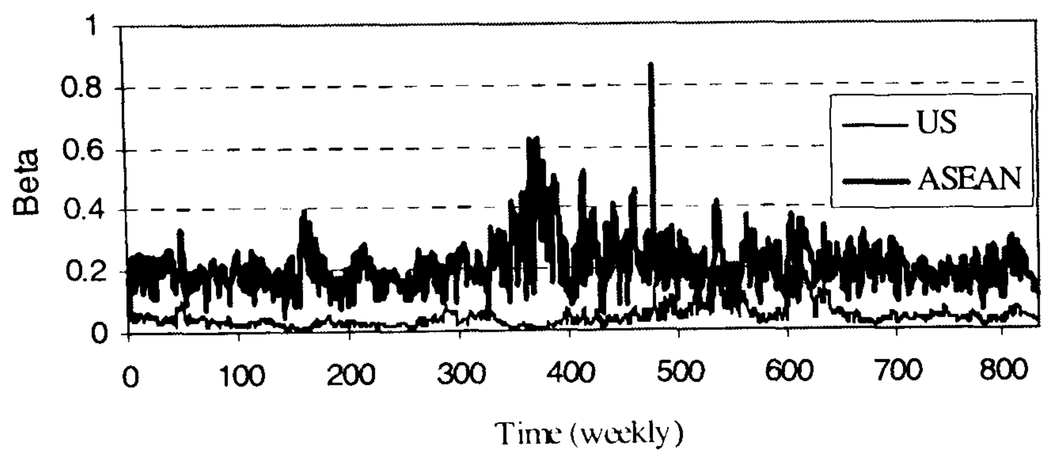
Time-varying variance ratio decompostion, Philippines



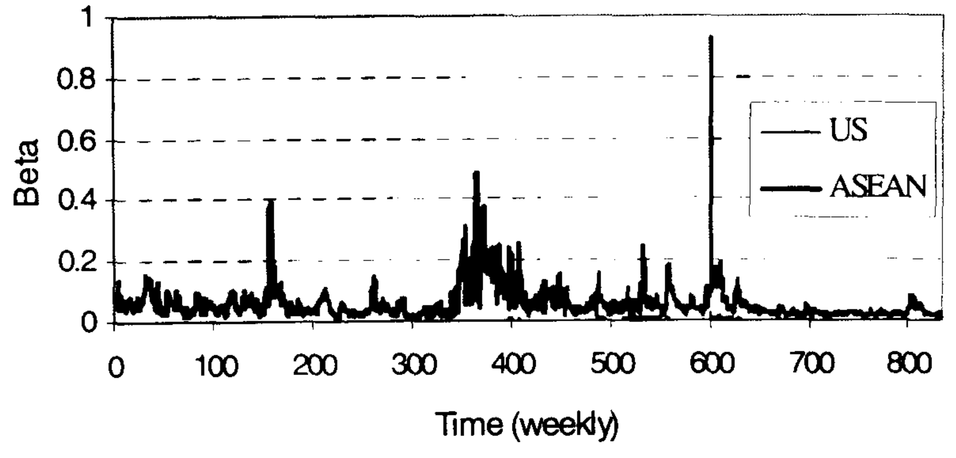
Time-varying variance ratio decompostion, Singapore



Time-varying variance ratio decompostion, Malaysia

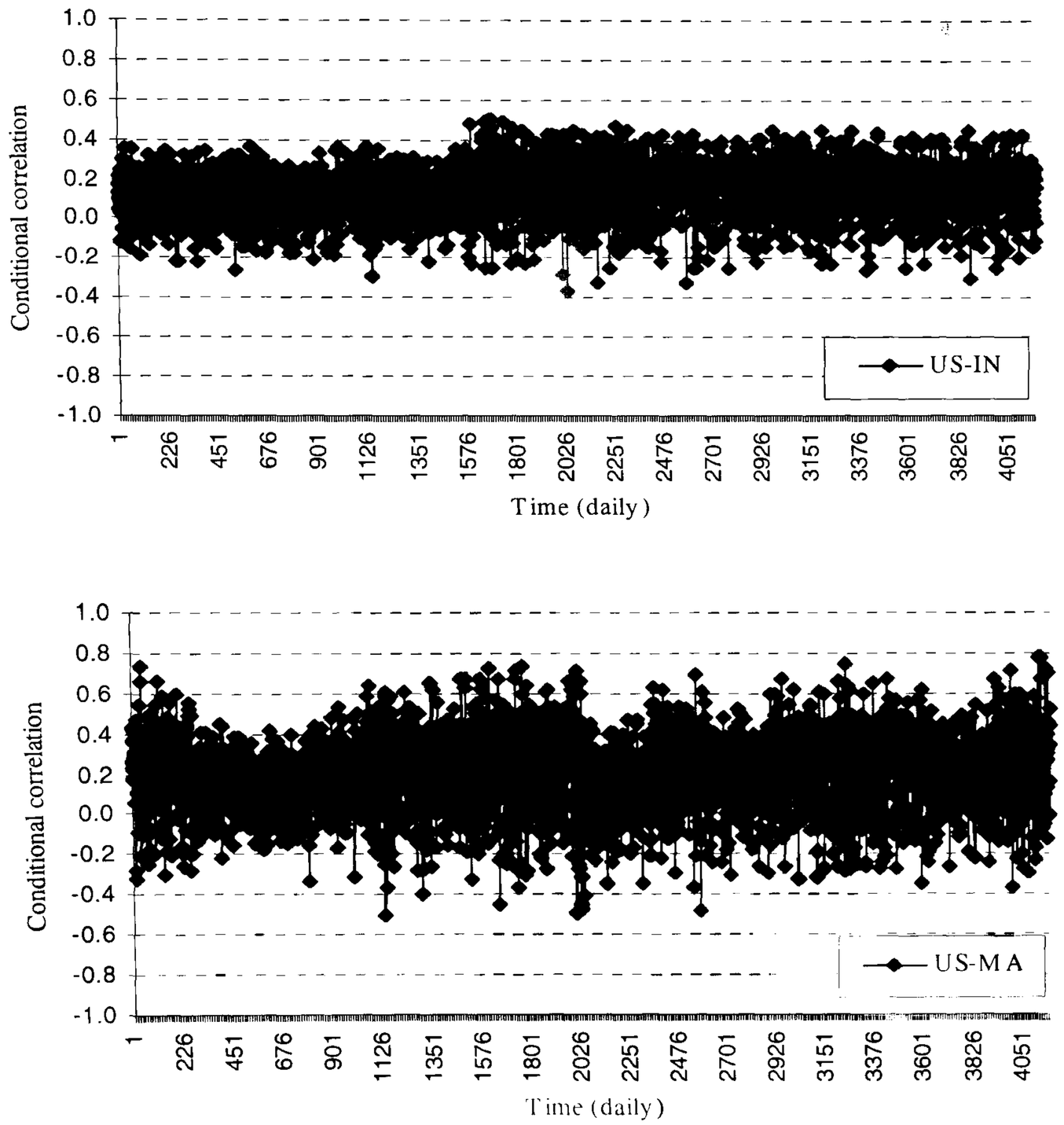


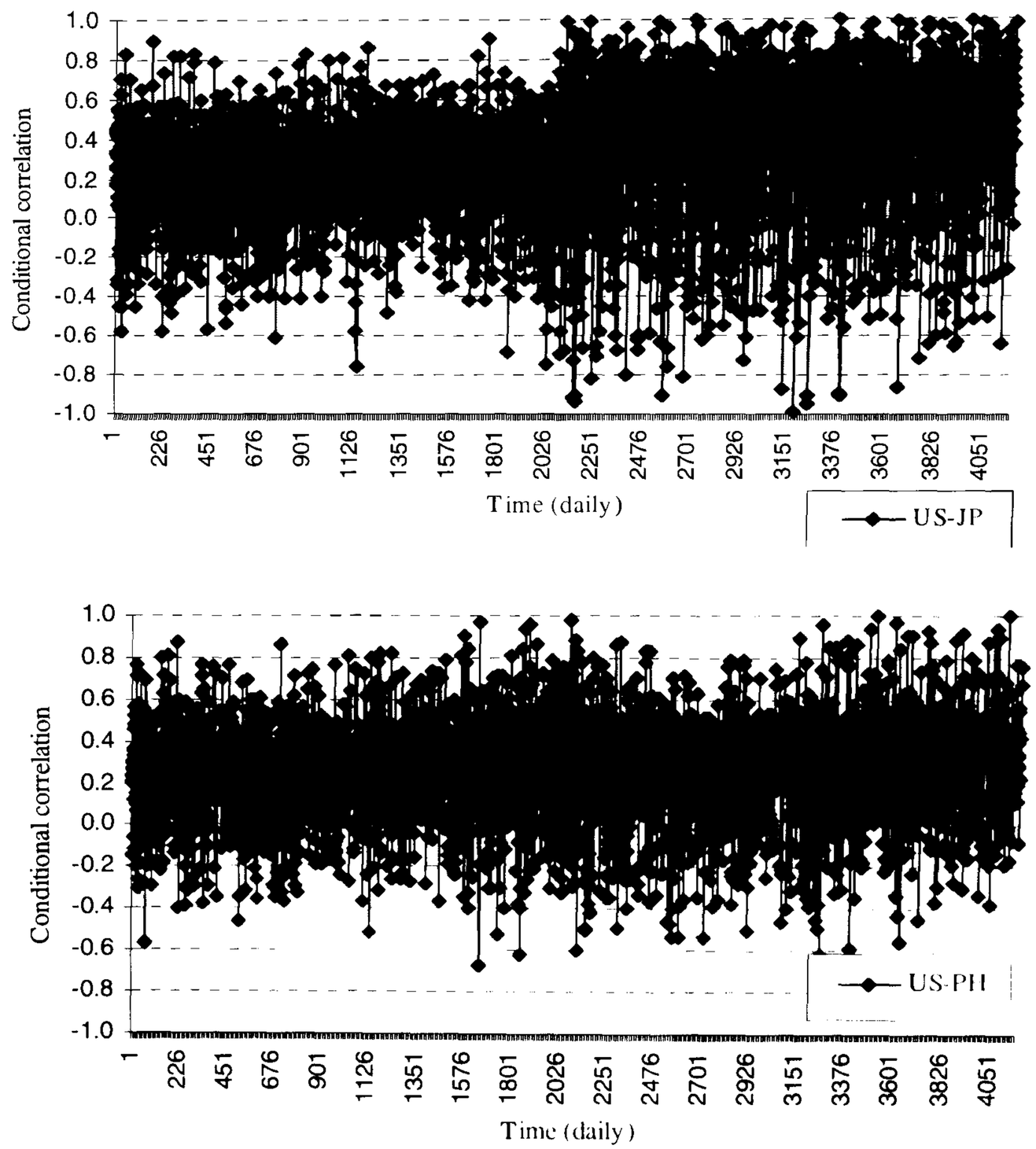
Time-varying variance ratio decompostion, Thailand



Appendix 3: Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

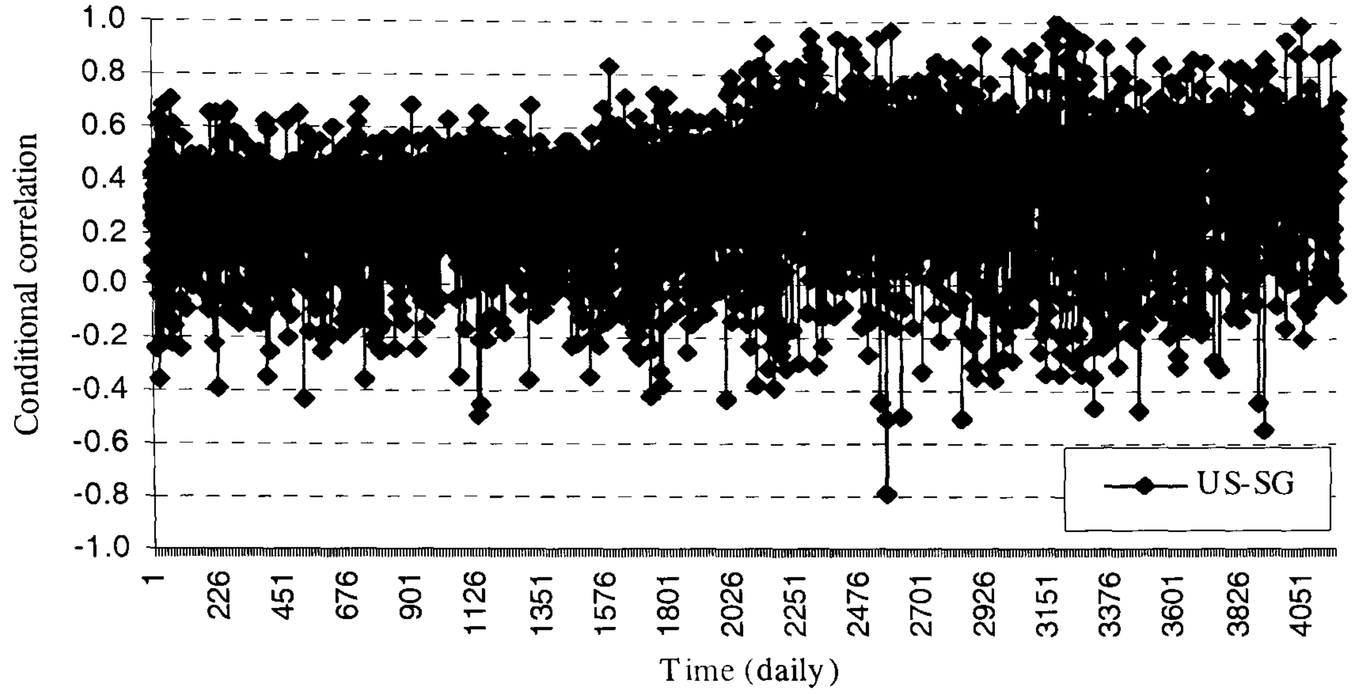
US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2

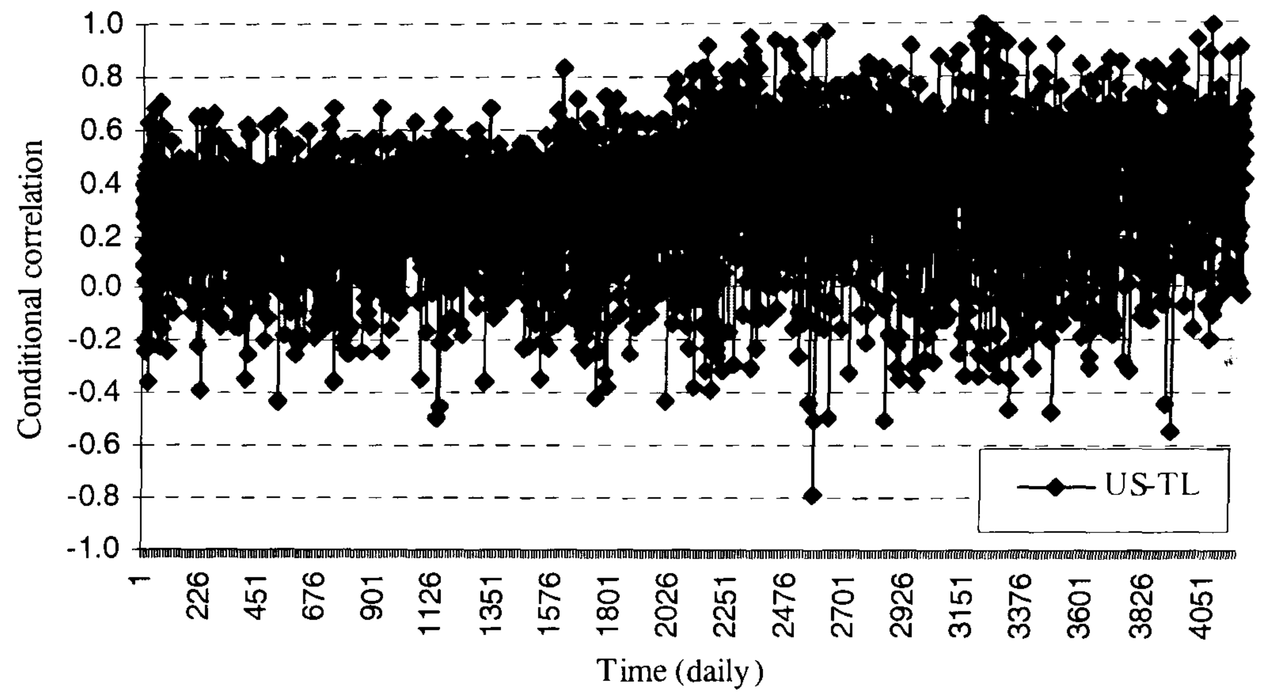


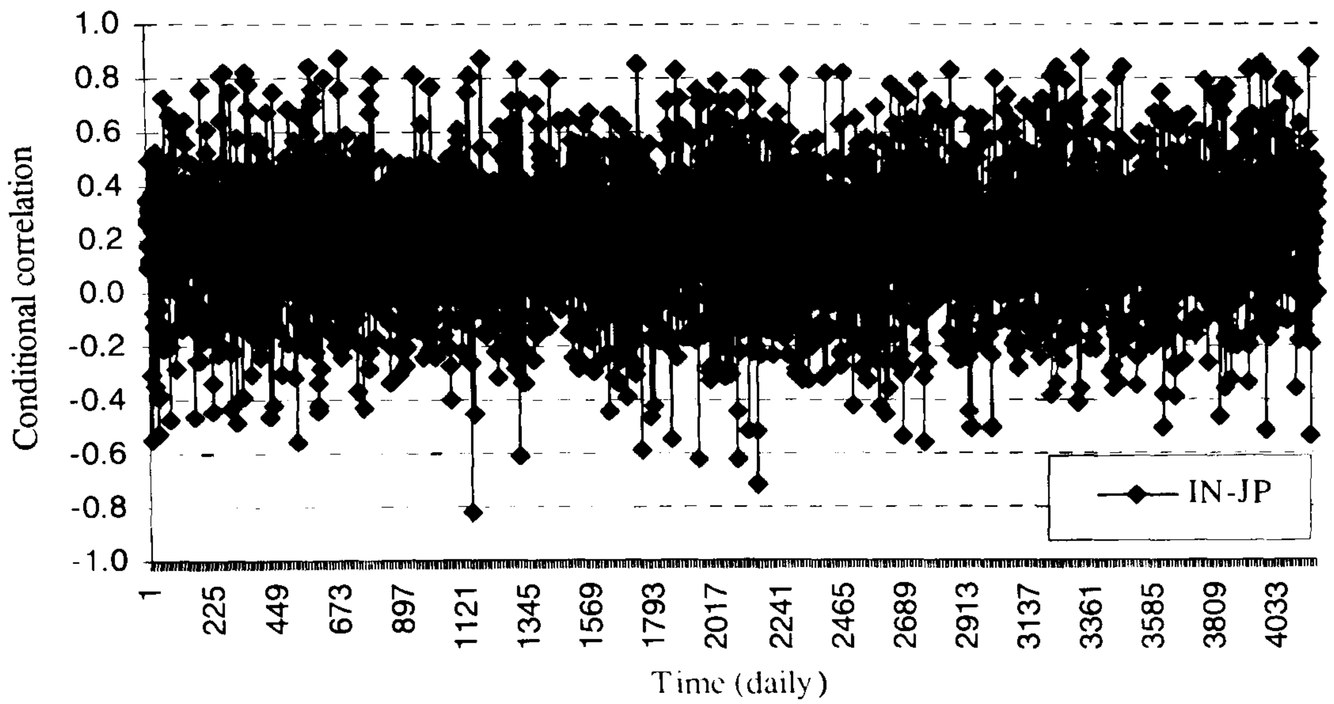


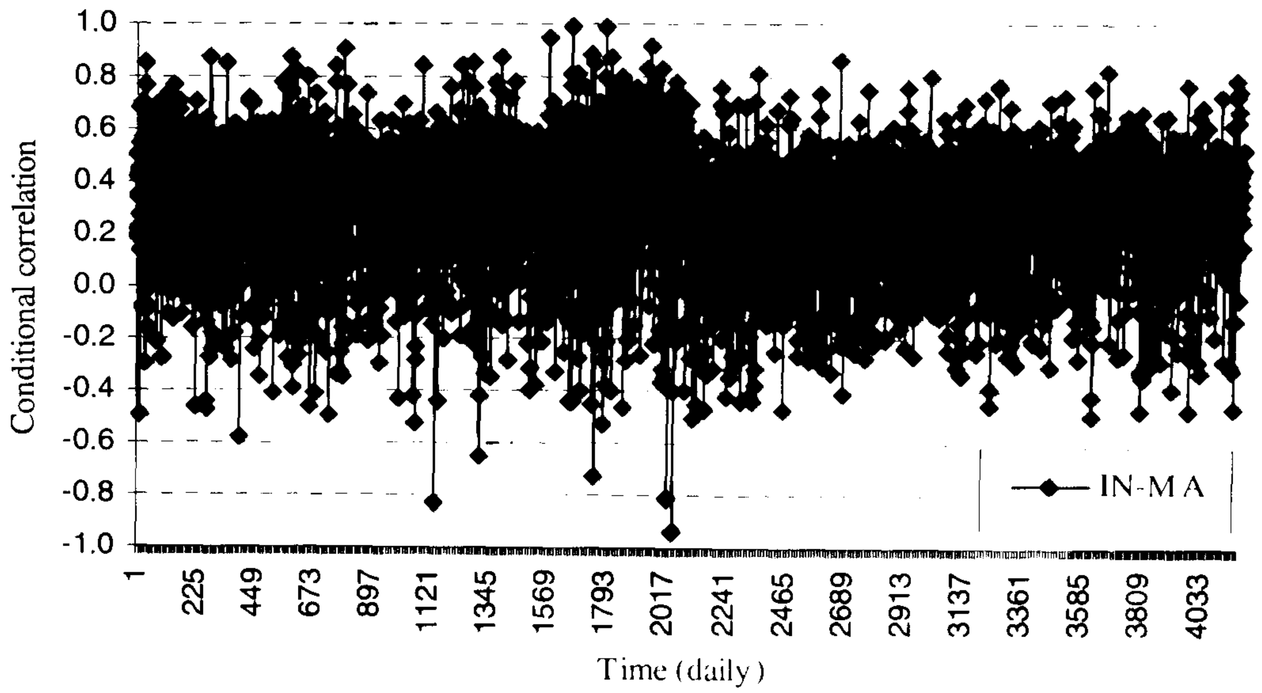
Appendix 3 (continued): Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2



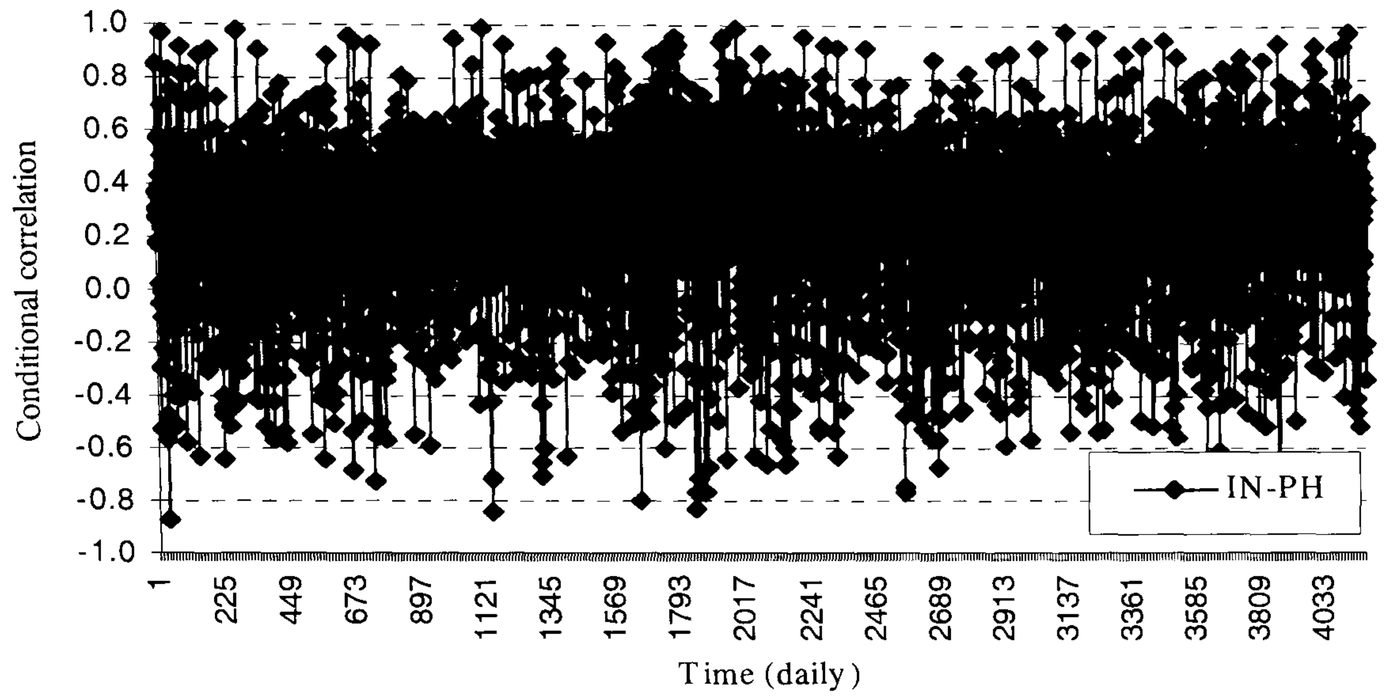


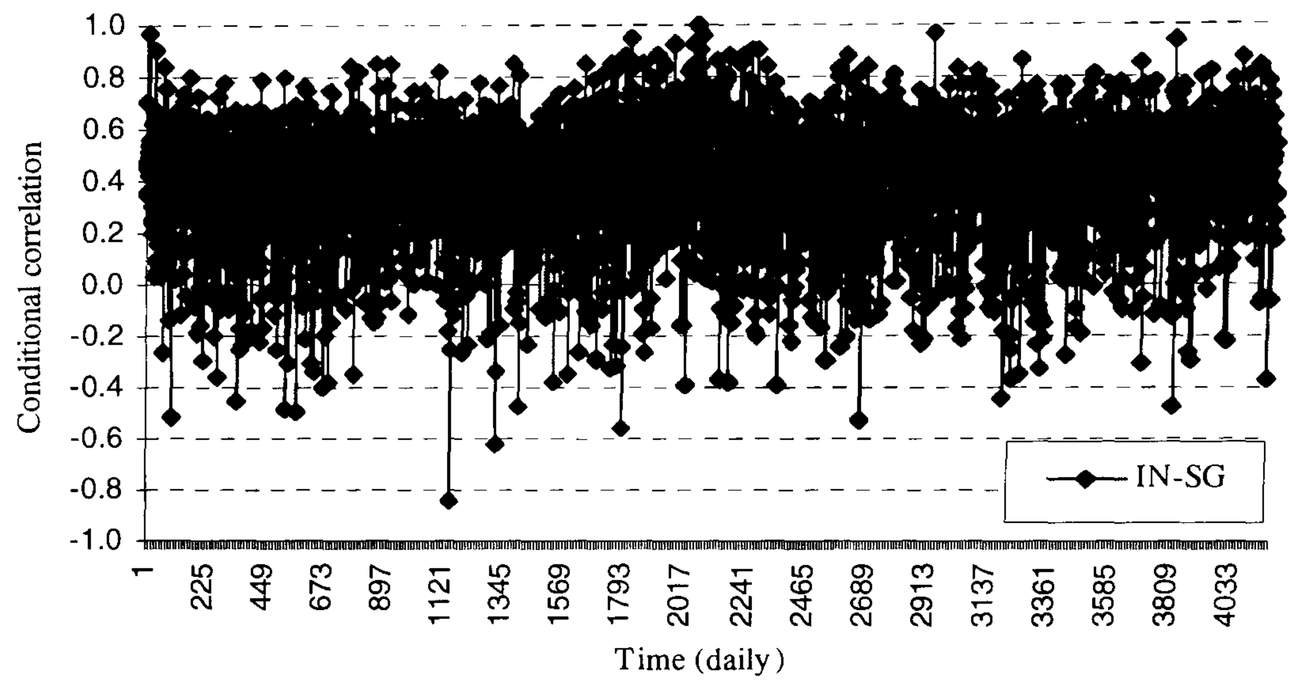


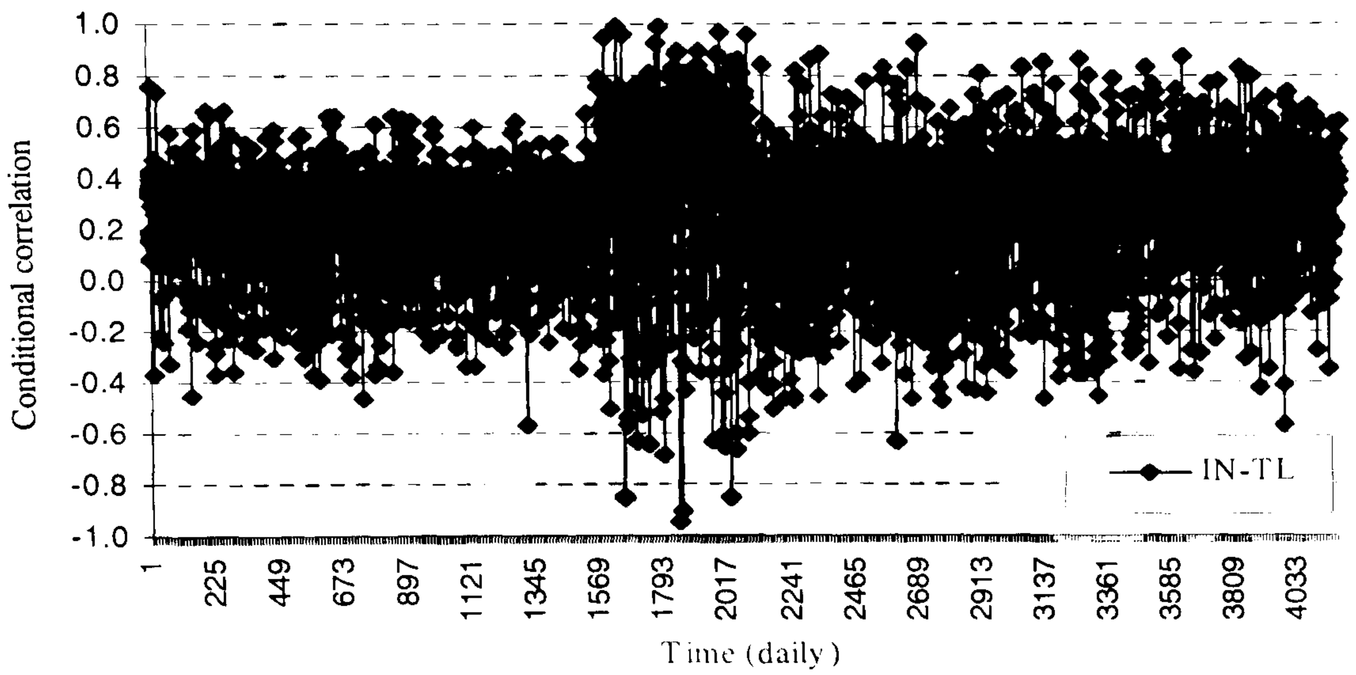


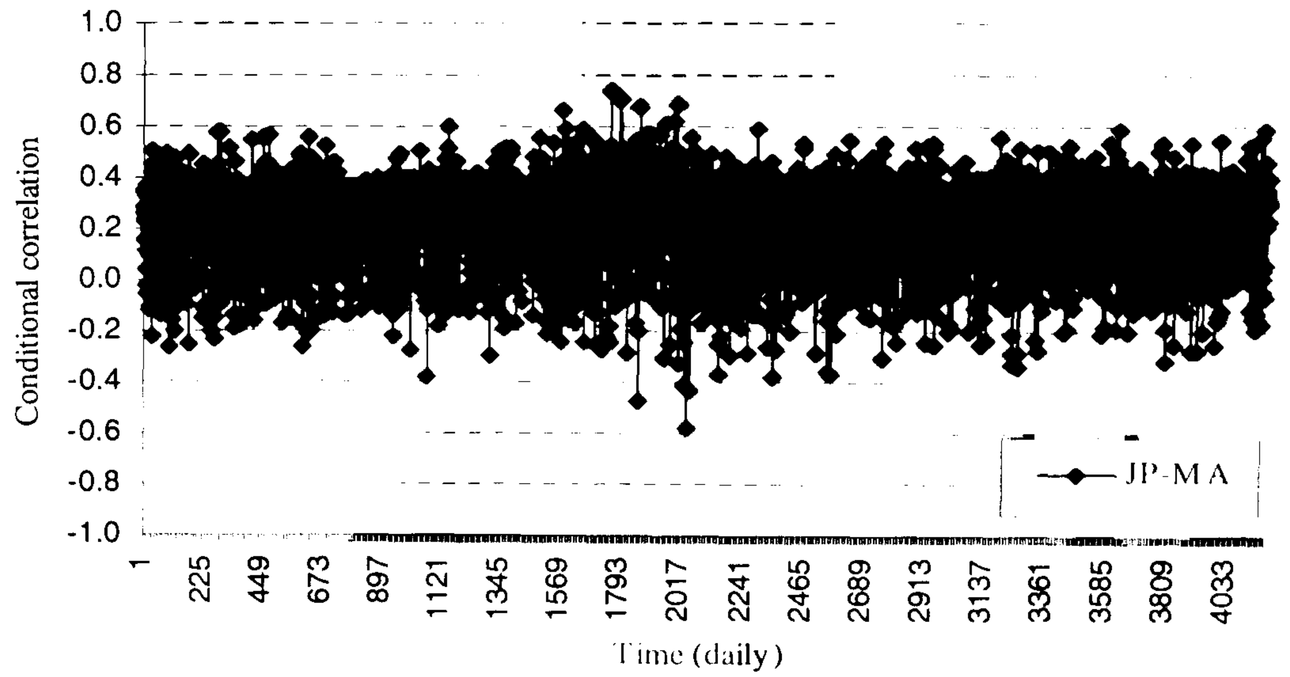
Appendix 3 (continued): Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2



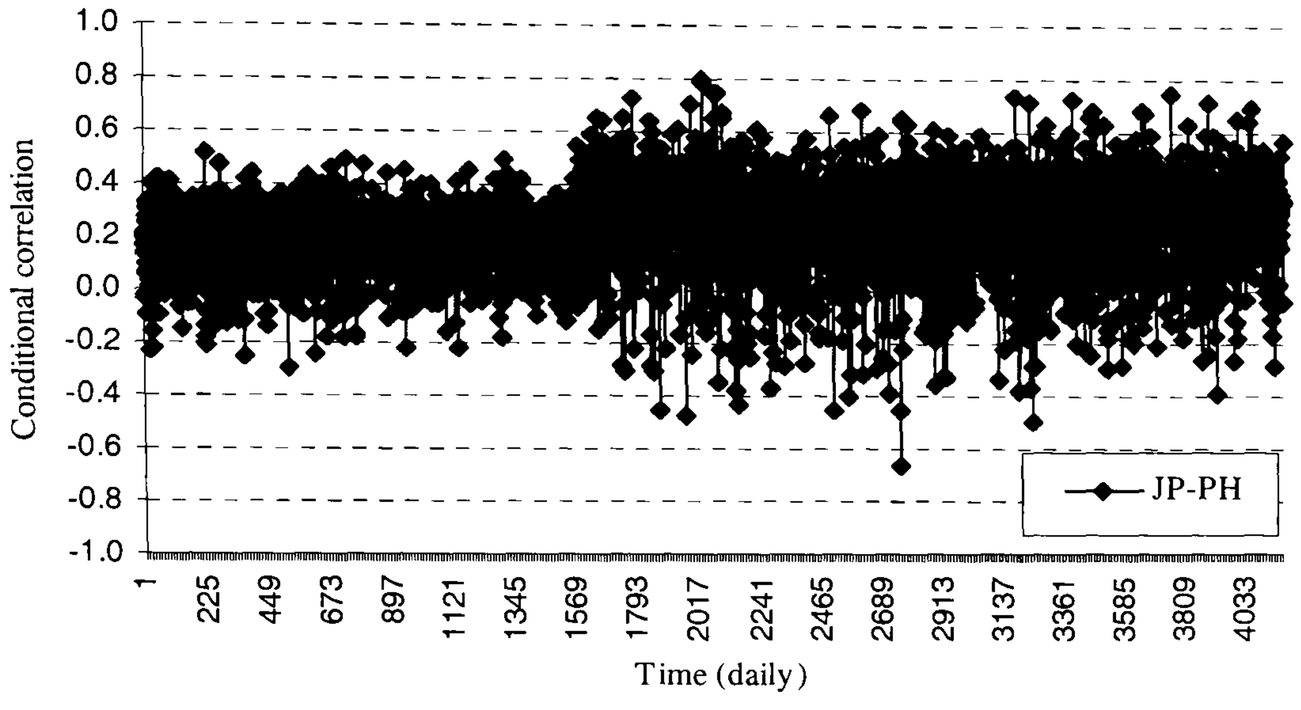


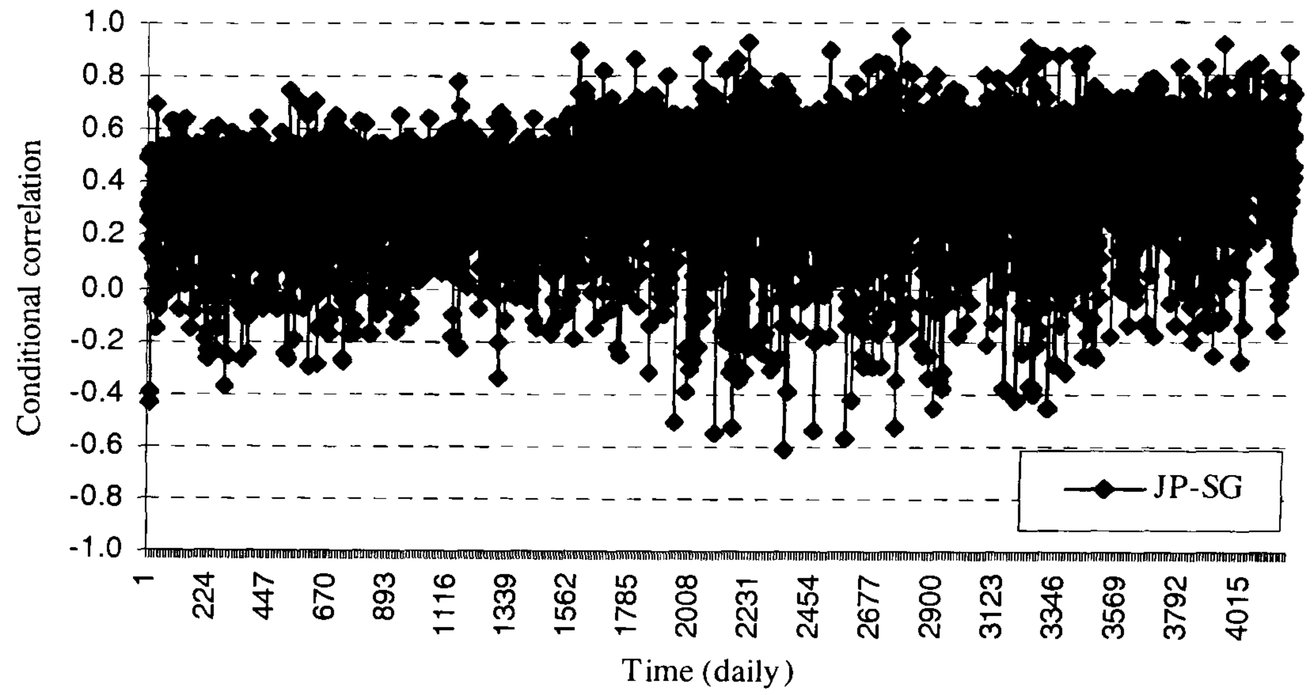


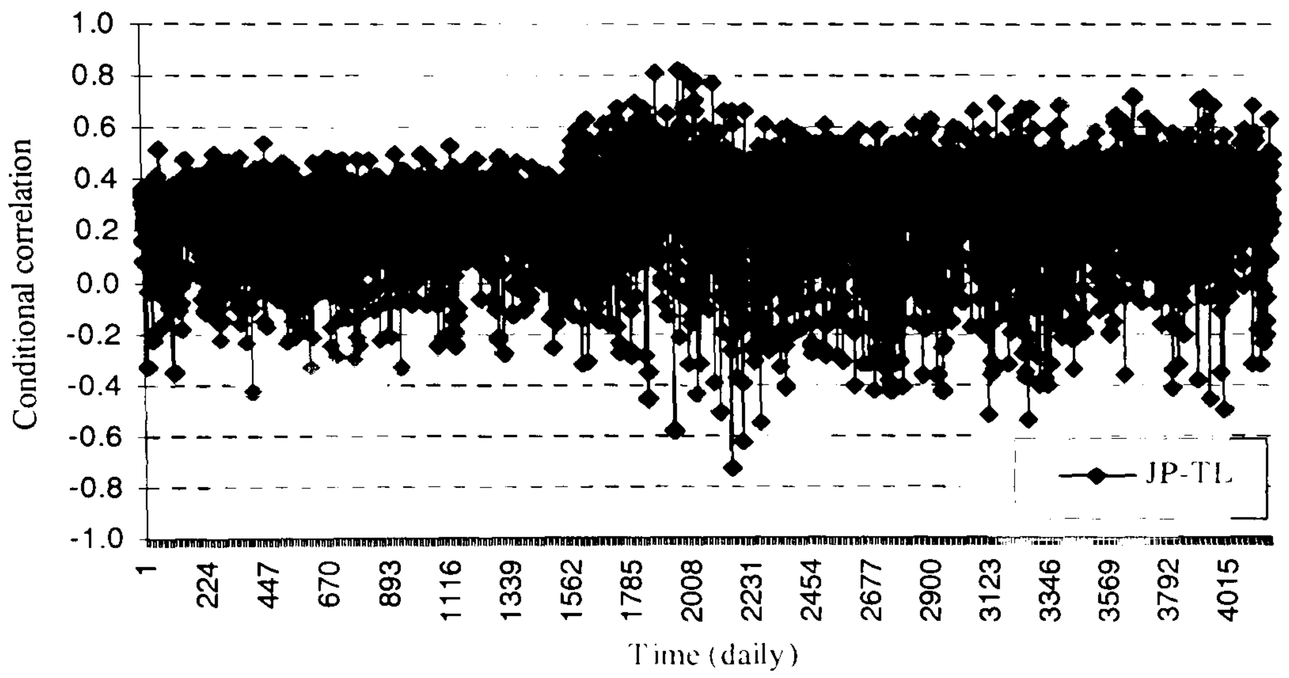


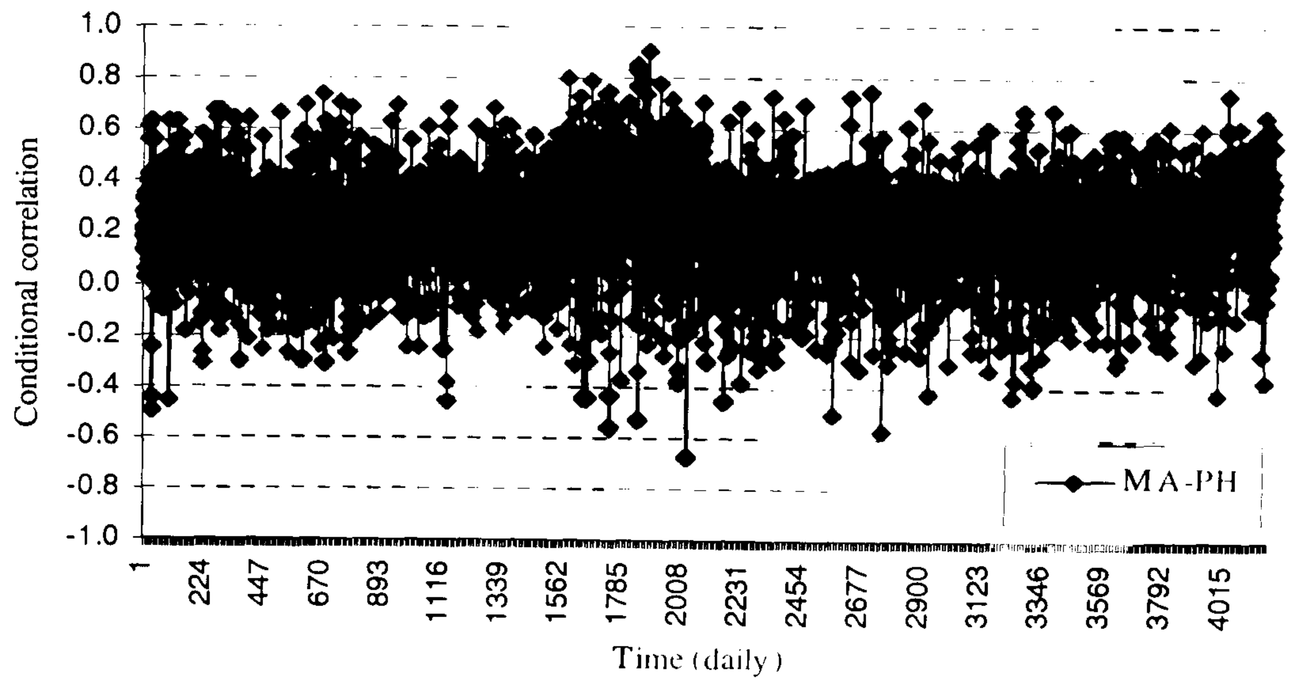
Appendix 3 (continued): Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2



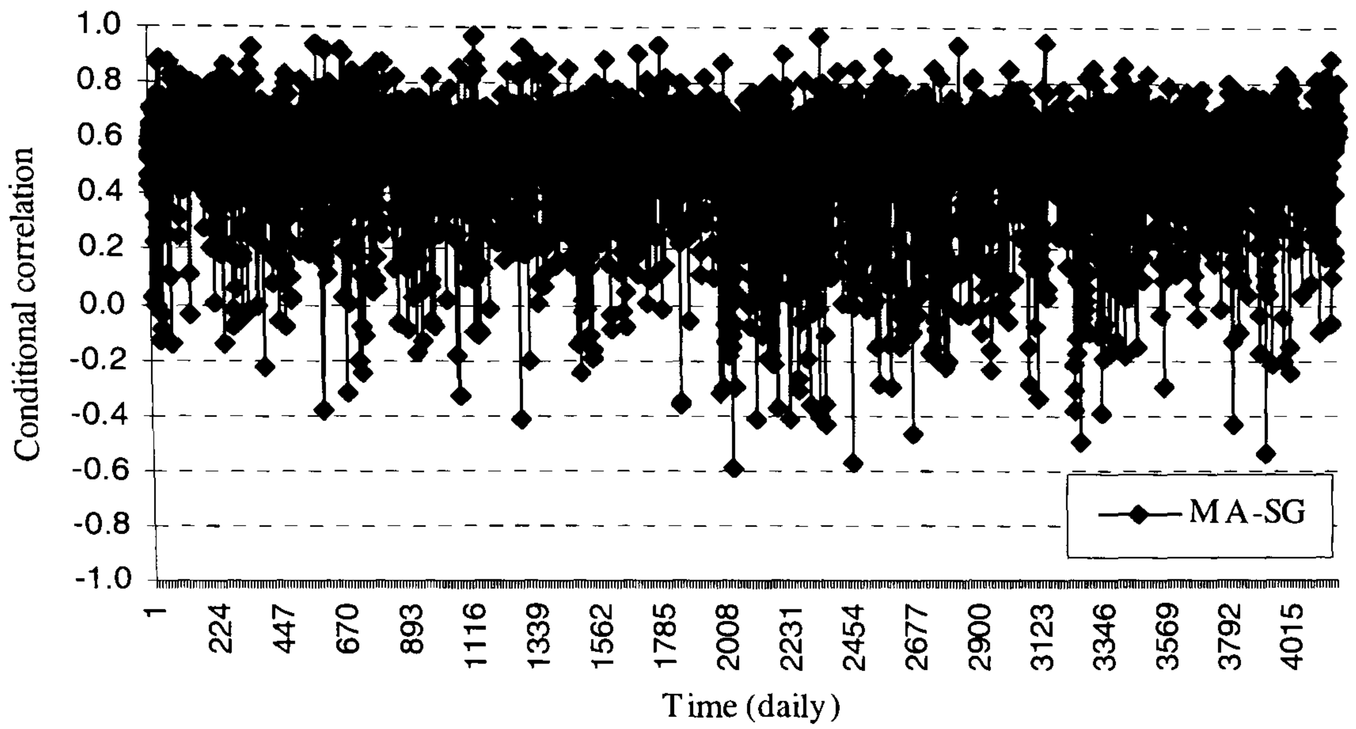


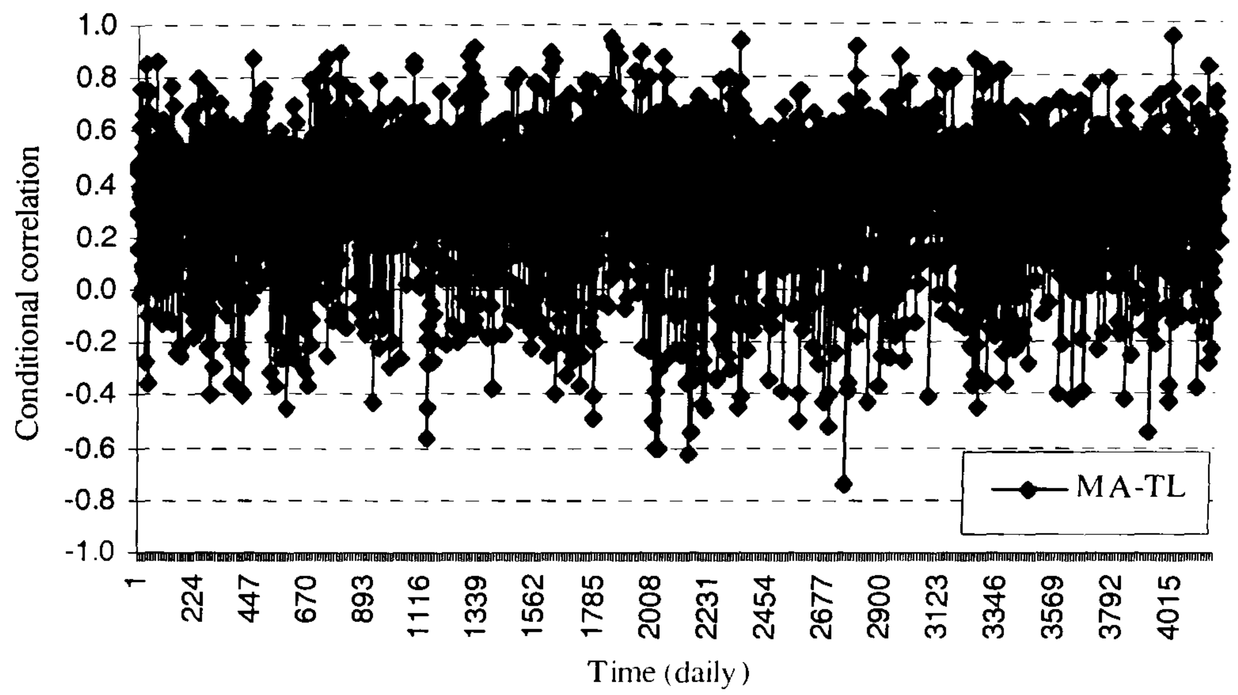


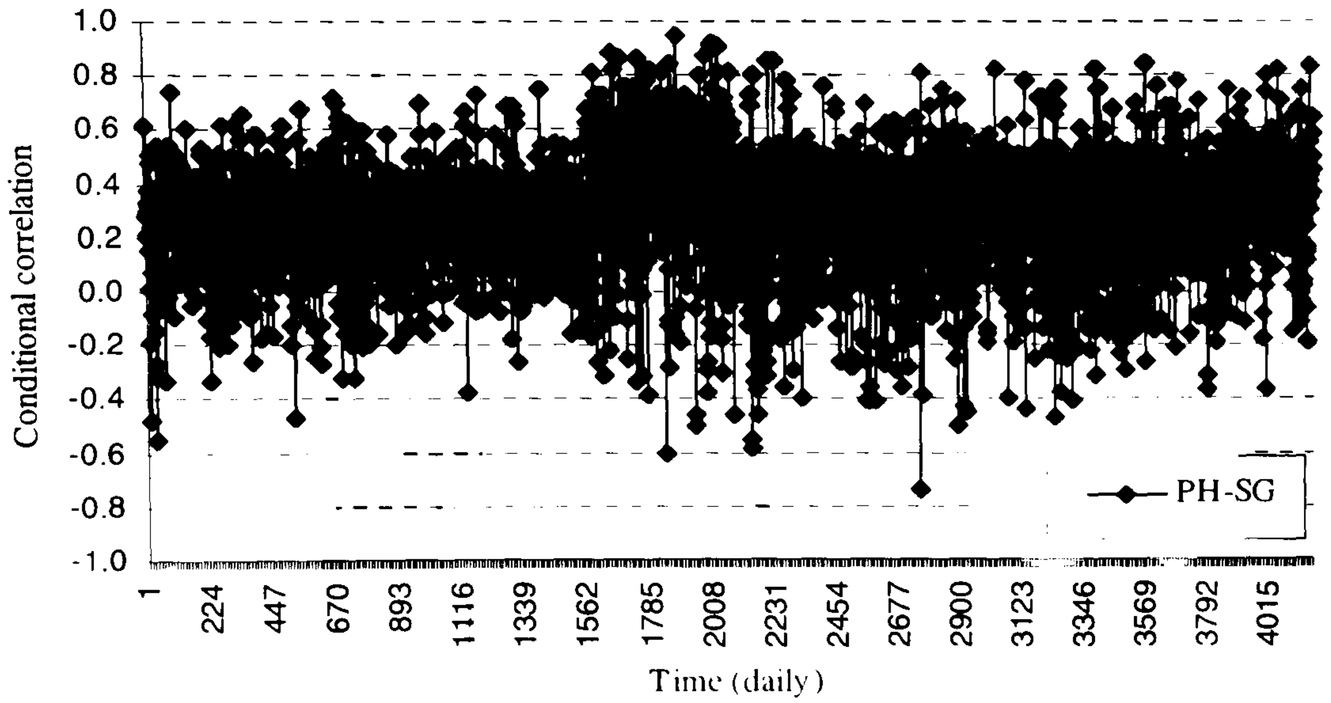


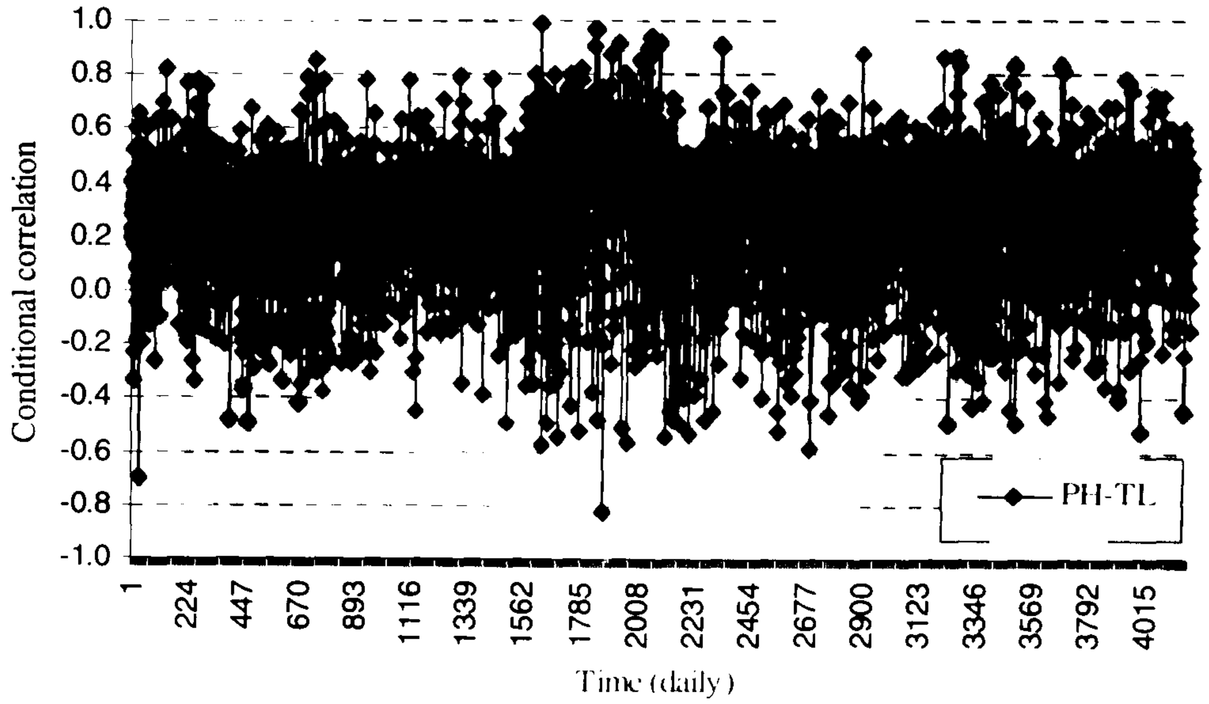
Appendix 3 (continued): Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2



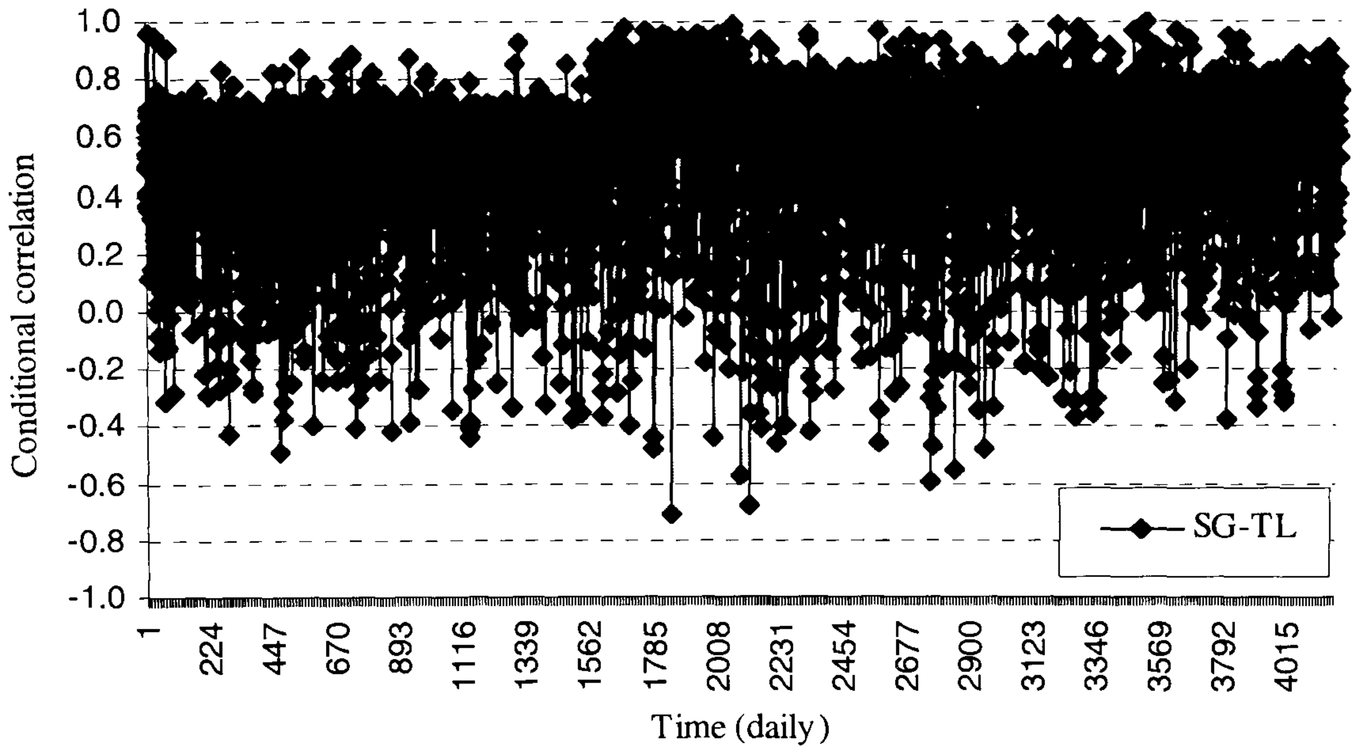




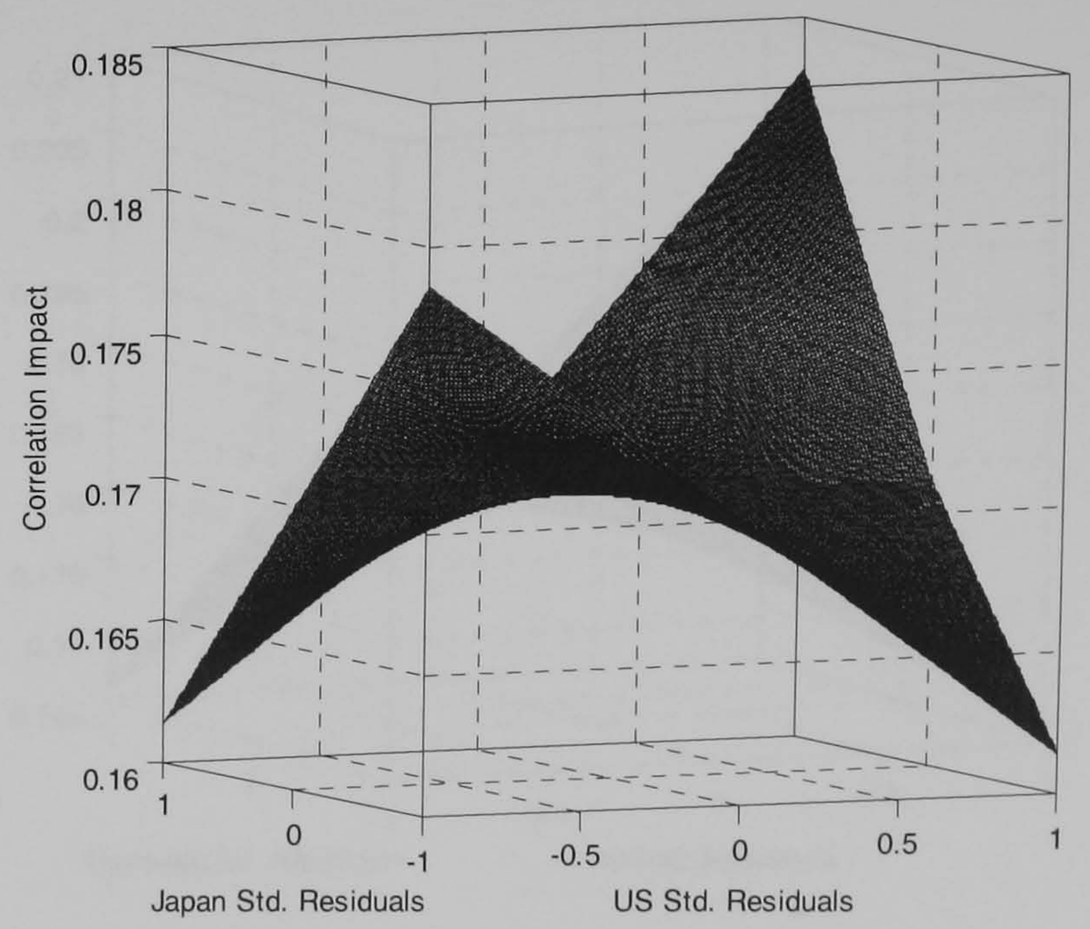


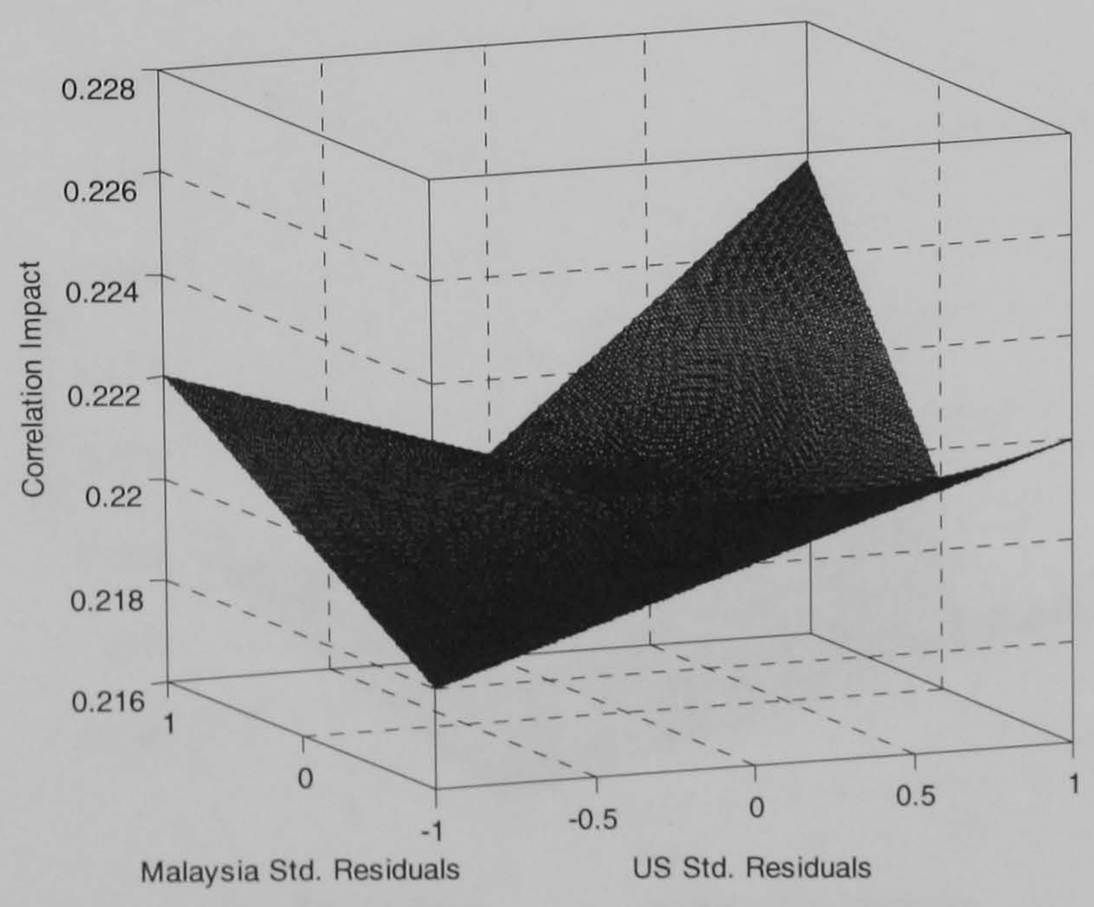
Appendix 3 (continued): Time-Varying Conditional Correlations in the US, Japan and the ASEAN.

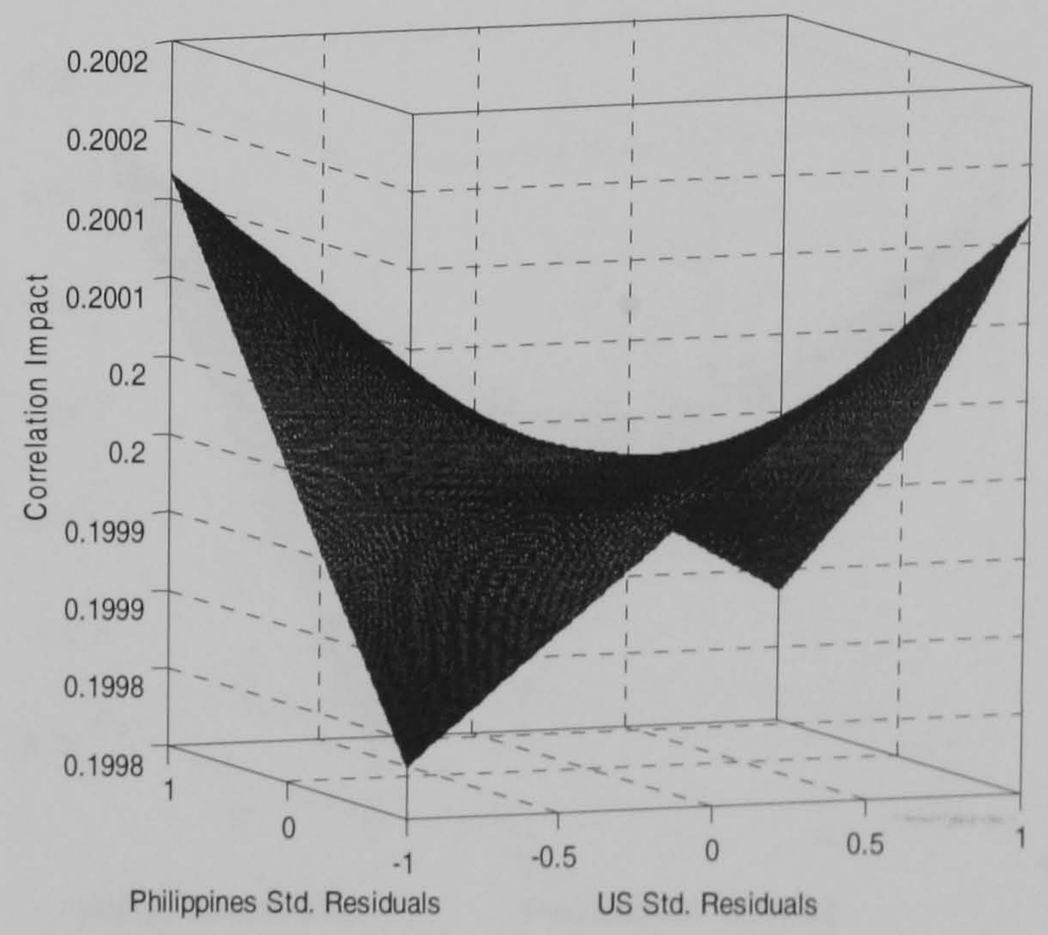
US, JP, IN, MA, PH, SG and TL stand for the US, Japan, Indonesia, Malaysia, the Philippines, Singapore and Thailand, respectively. The figures show daily time-varying conditional correlations which are calculated by equations 5.46-5.51 in sub-section 5.3.2.2



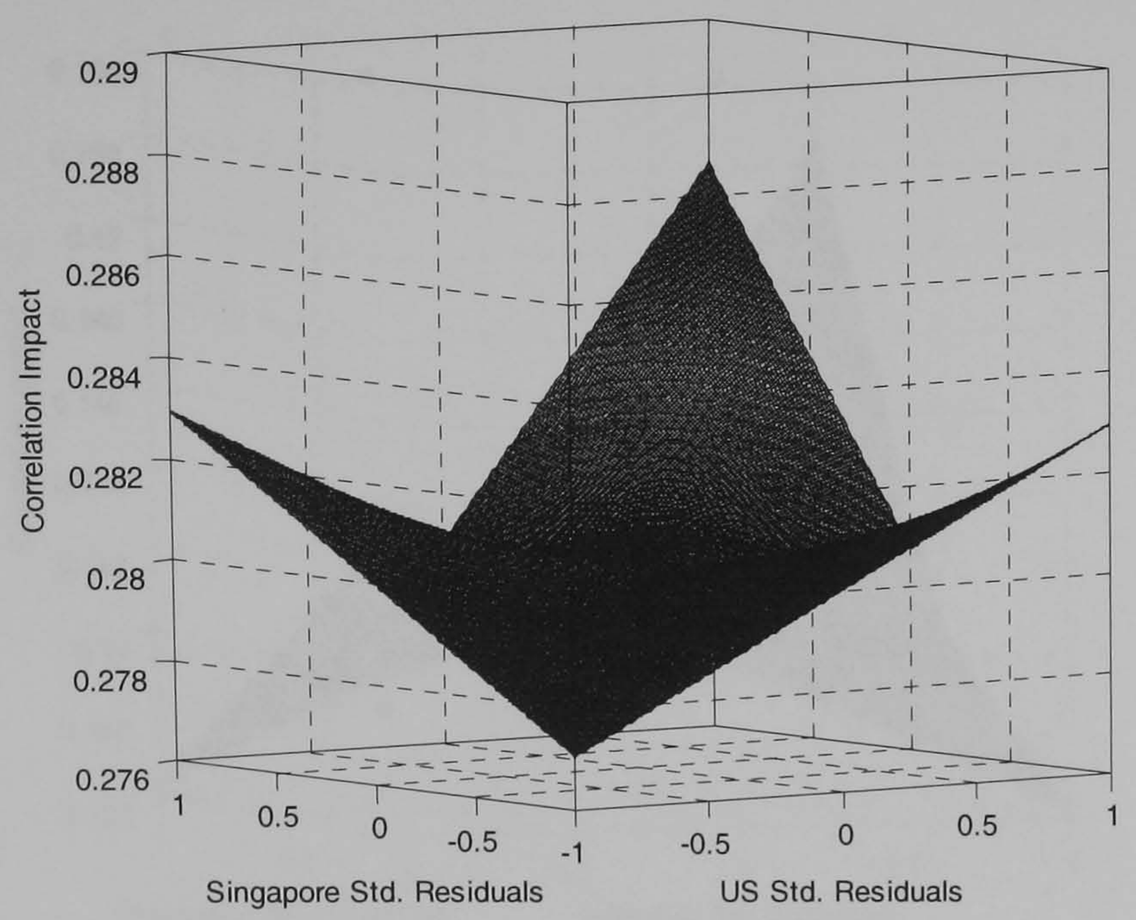
Appendix 4: News Impact on Conditional Correlations in the US, Japan and the ASEAN.

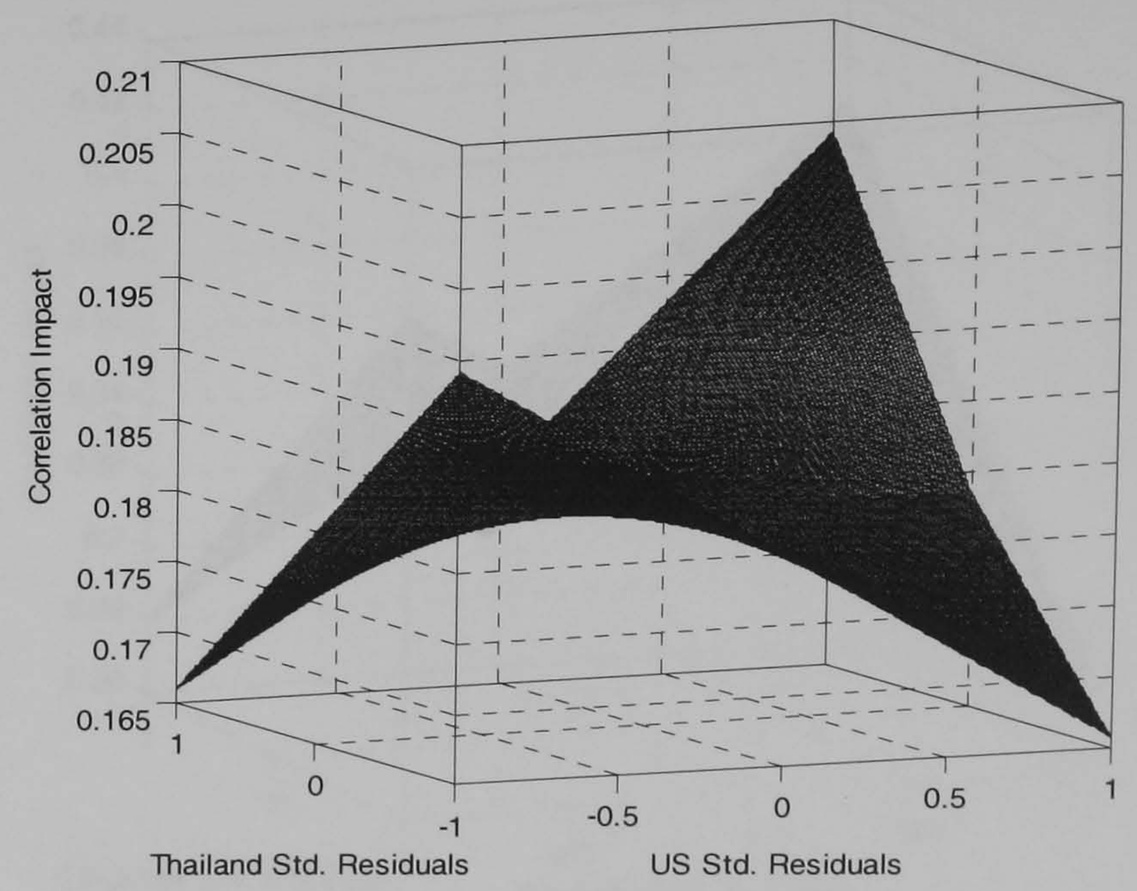


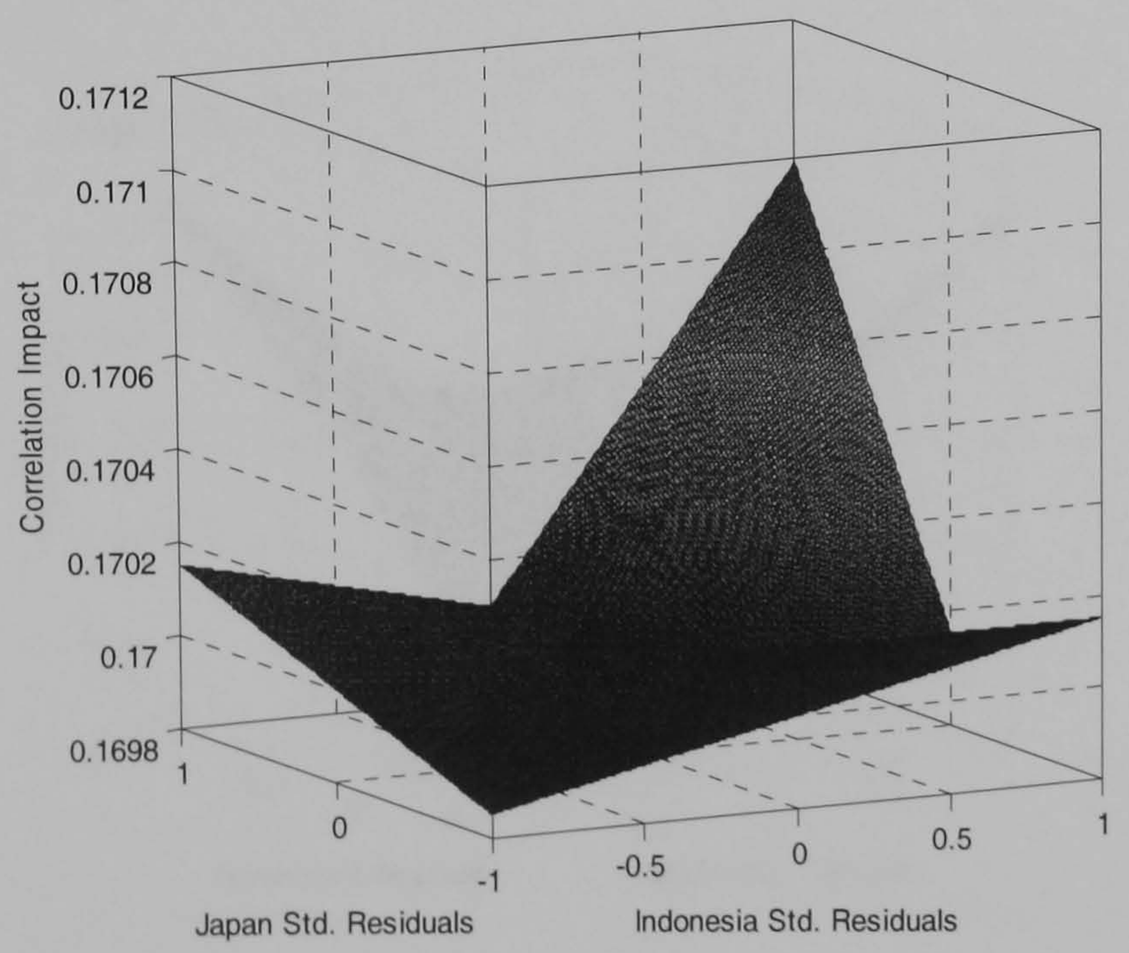


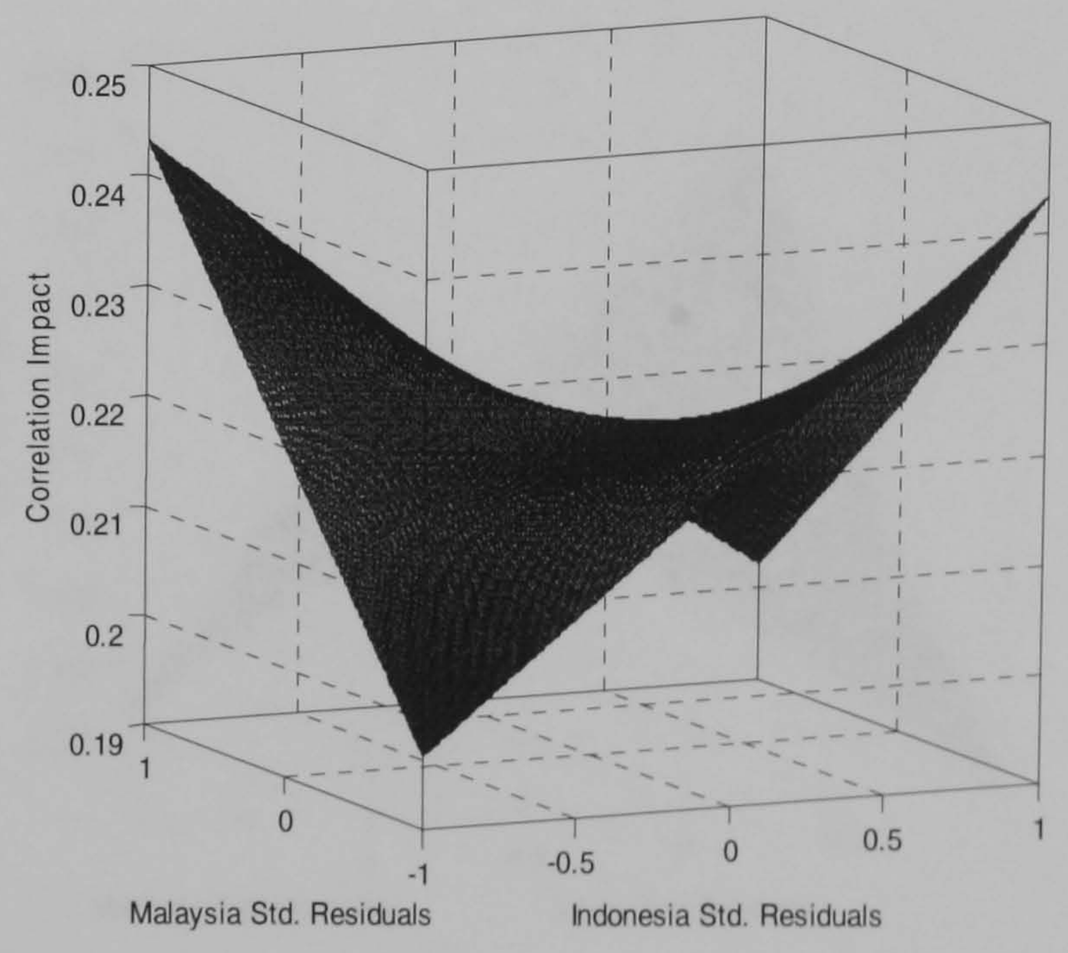


Appendix 4 (continued): News Impact on Conditional Correlations in the US, Japan and the ASEAN.

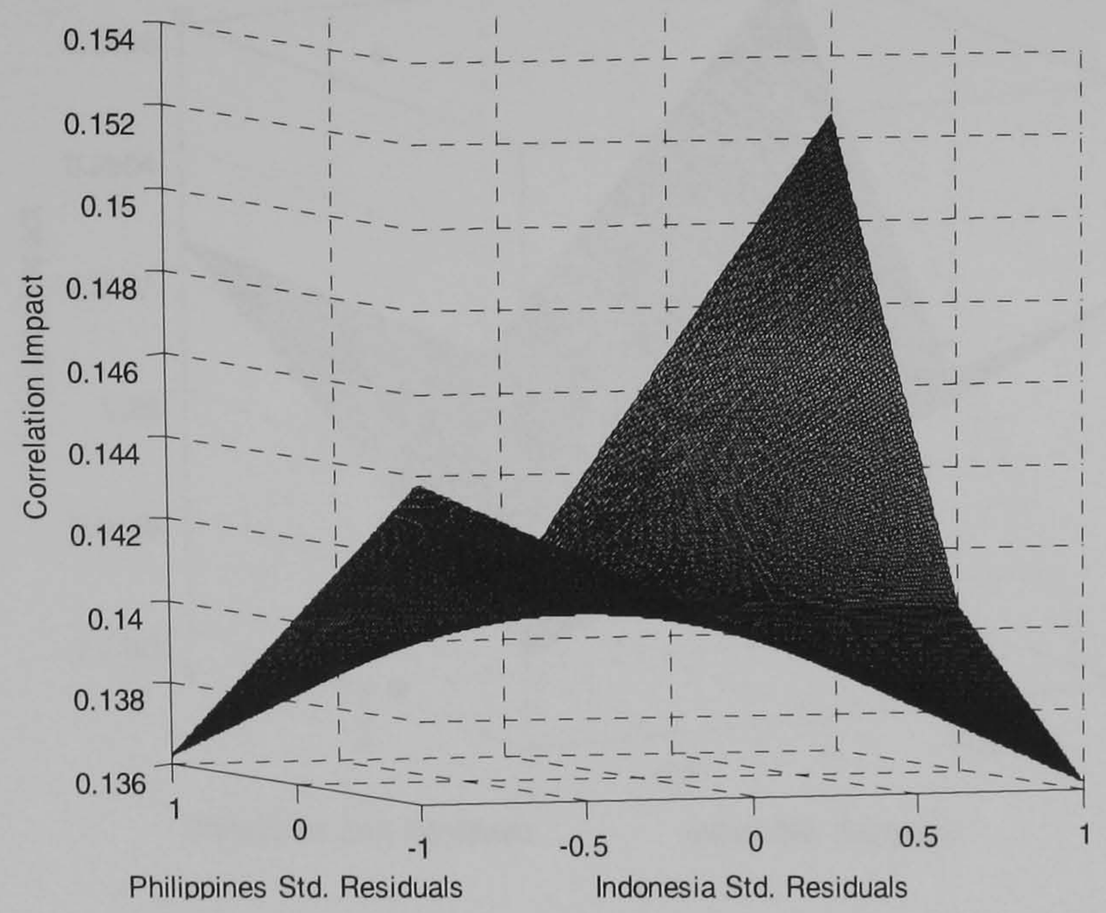


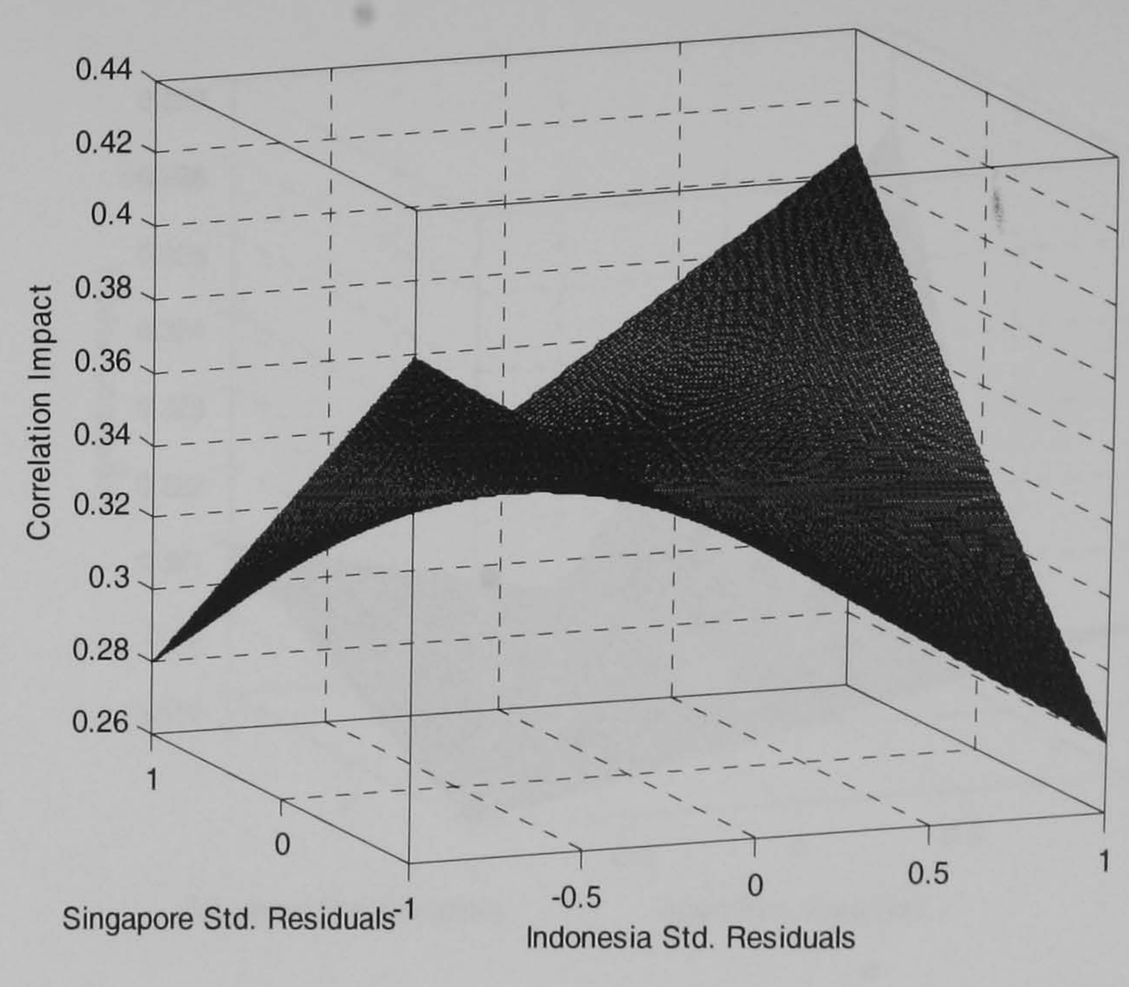


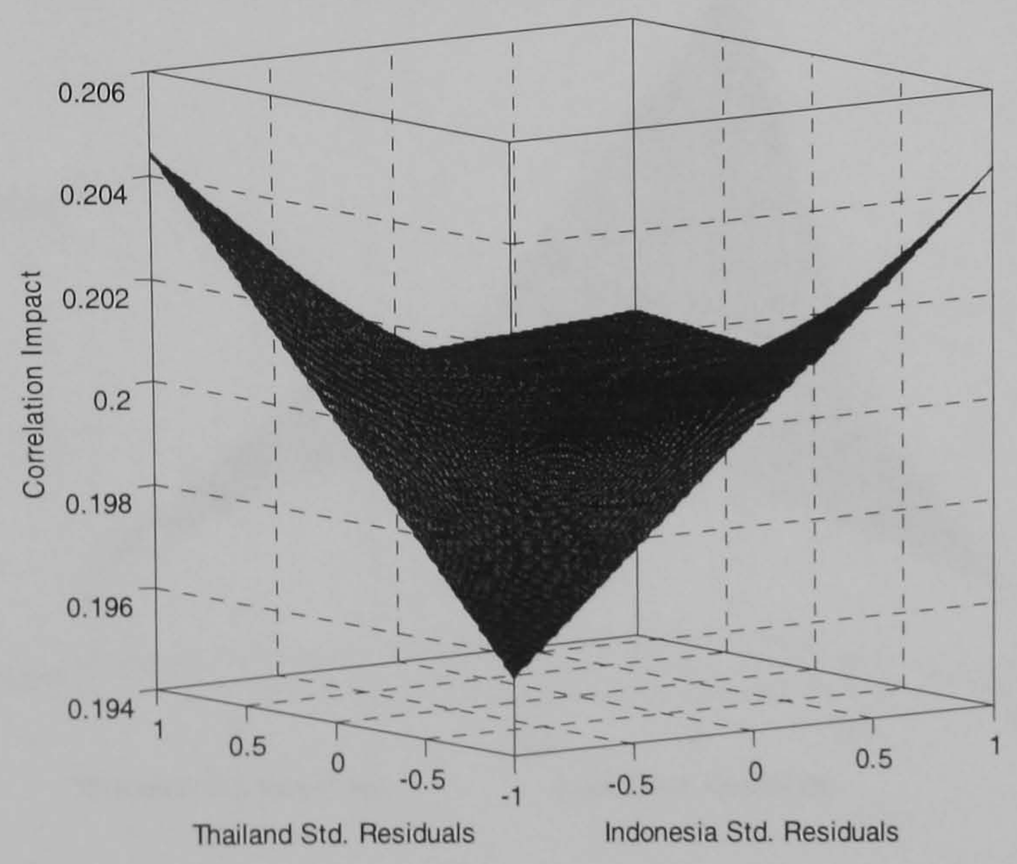


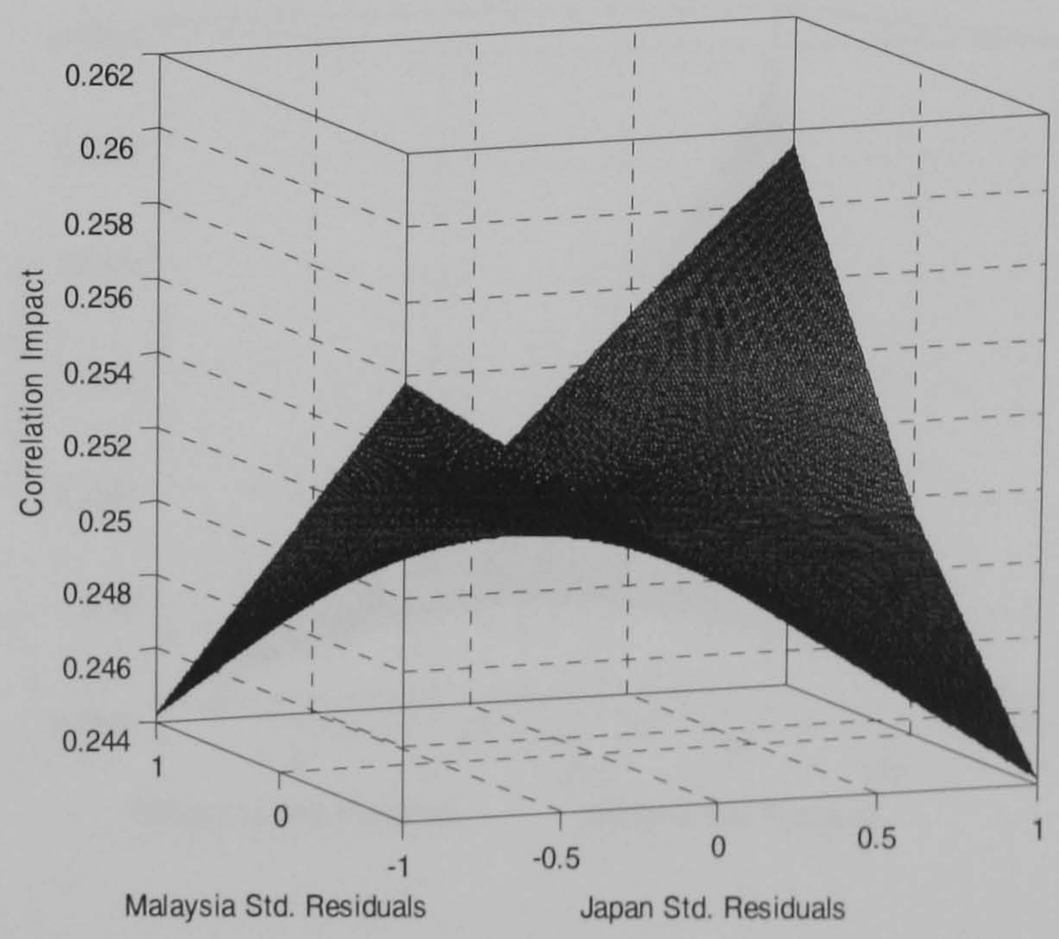


Appendix 4 (continued): News Impact on Conditional Correlations in the US, Japan and the ASEAN.

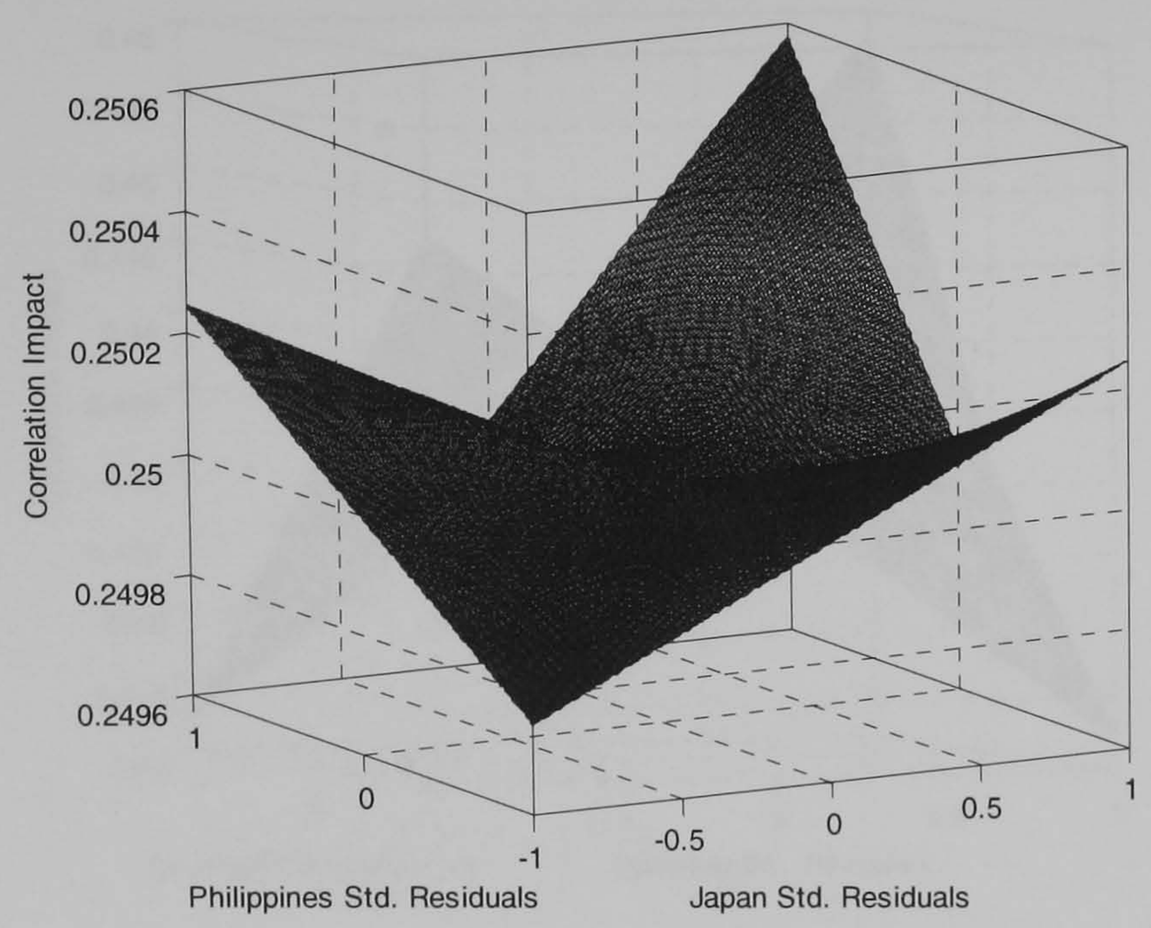


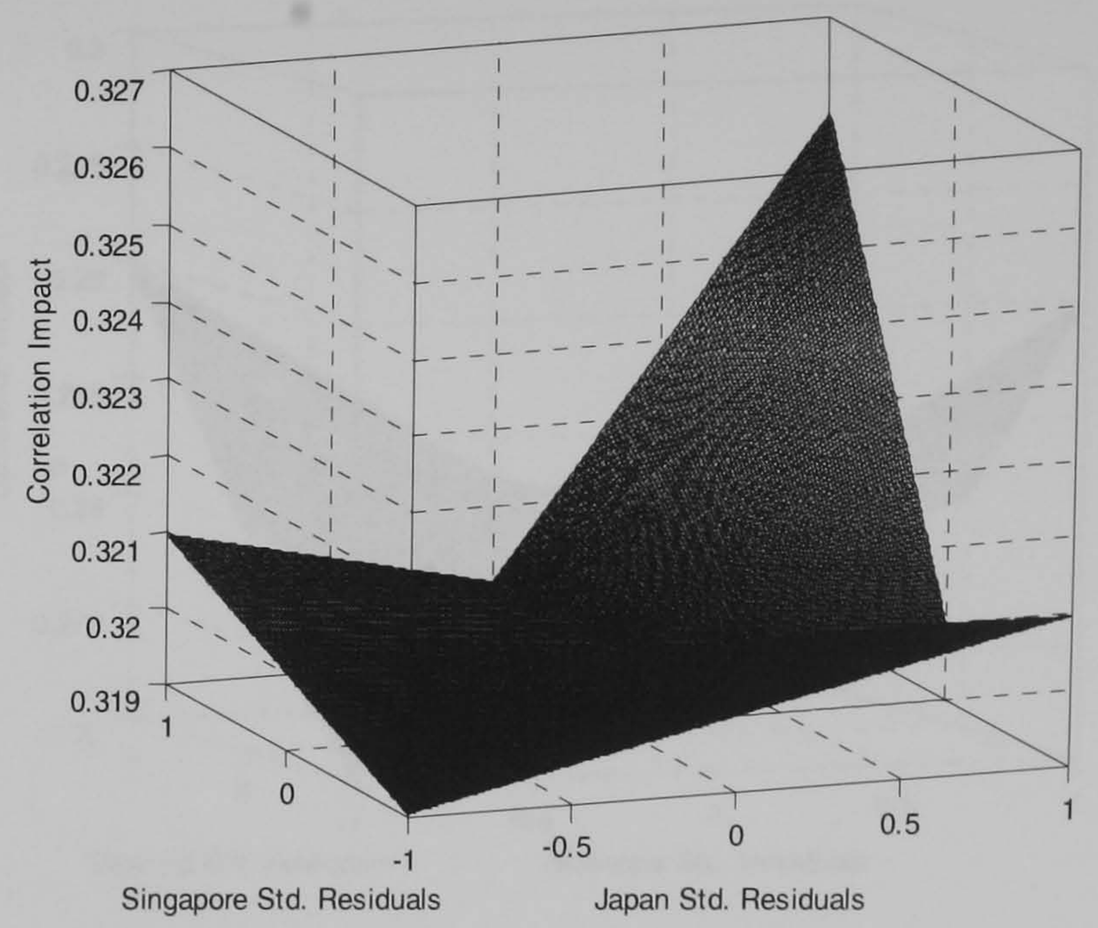


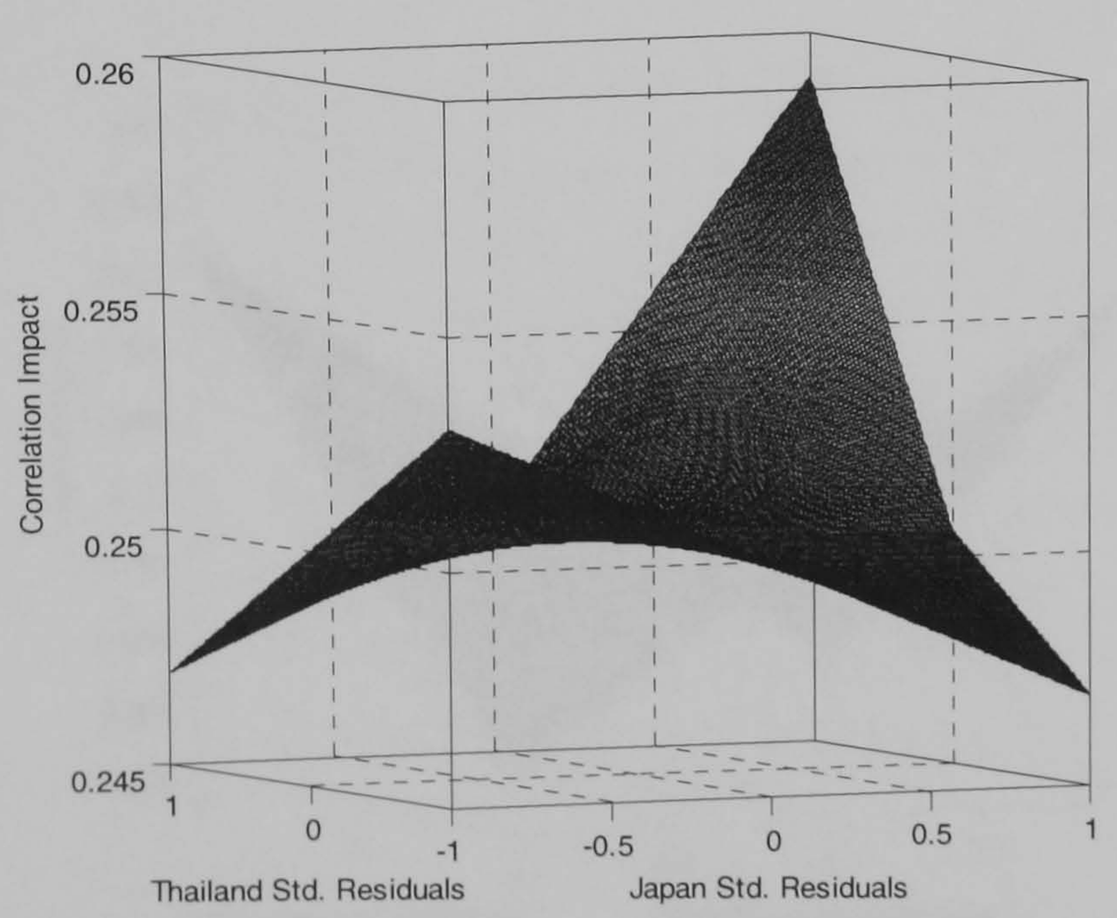


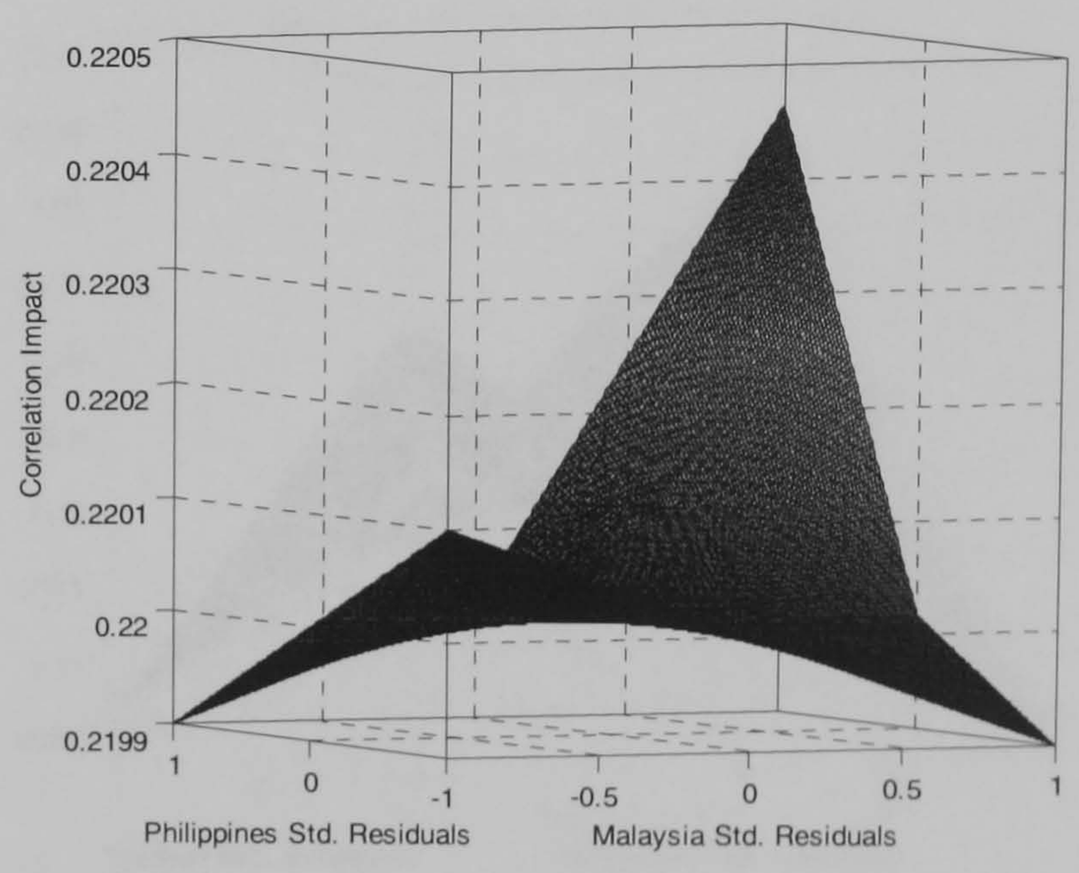


Appendix 4 (continued): News Impact on Conditional Correlations in the US, Japan and the ASEAN.

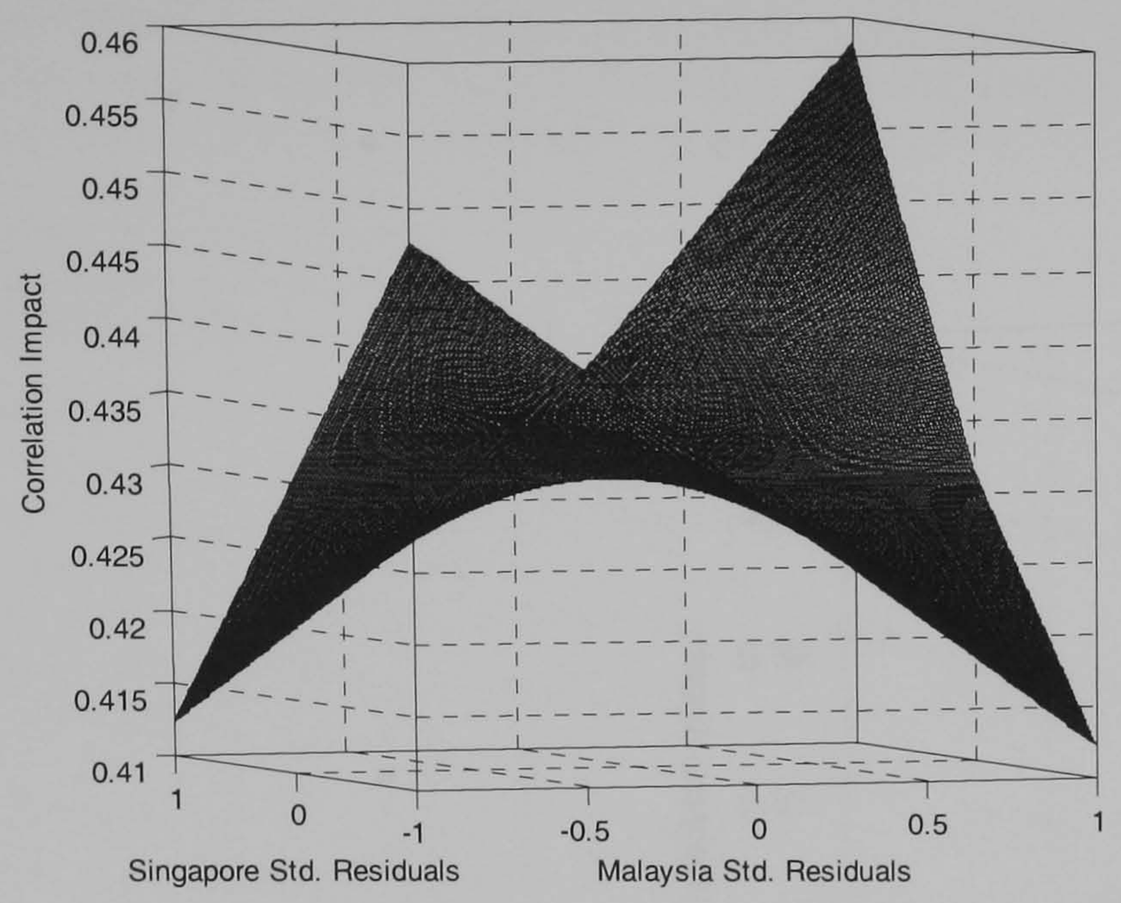


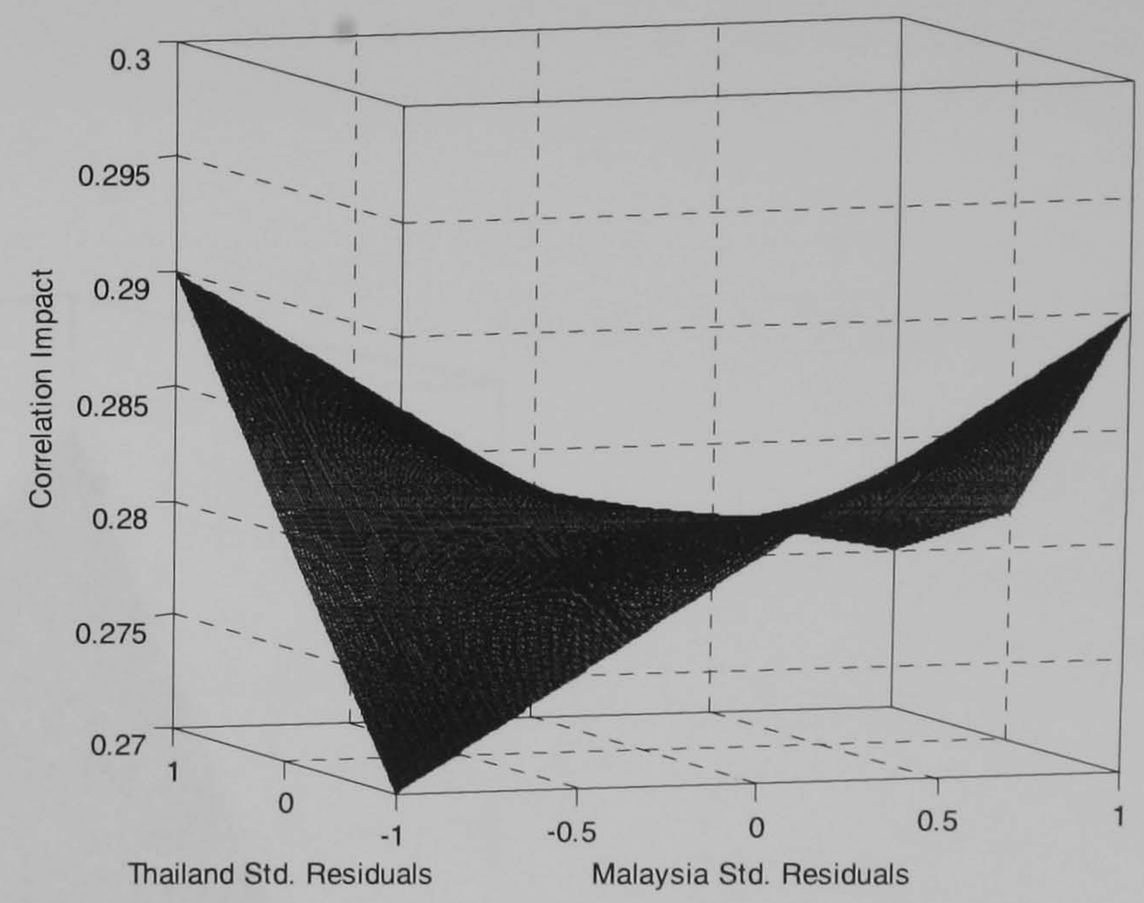


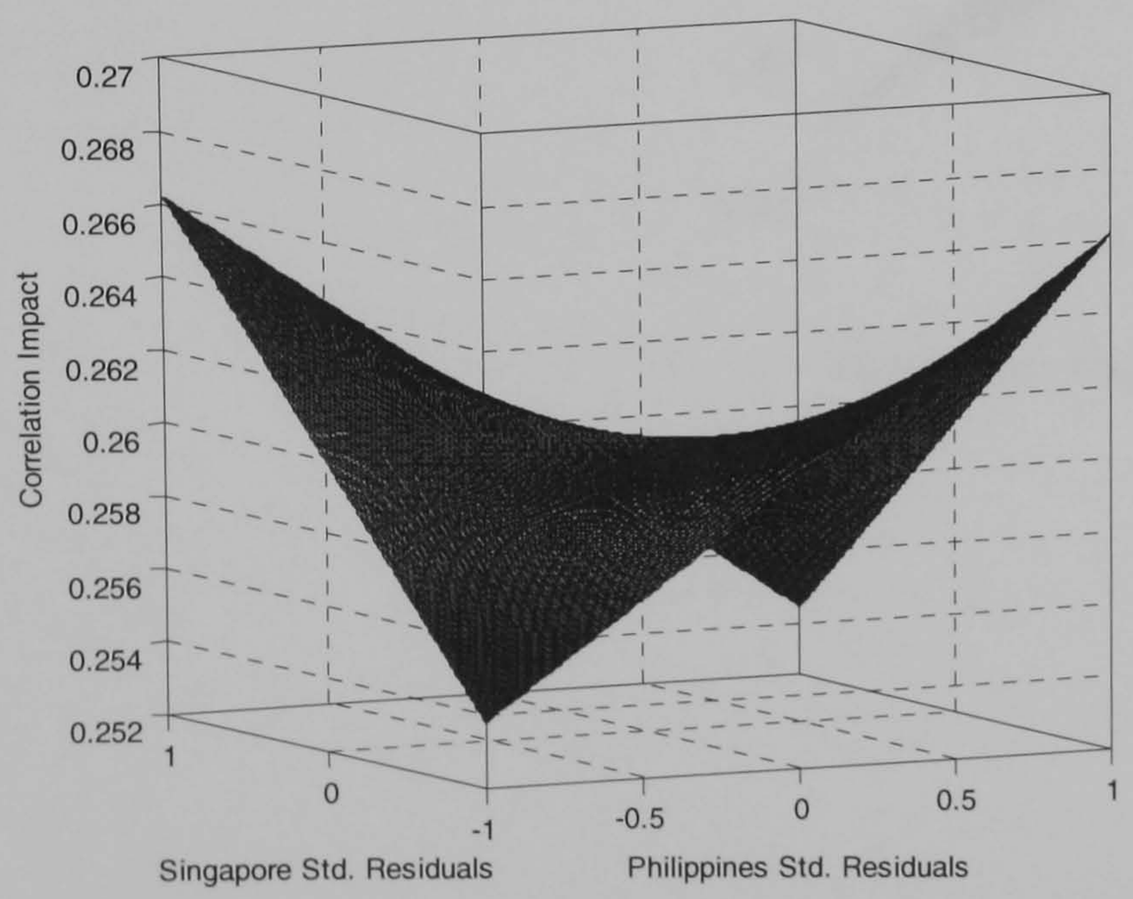


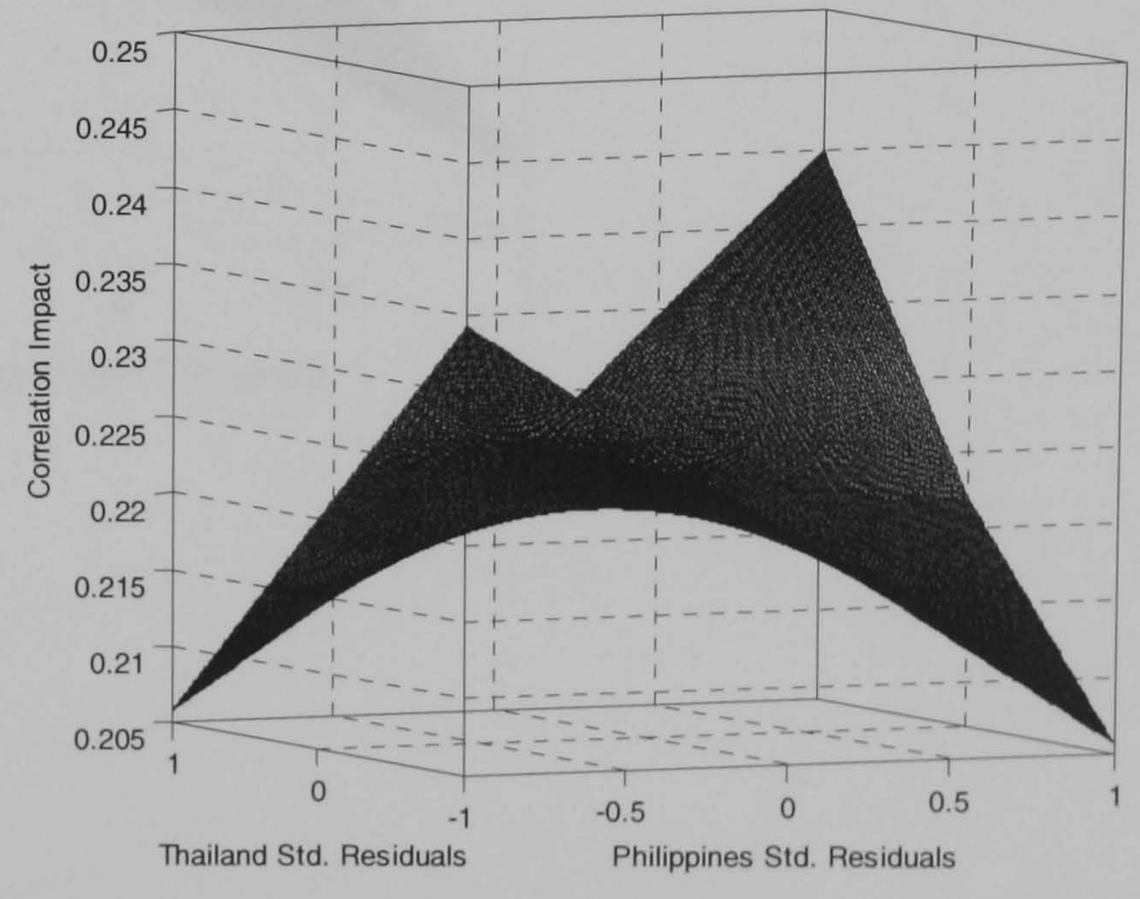


Appendix 4 (continued): News Impact on Conditional Correlations in the US, Japan and the ASEAN.

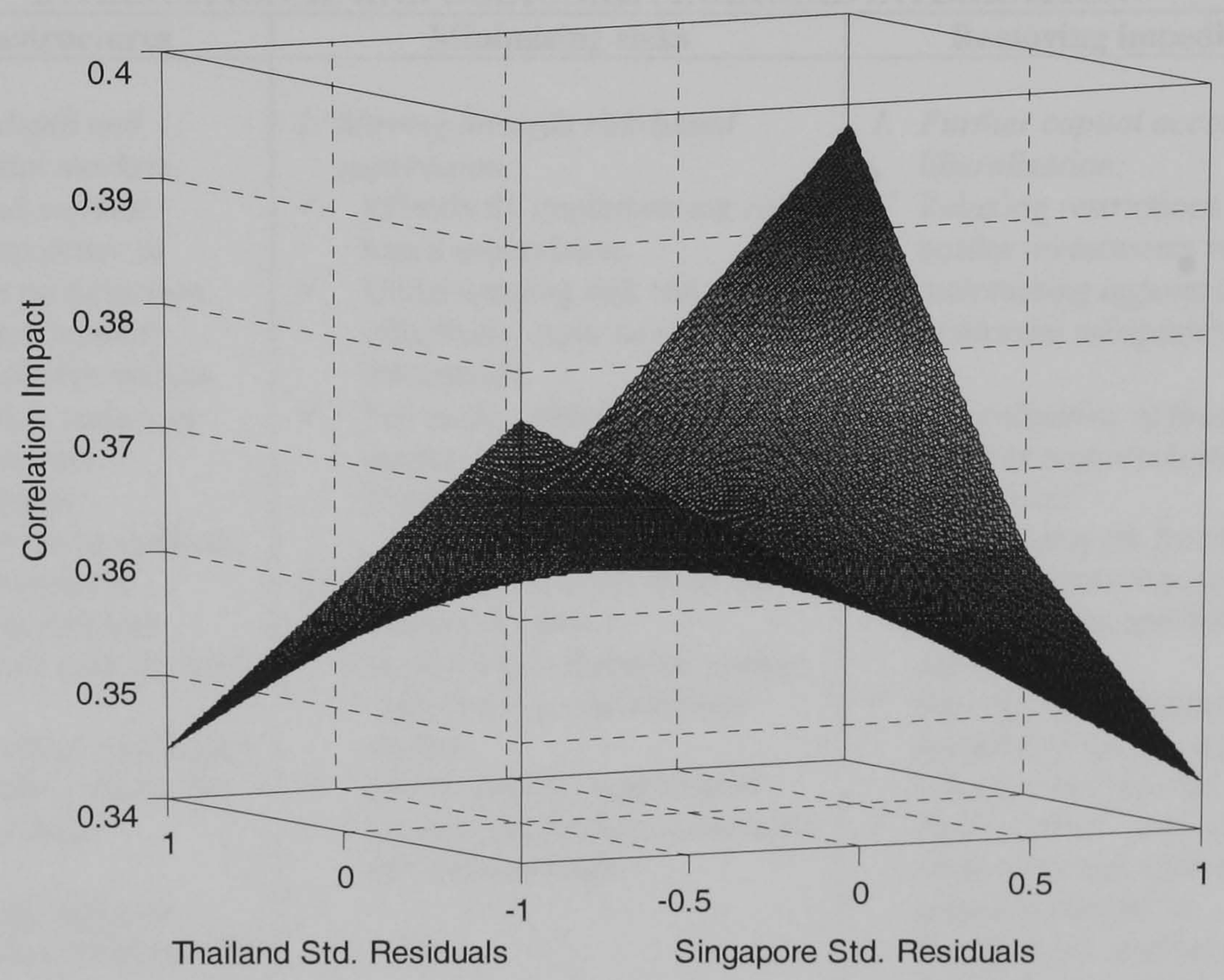








Appendix 4 (continued): News Impact on Conditional Correlations in the US, Japan and the ASEAN.



Appendix 5: Key Reforms to Foster Financial Integration

These key areas for reforms are well-recognised and Asian policymakers have already started many initiatives to address challenges in these key areas. These include steps to create regional Asian financial markets, such as the Asian Bond Market Initiative, the Asian Bond Fund, and the ASEAN Finance Roadmap; to collaborate in adopting global standards and best practices; and to establish regional mechanisms for crisis management and prevention.

INTERNATIONAL AND REGIONAL FINANCIAL INTEGRATION				
Strengthening capital markets	**Building infrastructures**	**Minimising risks**	**Removing impediments**	**Harmonising rules and practices**
1. Developing institutional investors (asset managers, insurance companies and, especially, pension funds): ✓ Appropriate tax treatment for long-term saving products. ✓ Transparency of such financial products. ✓ Level playing field vis-à-vis banks in competition for household savings. ✓ Rules on permissible products and investment guidelines. ✓ Moving pension funds away from state-sponsored plans, greater choice between defined benefit or contribution schemes. *2. Strengthening corporate governance:* ✓ Protection of minority shareholders: facilitating proxy voting, pre-emptive rights for existing shareholders to participate in capital increases, and mandatory disclosure of underlying and interlocking shareholdings. ✓ Need for cost effective legal channels for shareholders seeking redress to ensure that	*1. Enhancing the depth and liquidity of capital markets (especially, bond markets:* ✓ Improving transparency to promote market participation, and hence market liquidity. ✓ Encouraging different market participants with a variety of transaction needs and investment horizons. ✓ Developing derivative markets for different investors to construct their investment portfolios and risk management strategies. ✓ Changing prudential regulations or accounting conventions that might hinder trading. *2. Establishing links between national clearing and payments systems:* ✓ Increasingly adopting Delivery Versus Payment system. ✓ Establishing bilateral links between national Central Securities Depositories (CSD). ✓ Creating an International CSD for Asia (AsiaClear) to develop a cost-efficient service.	*1. Moving towards risk-based supervision:* ✓ Effectively implementing risk-based supervision. ✓ Understanding risk and effectively supervising institutions. ✓ For banks, effective implementation of the Basel II framework. *2. Addressing cross-sectoral and cross-border issues:* ✓ Improving cooperation among supervisors in the different sectors. ✓ Implementing consolidated supervision, both on a domestic and a global basis.	*1. Further capital account liberalisation:* ✓ Relaxing restrictions on cross-border investments while maintaining appropriate prudential safeguards. *2. Liberalisation of financial services and prudential regulation:* ✓ Liberalising the financial services sector based on the WTO process and bilateral agreements. ✓ Re-examining prudential limits on pension funds' and life insurers' investments. ✓ Relaxation of quantitative limits needs to be conditioned on ensuring robust risk management practices within the fund management and under the appropriate regulatory and supervisory framework.	*1. Strengthening implementation of global standards and best practices:* ✓ Establishing full-fledged regulatory and supervisory regimes. There is a need to strengthen solvency regulation and supervision, which then has to be complemented with sound corporate governance and effective risk management. ✓ Improving regulation and supervision of provident and pension funds. This would benefit members and increase the transparency of these institutions. ✓ Effectively supervising the contractual savings sector (asset managers, life insurers and pension funds) based on proper risk management and effective disclosure regimes. ✓ For capital markets, strengthening the supervisor's independence, powers to enforce the rules and capacity to conduct adequate surveillance (effectively sharing information with other sector supervisors both within he country and abroad).

rights can be practically enforced. ✓ Establishment of training programs for the Board of Director to provide them with a better appreciation of their role and responsibilities. ✓ Establishment of board committees (remuneration and nomination required) for listed companies to improve accountability. ✓ Insider trading regulations strengthened and rigorously enforced. ✓ Development of independent rating mechanisms fro the governance of banks. 3. *Improving the transparency and consistency of financial statements:* ✓ Moving to a common financial reporting framework, such as the International Financial Reporting Standards (IFRS). ✓ External audit of financial statements based on the International Standards on Auditing to ensure the consistent application of IFRS. ✓ Establishment of a regional or national supervisory body that ensures the quality and consistency of the auditor's work to increase public confidence in the transparency and quality of the financial statements.	3. *Creating regional credit rating agencies and benchmarks:* ✓ Exchanging information, experiences and skills among credit rating agencies in Asia to enhance their role in providing reliable market information. ✓ Adoption of best practices and common standards that ensure high quality and comparability of credit ratings.		2. *Regional efforts at harmonisation, countries work together voluntarily to:* ✓ Defining common objectives ✓ Setting regional guidelines combined with specific timetables for meeting objectives ✓ Establishing qualitative and quantitative benchmarks against best practice ✓ Translating regional guidelines into national policies by adopting specific policies tailored to national circumstances.

Source: Cowen et al (2006).

Appendix 6: Regulations on Cross-Border Portfolio Investments in Selected Asian Countries

COUNTRIES	CAPITAL INFLOW			CAPITAL OUTFLOW	
	Money market	**Bond market**	**Equity market**	**Residents**	**Non-residents**
Australia	Not subject to controls.	Not subject to controls.	Direct investments by non-residents.	Not subject to controls.	No restrictions on repatriation of capital or profits.
China	Non-residents are not allowed to purchase.	Qualified Foreign Institutional Investors (QFIIs) are allowed to invest in listed bonds subject to quotas.	QFIIs are allowed to invest in A-shares subject to quotas. No single QFII may hold more than 10 percent of a listed company.	Generally, residents are not allowed to invest abroad. Authorised banks may purchase foreign bonds using their own foreign currency funds. Foreign listed companies may repurchase their own shares listed abroad subject to approval.	Closed-end QFIIs must keep investments in China for three years, other QFIIs for one year. All remittances abroad must be done through the firm's foreign exchange account upon approval.
Hong Kong SAR	Not subject to controls.	Not subject to controls.	Investments in banks above certain limits require regulatory approval.	Generally free with limits for institutional investors.	No restrictions on repatriation of capital or profits.
Indonesia	Non-residents are allowed to purchase money market instruments locally.	Subject to regulatory approval. Non-residents may not purchase more than 1 percent of an investment fund.	Foreign investors are allowed to purchase shares without limitations except for joint securities companies that are financial companies as well. Non-residents may not purchase more than 1 percent of an investment fund.	Banks' transactions with non-residents are generally restricted. Insurance are not allowed to invest abroad except for private placements overseas insurance business.	No restrictions apply on repatriation of capital or profits. All payments must meet reporting requirements.
Japan	Not subject to controls.	Not subject to controls.	Direct investments by non-residents in a limited number of industries, such as the arms manufacturer, require prior notice.	Generally free to invest abroad. Prior notice required for limited number of industries, and some limits apply for some institutional investors.	No restrictions on repatriation of capital or profits.

Appendix 6 (continued): Regulations on Cross-Border Portfolio Investments in Selected Asian Countries

COUNTRIES	CAPITAL INFLOW			CAPITAL OUTFLOW	
	Money market	**Bond market**	**Equity market**	**Residents**	**Non-residents**
Korea, Rep. of	Open to foreign investors subject to registration, with exemptions given if they reside or work in Korea for more than six months.	Open to foreign investors subject to registration, with exemptions given if they reside or work in Korea for more than six months.	Open to foreign investors subject to registration, with exemptions given if they reside or work in Korea for more than six months. Investment in banks by non-residents exceeding 10 percent of stock requires regulatory approval.	There are prudential regulations on the assets/liabilities compositions of foreign exchange banks. Purchases of non-marketable bonds are subject to regulatory declaration. Regulatory approval is required for purchases of short-term securities denominated in Korean Won.	No restrictions on repatriation of capital or profits. All remittances abroad must be in foreign currency.
Malaysia	Not subject to controls.	Not subject to controls.	Investments in banks by non-residents are generally limited to 30 percent.	Residents without domestic credit facilities are allowed to invest abroad. Certain limits apply to those with domestic credit facilities, converting MYR to foreign currency to invest abroad. Institutional investors are subject to limits. Registration required for securities investments exceeding RM 50,000.	No restrictions on repatriation of capital or profits, subject to the provision of information on amounts exceeding RM 50,000.
New Zealand	Not subject to controls.	Not subject to controls.	Direct investments by non-residents above certain amount involving the acquisition of 25 percent of shares are subject bona fide investor test.	Not subject to controls.	No restrictions on repatriation of capital or profits.

Appendix 6 (continued): Regulations on Cross-Border Portfolio Investments in Selected Asian Countries

COUNTRIES	CAPITAL INFLOW			CAPITAL OUTFLOW	
	Money market	**Bond market**	**Equity market**	**Residents**	**Non-residents**
Philippines	Registration is required if the foreign exchange needed to service the capital repatriation of dividends, profits, and earnings is sourced from local banks.	Registration is required if the foreign exchange needed to service the capital repatriation of dividends, profits, and earnings is sourced from local banks.	Registration is required if the foreign exchange needed to service the capital repatriation of dividends, profits, and earnings is sourced from local banks.	Residents' investments abroad in excess of USD 6 million annually require prior regulatory approval. For smaller amount, investors must submit certain documentations.	Repatriation of capital, gains, profits, or dividends is allowed without approval, as long as proof of registration is available. Approval required if the foreign exchange for the investment will be purchased from domestic banks.
Singapore	Not subject to controls.	Not subject to controls.	Investments in banks above certain limits require regulatory approval.	Not subject to controls.	No restrictions on repatriation of capital or profits. SGD proceeds must be converted to foreign currency.
Thailand	No limitation applies except for certain short-term instruments issued by local financial institutions.	No limitation applies except for certain short-term instruments issued by local financial institutions.	Subject to various limits.	Requires regulatory approval.	Documentation required for repatriation.
Vietnam	Controls apply to all transactions in money market instruments	Free.	Foreign investors are allowed to hold up to 49 percent of a non-bank's current shares and 30 percent of a bank's current shares.	Not allowed to invest in shares and bonds abroad.	Foreign investors may only transfer investment capital abroad a year after a VND denominated securities trading account is opened with a custody agent.

Source: IMF, Asian Bonds Online.

Appendix 7: Implementation of Basel II in Asia.

COUNTRIES	AUTHORITIES' PLAN
Australia	Scheduled to take effect on January 1st 2008. The vast majority of authorised deposit-taking institutions (banks, building societies and credit unions) are expected to use the Standardised Approach.
China	Large banks with international operations are supposed to implement Basel II by 2010.
Hong Kong SAR	Planned to implement the Standardised, the Foundation Internal Ratings Based (FIRB), and the Basic Approaches, together with Pillar 2, and 3, in January 2007, and the Advanced Internal Ratings Based (AIRB) Approach in January 2008.
India	Scheduled to take effect from end-March 2007 for commercial banks. Initially, the Standardised Approach for credit risk, and the Basic Indicator Approach for operation risk will be adopted.
Indonesia	Planned to be applied in three to five year time frame, starting from simplest approach in 2008 to full application in 2010.
Japan	Scheduled to implement Standardised and FIRB Approaches by end-March 2007, and AIRB Approach by end-March 2008.
Malaysia	Planned to implement Standardised Approach in 2008 and FIRB Approach in 2010.
New Zealand	Scheduled to implement Standardised Approach in January 2008. Banks wishing to implement the Internal Ratings Based (IRB) and Advanced Measurement Approaches (AMA) from January 2008 must apply to the Reserve Bank of New Zealand (RBNZ) for accreditation by July 2006, which will be decided on a case-by-case basis. The RBNZ has a Terms of Engagement with the Australian Prudential Regulation Authority to ensure a coordinated approach to Basel II.
Pakistan	Planned to start to implement Standardised Approach in 2008 and IRB approach in 2010.
Philippines	Planned to start to implement Standardised Approach in 2007 and IRB in 2010.
Singapore	Scheduled to implement by end-2007 at latest. All approaches will be available but local banks are not expected to employ the most sophisticated techniques.
Korea, Rep. of	Planned to make all options available b end-2007.
Taipei, China	Planned to start to implement Standardised and FIRB Approaches in January 2007; AIRB and AMA in 2008.
Thailand	Planned to implement by end-2008.

Source: IMF staff.

Appendix 8: Asian Regional Policy Forums

EMEAP (Executives Meeting of East Asia and Pacific Central Banks) was established in 1991 as a forum of central banks, aiming at enhanced regional surveillance, exchange of views and information, and financial market development. Currently, there are three Working Groups (WGs): WG on Payments and Settlement Systems, WG on Financial Markets and WG on Banking Supervision.
11 members: Australia, China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, New Zealand, the Philippines, Singapore and Thailand. The secretariat function is offered by the BOJ.

ASEAN (Association of South East Asian Nations) was established in 1967. It has slowly grown from its original five members to current 10 members. The group's economic cooperation covers: trade, investment, industry, services, finance, environmental protection, agriculture, forestry, energy, transportation and communication, intellectual property, small and medium enterprises and tourism. Since 1999, meetings among representatives of finance ministries and central banks of ASEAN plus China, Japan, South Korea (ASEAN+3) have been held (initially the deputy level, then Ministers and Governors since 2000) to discuss topics such as, financial cooperation, regional surveillance, and human resource developments. A network of bilateral swap arrangement among ASEAN+3 countries is currently in place (Chiang Mai Initiative).
10 members: Brunei, Cambodia, **Indonesia**, Lao PDR, **Malaysia**, Myanmar, **the Philippines**, **Singapore**, **Thailand** and Vietnam (original members in bold). Secretariat is located in Jakarta, Indonesia.

ASEM (The Asia-Europe Meeting) was established in 1996. ASEM is an informal process of dialogue and cooperation bringing together ten Asian countries with fifteen EU member states and the European Commission. It holds summit level meetings every two years and Ministerial-level meetings in the intervening years (normally once a year). It addresses political, economic and cultural issues, with the objective of strengthening the relationship between the two regions, in a spirit of mutual respect and equal partnership.
26 members: Brunei, China, Indonesia, Japan, South Korea, Malaysia, the Philippines, Singapore, Thailand, Vietnam, the 15 EU member states and the European Commission.

Appendix 8 (continued): Asian Regional Policy Forums

SEANZA (South East Asia, New Zealand, Australia) was established in 1956, one of the oldest and also the largest in terms of membership of the regional policy forums. It is a forum among central banks, to conduct intensive, biennial central bank training courses. The very diversity of this group, however, argues against its practicality as a platform for more intensive central bank cooperation outside the training area.
20 members: Australia, Bangladesh, China, Hong Kong, India, Iran, Indonesia, Japan, South Korea, Malaysia, Nepal, New Zealand, Pakistan, Papua New Guinea, the Philippines, Singapore, Sri Lanka and Thailand.

SEACEN (South East Asian Central Banks) was established in 1972. Initially a training and research organisation for central banks, SEACEN has evolved from an informal grouping in the 1980s to a more substantive forum for discussion of central banking issues (became a legal entity in 1982).
13 members: Brunei, Indonesia, Fiji, South Korea, Malaysia, Mongolia, Myanmar, Nepal, the Philippines, Singapore, Sri Lanka, Taiwan and Thailand. The SEACEN Centre is located in Kuala Lumpur, Malaysia.

APEC (Asia Pacific Economic Cooperation) was established in 1989, originally meetings between only foreign/trade ministers. Finance ministers (central bank governors) began to meet annually since 1994.
21 members: Australia, Brunei, Canada, Chile, China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, the Philippines, Russia, Singapore, Taiwan, Thailand, Vietnam and the United States. The secretariat is in Singapore.

Six Markets Group (G-6, or G-4 plus 2) was established in 1994. Initially, it consisted of only four major Asian financial centrals (Australia, Hong Kong, Japan and Singapore). Since 1997, China and the United States have been invited to attend the meetings as well. The group's objectives include stability of the region's financial and foreign exchange markets. Meetings are attended by Vice Ministers of Finance and Deputy Governors of central banks.