University of Southampton

Faculty of Social Sciences

Three Essays on International Macroeconomic Interdependence in the Asian Crisis

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Submitted for the degree of Doctor of Philosophy

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August 2003

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

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THREE ESSAYS ON INTERNATIONAL MACROECONOMIC INTERDEPENDENCE IN THE ASIAN CRISIS

by Sugiharso Safuan

In the last decade the term contagion has gained popularity in the economic literature. It describes a feature of financial crises that have engulfed a number of countries in the world (ERM 92-93, Argentina, Brazil in 1994, the Asian crisis 1997, the Russian Cold 1998 elsewhere). Contagion is said to be present when cross-market linkages (measured by a number of different statistics, such as, e.g. correlation in asset returns) increase significantly in the times of crises compared to tranquil periods. In the recent literature, identifying the existence of such a crisis transmission mechanism has been the subject of lively debate.

The first part of the thesis examines the presence of such contagion in interest rate and stock market data in the Asian countries during financial crises. The tests focus on the specific transmission of financial disturbances in the countries afflicted by the crisis. The disturbances that arise when the reduced form is estimated in the first stage of the procedure are identified by a set of dummy variables. The change in the transmission mechanism is captured by the coefficients on the dummy variable. Using the model adopted in the first part of this thesis, it is found that contagion was present in both interest rate and stock market data during the East Asian crisis of 1997-98.

The second part of the thesis extends the model used in the first part of the thesis. A model is developed based on the co-integration framework. A change in transmission is then graphically detected through the plots of recursive maximum eigenvalues. The results based on a set of financial data suggest that the transmission mechanism substantially changed during the crisis period. This suggests that contagion was present.

The final part of the thesis focuses on the investigation of the sources of contagion and its transmission channel. Four sets of data on finance and trade are used to analyse the relative importance of the transmission channels of the shocks between the East Asian countries with their main trading partners. The results show that both trade and financial variables did play fundamental roles in the propagation of the East Asian crisis.

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ACKNOWLEDGEMENTS

It is a pleasure to acknowledge my indebtedness to my supervisor, Dr Peter Smith, for constant guidance, generous advice and encouragement. His comments, corrections, detailed reading of my numerous drafts and limitless patience have been invaluable during the process of completing this thesis.

I should also like to thank Professor Mathias Hoffmann, my joint supervisor, for stimulating discussions on international macroeconomics and applied econometrics. I have benefited enormously from his insight into econometric methodology and practice. His view and ideas have, without doubt, influenced my attitude to conducting this empirical research.

Many persons have played a crucial role in this adventure. In particular, I must mention Professor Ian Diamond for his trust in my potentialities and for his advice.

My deepest thanks go to everyone in the Department of Economics, in particular to office mates, Emmanuel Mulenga Pamu and Karima Kamal, for many constructive comments upon, and invaluable discussions about various aspects of life. I also thank Carry Turangan, Alfred Tan, Hendro Wibowo, and Romie O Bura for their advices and friendship.

I should also mention that my studies in the United Kingdom were supported by the QUE Project Department of Economics, the University of Indonesia in the form of PhD studentship.

My greatest debt is however to my wife, Usasana, for her understanding, support and continuous encouragement during the long period my study. To her and my lovely daughters Vania and Adilla, this effort is dedicated.

Finally, I am grateful to my parents for their patience, spiritual support and *love*. Unfortunately, my father has passed away during my study. To my mother and the memory of my father, this work is dedicated.

Highfield, Southampton — Sugiharso Safuan
May, 2003

Chapter 1

Introduction

The last decade has witnessed episodes of financial crises occurring in one country and tending to spread to other parts of the world. In 1992-93, it was the ERM countries that were affected. This crisis began in the second quarter of 1992 when the Bank of Italy devalued the lira against the DM. This led to a wave of speculative attack on the other European Monetary System currencies as the devaluation of the lira affected to other countries in the periphery. In late 1994, the Mexican Peso came under attack, and had to be floated after an unsuccessful devaluation. Within a relatively short period, the crisis moved to other Latin American countries in 1994 and 1995. These included Argentina, Brazil, Peru and Venezuela.

In 1997, it was Asia's turn to run into crisis. The crisis started on July 2, 1997 when the Thailand government abandoned its fixed exchange rate regime after several years of a pegged system. The abandonment of the peg in Thailand was followed by a free float of the Philippines peso on July 11 and the abandonment of the defence of the Malaysian ringgit on July 14. One month later, the crisis had engulfed Indonesia, with the rupiah starting to float on August 14. The crisis then spread to Hong Kong on 17 October 1997, and hit South Korea on 6 November 1997. In the six months after the first onset, the Indonesian rupiah depreciated more than 140 %. The Thai Baht and Korean Won depreciated by more than 80 %, and the Philippines peso and Malaysian ringgit depreciated about 50 %. The Singaporean Dollar and Taiwan dollar depreciated by around 20%. At nearly the same time, stock markets in these countries also collapsed and the effects spread to countries elsewhere in the world (e.g. Brazil and Argentina). In US$ terms, the Thailand stock market fell by 65 %, the Indonesian by 70 %, Philippines by 57 %, the Hong Kong by 33 %, and the South Korean by 72 %. Elsewhere, the Brazilian stock market prices fell by 31 %.

In recent years, financial crises with such characteristics have generated a large body of literature on economic interdependence and the transmission mechanism of shocks across countries. One strand of these studies has focused on developing a formal representation explaining how financial shocks occurring in particular countries can propagate internationally.

In the theory developed by Gerlach and Smets [26], it is argued that a devaluation of a currency in one country may lead to devaluation in other countries with a pegged exchange rate regime through a mechanism known as *product competitiveness*[1]. Essentially, the approach developed in their work views a currency devaluation as increasing the competitiveness of a country's export. Suppose two countries (say, A and B) are engaged in bilateral trade. A devaluation of the currency in country A

[1] Corsetti *et al.*[13] extend this view using a welfare approach. They argue that the devaluation due to competitiveness can be sharper than is required by any initial deterioration in fundamentals.

will increase the competitiveness of country A's exports compared to B. In order to safeguard their country's competitiveness, the monetary authorities in country B may follow A in devaluing their currency. The currency crisis that occurred in A may affect other countries even if they do not directly compete with country A. If one country devaluates its currency, then the country's exports will be relatively cheaper in international markets. A country whose exports are similar to the first country and competes in same market will be relatively less competitive. Thus, the increase of competitiveness in country A by devaluing its currency could have an indirect effect on another country's currency which competes in the same market. The spreading of currency crises under this framework is typically known as *trade contagion.*

Valdes [61] describes systematically how a crisis occurring in one country can spread to another country which is not in crisis or a country with strong macroeconomic fundamentals. According to Valdes [61] a liquidity shock occurring in one country can make international investors recompose their portfolios by selling their securities in one country and buying in other countries. With asymmetric information, the financial markets in emerging countries tend to be even more vulnerable. A shock to one country will generate large and unexpected swings in financial variable in other countries, even in countries with strong macroeconomic fundamentals. This is what is commonly called *financial contagion.*

Financial contagion can also occur through a mechanism called 'wake up call' (Goldstein, Kaminsky and Reinhart [28]). In this case, the crisis in one country acts as a wake up call for international investors to re-evaluate their portfolios in other emerging countries. Having assessed several countries based on their financial fundamentals such as, for example, the appreciation of the exchange rate, quality of investment, export performance, it was found that one or more country were susceptible since they had similar characteristics to the crisis country. In a variant of this theory, Chang, R and Majnoni [9] argue that contagion emerges only if a crisis in one country leads international investors to rationally update beliefs about fundamentals in other countries. A country is more vulnerable to contagion if its fundamentals, in particular its financial position, are weak.

The propagation theory of shocks across countries has become a powerful framework for helping to explain contagion during financial crises. It is often argued that with increased integration of the global economic and financial system, the effect of transmission of international disturbances appears to be stronger in a country where the domestic market is integrated with world capital markets. As a result, a country will be more vulnerable to a shock. If contagion exists, designing an appropriate policy will help the country to manage a crisis since international shocks are frequently disruptive.

There are a number of studies using a variety of different techniques to examine the existence of contagion in episodes of financial crisis. A correlation test (King and Wadhwani [43] is a popular approach, in which many researchers have used the change in conditional correlation for detecting the presence of contagion in financial markets. Comparing cross-country conditional correlations calculated with different subsamples is one way of detecting if there is a change in the transmission mechanism of international shocks. According to this approach, a significant increase in the conditional correlation during crisis periods is interpreted as evidence of a change in the transmission mechanism (i.e. contagion). Most empirical studies based on conditional correlation approach report that conditional correlations between markets increase significantly during periods of market turbulence[2]. However, it has been argued that the test for contagion based on conditional correlation analysis suffers from methodological deficiencies.

Recently, Forbes and Rigobon [24] criticized the use of the conditional correlation approach for detecting the presence of contagion. They argue that a high correlation across countries measured by the conditional correlation coefficient (King and Wadhany [43]) does not necessarily indicate contagion. A high correlation coefficient between two markets could either be due to higher volatility of the underlying shocks or to a change in the transmission mechanism of the common shock. Rigobon and Forbes [24] show that in the presence of heteroskedasticity the normal correlation coefficient is biased so that it is not appropriate as a test of contagion. Forbes and Rigobon [25] developed a heteroskedasticity test which is a revised version of the normal correlation coefficient that had been commonly used in previous studies. Using stock market returns data for a total of 36 emerging markets, the results of this study based on this test find that only a few cases in the sample indicate the

[2]In an earlier empirical study of contagion using this approach Calvo and Reinhart [4] examine the behaviour of the correlation of the stock market and Brady bonds between Asian and Latin American emerging markets after the 1994 Mexican crisis. They find evidence of cross-market contagion. Valdes [61] use secondary data on market debt prices and country credit ratings to show contagion in Latin America. He finds a higher correlation among Asian markets (i.e. contagion) even when he controls for market fundamentals.

presence of contagion.

Using a similar test, Baig and Goldfajn [1] focus on investigating the existence of financial contagion in East Asia (Thailand, Malaysia, Indonesia, Korea, and Philippine). The data are the exchange rate, the interest rate, equity and sovereign debt spread. The results of this study show that there is evidence of cross-country contagion among currencies and sovereign spreads.

Bordo and Panini [2] extend the cross-market correlation approach suggested by Forbes and Rigobon. They investigate several episodes of financial crisis including the East Asian collapse. Using weekly data on bond prices and interest rates, the study finds little evidence of a significant increase in cross market correlations over the period studied.

In more recent study, Caporale *et al.* [5] show that arbitrarily splitting the sample into crisis and non-crisis periods as in the approach advocated by Forbes and Rigobon [25] will affect the power of rejection of the null hypothesis. They suggested a solution to this problem. First, they estimated a sample that covers both crisis and non-crisis periods. Second, the splitting of the sample into crisis windows is endogenized. In an application to the data on stock markets for eight East Asian countries (Indonesia, Malaysia, South Korea, Thailand, Hong Kong, Singapore, Taiwan, and Philippines), they find that contagion was present.

Whereas the approach advocated by Caporale *et al.* [5] offers a number of clear advantages over the Forbes and Rigobon approach, in order to identify the presence of contagion, both techniques use a structural model of interdependence which is based on only two markets. In fact, the two techniques yield different conclusions. It is also often argued that one of the most distinctive characteristics of the Asian crisis is the speed at which it spread to many countries, almost at the same time. Thus, the use of the framework suggested by Forbes and Rigobon [52] and its variant which relies on two markets may not fully capture all the characteristics of the crisis. Given the limitations of the existing techniques and the apparent importance of identifying the existence of financial contagion that have been emphasized in the theoretical literature, it would appear useful to provide additional evidence of contagion using different approaches.

The first part of this thesis contributes to the empirical literature on the transmission mechanism of shocks by re-examining the existence of financial contagion based on the methodology suggested by Favero and Giavazzi [21]. In the original model, the authors applied this approach using data on interest rates in the ERM. In this thesis, we extend this approach by using daily data on both interest rates and stock markets. It has been argued that the approach advocated by Favero and Giavazzi [21] has a number of potential advantages compared to the one proposed in Forbes and Rigobon's study. In particular, the procedure allows countries afflicted by the crisis to be included in the structural model. The use of this model is well suited for the case where the period of crisis is short.

The key step in implementing Favero and Giavazzi's procedure is to estimate a VAR model representation of the return process in all markets under investigation. Then, outliers are identified and the residuals are whitened by introducing dummies into the model. Based on *a-priori* economic knowledge each outlier is earmarked as originating in one particular country or as a common shock. If the dummies that are associated with idiosyncratic shocks are also significant in markets other than the one in which they originated, this is interpreted as evidence of a crisis-contingent transmission mechanism (i.e. contagion).

Using data on stock market prices and daily nominal interest rates from Indonesia, Malaysia, Thailand, Singapore, Korea, and Philippines, it is found that contagion was present in both interest rate and stock market indices.

The empirical test of the presence of contagion presented in chapter 2 basically relies on some a-priori knowledge about the source of the outliers that arise when the reduced form is estimated in the first stage of the procedure, whereas the change in the transmission mechanism is captured solely by the coefficient on a dummy variable. Recently, the use of the coefficients on the dummy variables as a way of measuring changes in the transmission mechanism of shocks has been the subject of criticism. It is argued in Caporale *et al.* [5] that the contagion should be modelled as a shift in the slope coefficient rather than an intercept shift. Moreover, as argued in Chapter 3, the dynamic interaction between the variables in the model suggested by Favero and Giavazzi [21] is effectively unchanged. Therefore, the use of the coefficient of a dummy variable as the way of measuring the transmission of international shocks may not be appropriate.

In a similar context, as argued in Forbes and Rigobon [53], it is important in the early stage (before testing for the presence of contagion) to identify specific transmission channels through which financial disturbances from one market can spread across countries. In the Forbes and Rigobon study, this is done by developing a structural model to take into account three main econometric issues : endogeneity, heteroskedasticity and omitted variables. However, their structural model comes with a very restricted feature. In particular, their model requires a few identification assumptions that can sometimes be implausible. This issue is addressed in Chapter 3 where a new approach is introduced in order to detect changes in a specific transmission mechanism (i.e. contagion). The advantage of the approach is that it does not require any potential implausible identifying assumptions and is entirely based on the data.

Chapter 3 of this thesis begins by showing how the presence of a cointegration relationship can be interpreted as a structural model between two financial markets whereas the error correction term is interpreted as the transmission mechanism of the disturbance. In turn, the changes in the transmission mechanism are a change in the error correction mechanism. Within this framework, evidence of cointegration is a necessary condition for the propagation of the shocks across countries. In practice, the approach is used to identify potential structural linkages between the financial markets under investigation. The presence of contagion is then detected by looking at the stability of the cointegrating relationship using the recursive eigenvalue method first suggested by Hansen and Johansen [33]. Using four datasets (daily stock market price indexes, daily interest rate data, money market rates and monthly deposits) for 6 Asian countries (Indonesia, Malaysia, Singapore, Thailand, Philippines, and Korea), the first step of this approach is to perform a unit root test in order to ensure that all of the series under investigation are non-stationary. The unit root test results presented in Chapter 3 indicate that the hypothesis of a unit root is not rejected at a 5 % significance level for any of the series. The second is to identify any structural relation in the series through Johansen test for cointegration for all possible pairs from the four different sets of information.

Based on the evidence of cointegration, Chapter 3 then proceeds to the main focus: for each pair of series found to be integrated, the recursive maximum eigen value is computed. The analysis based on the approach developed in Chapter 3 yields three interesting results. First, there is mixed evidence of pair-wise cointegration between the markets over most of the periods. Second, the results show considerable instability in the period shortly before and during the Asian crisis. Finally, while there are a number of important episodes during which the transmission changed substantially, it cannot explain the extent and severity of the crisis.

Chapters 2 and 3 are essentially concerned with the existence of contagion and how we should conduct tests for its presence but less attention is paid to the factors that drive contagion. Chapter 4 in the thesis, therefore, is aimed at addressing this issue. In particular, it examines which specific transmission channel is relatively more important in the transmission of financial shocks.

Theoretically, a negative shock can be transmitted across countries through a number of channels, such as, for example, trade linkages through bilateral trade and/or the role of third market, the similarity of macroeconomic fundamentals, sudden shifts in market expectations (financial linkages), and common shocks.

There are a number of studies analysing the importance of different transmission channels of the international shocks (Eichengreen, Rose, and Wyplosz [16], Glick and Rose [27], Kaminsky and Reinhart [39], Carramazza *et al.*[7], and Van Rijckeghem and Weder [54]. This literature generally concentrates on identifying the role of two different transmission channels of the shock : trade and financial links. In this case, the transmission of international shocks is measured in term of probability.

In order to identify which of these transmission channels are relatively important, most of the tests in these papers have used cross-country data and a probit/panel probit model where trade and financial indicators are treated as exogenous variables. The dependent variable takes values (i.e. 0 and 1) which reflect the probability that a country will suffer a crisis given that another country (ground zero) experiences a crisis. Under this approach, the relative importance of different transmission channels is tested by looking at the significance of the regression parameters of the trade and financial indicators (i.e. the significance of these variables in affecting the dependent variable). Thus, in principle, the researcher is able to estimate the relative influence of the determinants of financial crises.

In Eichengreen, Rose, and Wyplosz [16], data on a total of 20 industrialized countries are analysed using a probit model. Independent variables in their study are measures of fundamental variables such as the budget deficit, inflation, exports/imports, domestic credit growth, international reserves in both pre-crisis and crisis periods. Rejection of the null hypothesis that the trade variables do not affect the probability of the crisis after controlling for macroeconomic fundamentals is interpreted as indicating that the variable in question is important in driving the transmission of international shocks. Using this approach Eichengreen, Rose, and Wyplosz [16] study the collapse of the fixed exchange rate regime in European countries at the end of 1992. They find that shocks are transmitted across countries mainly though the trade channels.

Based on a similar framework, Glick and Rose [27] examine the pattern of trade data for five different crises: the 1971 Bretton Wood system collapse, the Smithsonian Agreement breakdown in 1973, the EMS crisis of 1992-93, the Mexican Crisis in 1994-5, and the 1997-8 East Asian Crisis. According to Glick and Rose [27], the currency crises that hit the EMS countries, Mexico, and Asia were largely regional phenomena. Their observations on of currency crises and the pattern of their trade data suggest that they are related. Once a country had suffered a speculative attack (Thailand in 1997, Mexico in 1994 and Finland in 1992 - for EMS crisis), its trading partners and competitors were disproportionately affected.

In the light of competitive devaluation theory [26], Glick and Rose hypothesise that it is likely that the trade channel played an important role in spreading the currency crises. Based on the probability approach, Glick and Rose use direct and indirect trade indicators to assess the possibility of one country suffering a speculative attack when another country is under attack. After taking account of macroeconomic fundamentals and financial imbalances that might lead to a currency crisis, the results of this study are quite striking. They find that there is strong evidence that currency crises tend to spread along regional lines. Their results also suggest that the incidence of speculative attacks across countries is linked to the importance of trade linkages (i.e. trade contagion). Cerra and Saxena [8] focus on estimating the conditional probabilities of crisis in Indonesia based on domestic economic fundamentals, common external shocks, or contagion from neighbouring countries, which is measured by the exchange rate pressure index from Thailand and Korea. The results of this study indicate that the inclusion of the exchange rate pressure index improves the transition probability of Indonesia's currency crises, suggesting that contagion was present.

In general, the results of these studies suggest that trade links are major sources of contagion. In the recent literature, Kaminsky and Reinhart [39] studied the Tequila crisis of 1994-95, the Asian flu of 1997, and the Russian Cold of 1998 and examined four different channels through which shocks can be transmitted across borders during these periods. They classify the channels into two groups. The first group deals with the linkages among financial markets, namely, liquidity channels, mutual funds, and cross-market hedging. The second group deals with trade in goods and services. The results of their study showed that the trade and financial channels were linked in most of the countries studied. In the Asian crisis case, the forecasting performance of the likelihood of the crisis based on the financial sector link is greater than the improvement gained from trade links. The conclusion of this study also highlighted the role of common creditors of the Asian country crises (i.e. Japanese and US banks) in propagating international disturbances. Caramaza et al. [7] investigate the transmission channel of currency crises in Mexico, Asia and Russia by constructing a variable called common lender used for measuring a country's vulnerability to crises. After controlling for macroeconomic fundamentals and trade linkages, the financial linkage is always significant. They also test whether the effect of these variables on the crisis/non-crisis borrowing countries is different. The result of this study shows that countries experiencing a crisis relied more on bank lending for funding than non-crisis countries.

Van Rijckeghem and Weder [54] developed a new indicator that measured competition for bank funds. The result of the study shows that the extent of fund competition is more robust than the trade linkage after controlling for fundamental macroeconomic variables. In the case of Asia, however, which transmission channel is more responsible for the crisis is difficult to detect, since both variables are highly correlated.

While there is little agreement on which factors are more important in driving financial crises, it is argued in this thesis that, in the Asian crisis case, it is very likely that the spread of international disturbances during the East Asian crisis was caused by both trade and the financial channels simultaneously, with Japan and US acting as the main partners. However, one of these channels might have been more important than the other. In this case, applying cross section regression analysis and treating trade and financial variables as exogenous variables does not capture the magnitude of the joint dynamic relationship which may exist between them. Furthermore, if the trade and financial indicators appear to be highly correlated, it is difficult to distinguish which channel is more importance (see, e.g. Van Rijckeghem and Weder [54], Kaminsky and Reinhart [41])

Chapter 4, therefore, tests the relative important of the transmission channels in the transmission of financial shocks. The approach is based on time series data. In doing this, four variables, namely, direct (indirect) bilateral trade, interest rates and exchange rates are analysed within a cointegrated VAR framework. The empirical analysis is conducted using the Johansen method of cointegration. Within this framework, the relatively more important transmission channel is determined by observing its response to disequilibrium. If financial variables play a significant role in transmitting the shocks, they should not be weakly exogenous in the cointegrated system. The rejection of the null hypothesis of weak exogeneity would be suggestive that the variable under examination is important in channelling shocks.

Using data for six East Asian countries (Indonesia, Malaysia, Singapore, Thailand, Korea, and the Philippines) and their major trading partners (US and Japan) as well as their trading partners in the same region, the results presented in Chapter 4 show that in the vast majority of cases the trade and financial variables are cointegrated. In most cointegrated cases, the exchange rate, interest rate differentials, bilateral trade and indirect trade indicators, are not weakly exogenous. The empirical findings suggest that both trade and financial variables did play a fundamental role in the propagation of the East Asian Crisis.

Chapter 4 also investigates the causal relationship among set of the trade and the financial variables. In causality tests between financial and trade variables among countries within the Asian region, the results of this study indicate that there is little evidence of two-way causality between trade and financial variables. The results also indicate that less than 50 percent of all possible pairs analysed in Chapter 4 appear to have one direction causality from trade to finance or vice versa.

Chapter 2

Transmission of Financial Shocks in the Asian crisis: empirical evidence of contagion

2.1 Introduction

The recent episode of financial crisis that hit a number of countries in East Asia in 1997-98 was characterised by a massive movement in exchange rates, capital flows, stock prices and other financial asset prices. One of the most distinctive features of the Asian crisis was the speed of transmission to other countries. In the recent policy-based discussion on this issue, it has been suggested that capital mobility has gone too far, creating a highly unstable international financial system.

It is often argued that with increased integration of the global economic and financial system, the effect of transmission of international disturbances appears to be stronger in a country where the domestic market is integrated with world capital markets. As a result, a country will be more vulnerable to shocks. If *contagion* exists, designing an appropriate policy will help the country to manage a crisis since international shocks are frequently disruptive.

Contagion is a relatively new concept and has been defined in various ways in the empirical economic literature. In a very broad meaning, contagion is said to be present when a financial shock originating in one market (country) then spreads to other markets (countries). It may also be the case that the nature of interdependence between markets changes in times of crisis. In the recent literature, identifying the existence of such a crisis transmission mechanism has been the subject of central and lively debate (See : Forbes and Rigobon [24] [25], Caporale *et al.* [5]).

In this chapter, we use data from a group of Southeast Asian countries (Indonesia, Thailand, Singapore, Malaysia, the Philippines, and Korea) to investigate such *contagion* that has been at the center of recent debates on the international financial system[1]. We address this issue by using a variant of a 'contagion test' that has been suggested in the recent literature (Favero and Giavazzi [21]), to identify whether a crisis causes changes in the transmission mechanism in stock market returns and interest rates. A particular attractive feature of the approach we use is that it allows us to include countries afflicted by the crisis in the structural model. It is also argued that the approach is well suited for the case where the period of crisis is short. We find that the transmission mechanism generally changes in the period of financial crisis. Our empirical findings suggest that contagion was present.

The chapter is organized as follows. Section 2.1 is the introduction. In Section 2.2 we discuss the data used in the analysis and their properties. In Section 2.3,

[1] See:Fischer [22]. See also the World Bank Web Site in Contagion of Financial Crises(2000) at http://www1.worldbank.org/economicpolicy/managing20volatility/contagion/.

we provide a brief review of the methodological discussions on detecting contagion. The outline of the methodology used in the chapter to detect contagion in our five countries is presented in Section 2.4. Section 2.5 contains the results of the empirical test. Finally, Section 2.6 is the conclusion of this chapter.

2.2 Theories Explaining Contagion

Contagion has become an important concept in the economics literature. There are numerous theories with a wide range of views seeking to explain the existence of contagion in financial markets. Among these popular theories are: the theory of herd behaviour, the country evaluation or 'wake-up call' theory, multiple equilibria, and endogenous liquidity theory.

The herd theory emphasizes investor behaviour in financial markets. According to this view contagion occurs because of the existence of incomplete or asymmetric information in financial markets. Calvo [3] developed a model characterised by the existence of asymmetric information, or a situation in which investors have different abilities to gather information in financial markets. As a result, investors have different knowledge regarding returns on investment in one country. The market participants who lack information about the market will tend to follow other informed market participants. As a consequence of this, the markets will be vulnerable to panic, rumours and fads, and investors may often behave irrationally. A shock in one country can result in a large and unexpected swing in financial variables (i.e. stock market price, interest rate, and exchange rate) even in emerging countries with healthy fundamentals. Kodres and Pritsker [44] also explain that volatility in asset prices from one market or country can spread to elsewhere and sometimes be more intense in the market with asymmetric information than in a market with full information about its fundamentals.

In the 'wake-up call ' theory, contagion occurs when investors reevaluate their portfolio model in emerging countries (Goldstein, Kaminsky and Reinhart [28]). In this case, a crisis in one country allows investors to reevaluate their model of emerging countries. One focus of this literature is on the assessment of macroeconomic fundamentals. When new information (such as a weak banking sector) is included, it is possible that the revised forecast suggests that one country is vulnerable. A variant of this theory developed by Chang and Majnoni [9] argues that contagion emerges only if a crisis in one country leads international investors rationally to update beliefs about fundamentals in other countries. A country is more vulnerable to contagion if its fundamentals, in particular its financial position, are weak. Given a country's experience of financial crises the contagiousness of a crisis depends on the amount of information it releases. If information is sufficient for investors, then they can discern whether the crisis is caused by fundamentals or beliefs, a fundamentals-driven crisis is more contagious than a beliefs-driven crisis, and is more contagious than when information is less complete.

A model of multiple equilibria is developed in Masson [47]. This theory explains how the change in expectations of market participants in one country can cause markets in emerging economies to shift from good to bad equilibria. This will result in a large drop in the value of financial variables such as stock market prices and exchange rates.

Finally, the liquidity theory says that contagion occurs because international investors in one country face problems in financing their projects after the country is hit by a financial crisis. As described in Valdes [61], in this case a rational international investor will seek liquidity to satisfy regulatory requirements. If they cannot find cash in one country, they will seek a solution in a second country by readjusting their portfolios. Selling a substantial asset in the second country will result in a sharp decline in asset prices in the second country. The theory predicts that an increase in the degree of illiquidity from a particular country (measured by the probability of repayment) will increase the probability of illiquidity in a second country. All of the theories discussed above suggest that the behaviour of financial variables will be different in periods of financial crisis as compared with tranquil periods.

2.3 Methodological Issues

As a new concept, financial contagion does not have an established definition in the economic literature. As a consequence of this, the perception, definition, and the way to conduct tests of contagion vary across studies [2]. At the empirical level, there are at least three distinct methods suggested in the literature to identify contagion, namely : the correlation between asset prices in two or more financial centers, the conditional probability that a crisis occurs in a country (financial centre), and a change in volatility.

[2] An extensive discussion addressing this issue can be found in Pritsker [50], Forbes and Rigobon [23].

Since the correlation coefficient approach is widely used in the empirical literature, in this paper we concentrate on this approach. In particular, in the first part of this section we provide a summary of the recent discussion addressing the use of correlation coefficients (King and Wadhwani [43]) as a measure of contagion similar to structural models developed by Forbes and Rigobon [23], Corsetti *et al.* [12], and Caporale *et al.* [5]). The next section will outline the approach adopted in this study.

2.3.1 The Correlation Coefficient Approach for Testing Contagion.

The correlation coefficients approach has been used to test the presence of financial contagion in the empirical literature in various contexts (see: King and Wadhwani [43], Hamao,Y *et al.* [32], Lee, S.B and Kim.,K.J [55], Calvo, S and C.M Reinhart [4], Baig and Goldfajn [1], among others). Comparing cross-country correlations calculated from sub-samples is the feature of the technique. Evaluation based on this approach reveals that if the conditional correlation coefficients between two markets increase significantly after a shock to one country (confirmed by conditional correlation test), this would suggest that contagion has occurred. In fact, most investigations under this approach find that contagion occurred in the market under examination.

In more recent literature, however, Forbes and Rigobon [25] have argued that the detection of contagion under such criteria will be misleading, particularly in a market exhibiting heteroskedasticity. With heteroskedasticity, there will be a bias toward a higher correlation during a period of turmoil. Unconditional correlation is always increasing as the volatility in asset prices increases even though the *actual correlation (cross-market linkages)* between two markets does not change. As a result, the use of this test could incorrectly lead to the conclusion that contagion exists. The effect of the bias on the actual correlation can be explained in the following simple model:

$$y_t = \beta x_t + \gamma Z_t + \varepsilon_t \tag{2.1}$$

$$x_t = \alpha y_t + Z_t + \eta_t \tag{2.2}$$

where x represents the foreign market, y represents the national market, and ε_t and η_t are stochastic country-specific shocks. Forbes and Rigobon [25] assume that $\alpha = 0$, i.e., there is no feedback from the domestic market to the foreign market, and $Z_t = 0$, i.e., there is no global shock in the financial markets. Forbes and Rigobon [25] showed that during a period of market turbulence in which markets tend to experience high fluctuations, the correlation coefficient always increases even though the cross market linkage (β) in the period of the crisis does not change compared to the period of tranquility. This is because the country-specific shocks (i.e. ε_t) exhibit heteroskedasticity. Therefore, the parameter stability test based on conditional correlation suffers from heteroskedasticity bias. Forbes and Rigobon [25] provided a solution to this problem and developed a heteroskedasticity-robust parameter stability test on the correlation coefficient which is a revised version of the normal correlation that had been commonly used in the previous studies.

Forbes and Rigobon analysed the performance of the proposed tests by comparing the results of the two tests (conditional and unconditional correlation tests) estimated from the same data, namely, daily data for stock market prices of up to 36 developed and emerging countries. The results of this study is very interesting. In the tests based on the conditional correlation coefficient, they found that about 50% of the sample during the Asian and US crash, and 20 % of the sample during the Mexican crisis indicate that the cross-market correlation had significantly increased (i.e. contagion was present). When the same tests are based on the unconditional correlation coefficient, this study found that in most cases correlation was relatively stable (i.e. contagion was not present). Thus, Forbes and Rigobon [25] argue that detection of contagion should focus on the stability of cross-market linkage rather than just using a plain correlation coefficient.

The effect of a shock to one country (or group of countries) on the stability of cross-market linkages is a central issue in the Forbes and Rigobon's approach. Forbes and Rigobon [24] also argue that in countries that are historically correlated (in trade and or finance) or closely integrated into global financial markets, the volatility of asset prices and other financial variables could be the result of simultaneous changes in economic fundamentals, risk perception, and preferences of market participants. The volatility in asset prices arising from global or local factors are normally transmitted internationally. The effect of country specific or global shocks could be more intensive because of their linkages. As a result, to isolate the effect of one shock on the stability of the cross market linkages is difficult. In this case, Forbes and Rigobon [24] argue that the parameter stability test for detecting the presence of contagion is not only affected by heteroskedasticity bias, but also endogeneity bias.

Rigobon [53] developed a test for the stability of the structural parameter by assuming $\alpha, \beta \neq 0$ i.e. the market exhibits both heteroskedasticity and endogeneity in its variables. As a result, the stability of the test is affected not only by heteroskedasticity but also by endogeneity of the variables under investigation. To solve this problem, he proposes building a test using two variance-covariance matrices. The idea is to examine whether the observed increase in the covariance between the two markets can be attributed to a change in the relationship between them or to an increase in the variance of one of them within the same framework of inter-market-relationships. Building upon the conventional framework of a simultaneous equation model, Rigobon solves the problem of distinguishing between contagion or plain interdependence by estimating the structural parameters via instrumental variable methods. The term interdependence denotes the existence of strong linkages between two economies in all states of the world. The test for contagion then boils down to a Hausman-type specification test of instrument validity [34]. The changes in the transmission (as measured by the coefficient of instrumental variable estimators) after shocks to one country suggests that contagion is present.

In the empirical part of the Rigobon's study, the author analyzed pairs of observations for 36 countries using daily data on stock market returns covering the period from January 1993 to December 1998. A crisis window in their study is arbitrarily determined. Given the tranquil and crisis windows, the two instrumental variables estimators are computed. The test is thus to determine if the two estimators are statistically the same. Finding that the two estimators are statistically different during tranquil and the stable periods is then interpreted as evidence of contagion. The results of this study show that the pair-wise transmission mechanism during crisis time and tranquil periods for the 36 countries is relatively stable. In the Asian crisis, the study finds that in less than 15 percent of possible pairs of observations did the parameters change, suggesting that no contagion was present.

In the recent literature, Rigobon's approach has been criticized by several researchers. Caporale *et al.* [5] argue that the assumption of ($\alpha = 0$) is not appropriate for capturing the reality of the crisis, especially in the case of the Asian crisis. Dungey and Martin [15] pointed out that the power of rejection of the test proposed by Forbes and Rigobon is low. They also argue that the arbitrary choice of the window of crisis in Forbes and Rigobon's study can be seen as undesirable since it affects the inference of the test. In response to these criticisms, Caporale *et al.* [5] provide a solution to this problem by estimating a full sample and by endogenizing the choice of crisis windows. Applying their methodology to data on stock markets for eight East Asian countries (Indonesia, Singapore, Philippines, South Korea, Malaysia, Taiwan, Hong Kong, and Thailand), they find that contagion was present.

It is clear that the Rigobon and Caporale approaches have a number of advantages compared to the simple conditional correlation test. Nevertheless, it should be noted that the tests for the existence of contagion using the approaches reviewed above are based on only two markets. It is often argued that the Asian crisis differs from previous crises in several key respects. One of the most distinctive features of the Asian crisis is the speed of transmission to many countries. Thus, the use of the framework suggested by Forbes and Rigobon and its variants which rely on only two markets may not fully capture all the characteristics of the crisis.

The present study provides additional evidence of contagion in the East Asian crisis based on another variant of the 'contagion test' that has been suggested in the recent literature (Favero and Giavazzi [21]), to identify whether there exists a change in the transmission mechanism in stock market returns and interest rates.

It is argued that the technique has a number of potential advantages compared to the one proposed in the Forbes and Rigobon study. In particular, the procedure allows countries affected by the crisis to be included in the structural model. Moreover, the approach is well suited to the case when the period of crisis is short. The remainder of this section outlines the Favero and Giavazzi approach.

2.3.2 The Favero and Giavazzi Approach

The framework suggested by Favero and Giavazzi (FG) includes the following steps: first, estimate an unrestricted VAR for the market under investigation. This step is meant to identify the channel through which shocks are normally transmitted. A set of dummies may be introduced in the structural model to solve heteroskedasticity or normality of the residual resulting from the first step regression. The second step is to identify the outliers based on an a-priori knowledge, i.e. each outlier is earmarked as originating in one particular country or as a common shock. The final step is to test for the presence of financial contagion, namely, if the dummies that are associated with idiosyncratic shocks are also significant in markets other than the one they originated in, this is interpreted as presence of contagion.

For simplicity, let R_1, R_2, and R_3 be the interest rates of countries 1, 2, and 3. One of these countries is assumed to act as 'core' in the system. Suppose that the core is country 1, so that $S_{21} = (R_2 - R_1)$, $S_{31} = (R_3 - R_1)$ represent the interest rate differentials of country 2 and 3 with respect to country 1.

A reduced form of the system which describes a conditional distribution of a joint process generating the return of S_{21} and S_{31} can be expressed by the following :

$$\begin{pmatrix} S_{21,t} \\ S_{31,t} \end{pmatrix} = \begin{pmatrix} \pi_{11} & \pi_{12} \\ \pi_{21} & \pi_{22} \end{pmatrix} \begin{pmatrix} S_{21,t\text{-}1} \\ S_{31,t\text{-}1} \end{pmatrix} + \begin{pmatrix} u_{1,t} \\ u_{2,t} \end{pmatrix} \tag{2.3}$$

$$\left[\begin{matrix} u_{1t} \\ u_{2t} \end{matrix} \mid I_{t-1} \right] \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_{1t} & \sigma^2_{12,t} \\ \sigma^2_{21,t} & \sigma^2_2 \end{pmatrix} \right]$$

According to FG, since the sample observations include the period of market turbulence, it is very likely that the residuals of the structural interdependence will exhibit heteroskedasticity and non-normality. However, using standard tests (i.e. normality and heteroskedasticity), the problem can be easily detected. Favero and Giavazzi argued that in the model described above (i.e. equation 2.3), the residuals that suffer from heteroskedasticity problem can be eliminated by introducing a set of dummies, d, in the system. Re-specifying equation (2.3) after introducing the set of dummies, the model is given by

$$\begin{pmatrix} S_{21,t} \\ S_{31,t} \end{pmatrix} = \begin{pmatrix} \pi_{11} & \pi_{12} \\ \pi_{21} & \pi_{22} \end{pmatrix} \begin{pmatrix} S_{21,t-1} \\ S_{31,t-1} \end{pmatrix} + B^{-1} \begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix} \tag{2.4}$$

where

$$\begin{pmatrix} \epsilon_{1,t} \\ \epsilon_{2,t} \end{pmatrix} = \left(I + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} d_{1t} & 0 \\ 0 & d_{2t} \end{pmatrix} \right) \begin{pmatrix} \epsilon^{l}_{1t} \\ \epsilon^{l}_{2t} \end{pmatrix} \tag{2.5}$$

and

$$\left(\begin{matrix} \epsilon^{l}_{1t} \\ \epsilon^{l}_{2t} \end{matrix} \mid I_{t-1} \right) \tilde{} N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_1 & \sigma^2_{12} \\ \sigma^2_{21} & \sigma^2_2 \end{pmatrix} \right] \tag{2.6}$$

where $\epsilon_{1,t}$, $\epsilon_{2,t}$ are the structural shocks which exhibit heteroskedasticity and non-normality. **d** is the vector of dummies capturing the market turmoil that occurred in country 1 or country 2[3]. We use this methodology in our analysis, and results are reported in Tables 2.12-2.2.14 and Tables 2.21-2.23. B is a matrix defining the contemporaneous feedback of the variables included in the model ($S_{21,t}$, $S_{31,t}$ and $S_{21,t-1}$, $S_{31,t-1}$). $\epsilon^{l}_{1t}, ..., \epsilon^{l}_{2t}$ are white noise disturbances. A is a 2x2 matrix containing

[3] For illustration, suppose that the evidence of the speculative attack on Thailand's currency on 15 July 1997 can be captured by two dummies, namely, $d_{1t=15/7/1997}$ and $d_{2t=15/7/1997}$. In this case, $d_{1t=15/7/1997}$ and $d_{2t=15/7/1997}$ denote dummies capturing the market turmoil that occurred on 15 July 1997 in country 1 and in country 2, respectively. Within this framework, therefore, the value of the dummies are constructed as follow: In country 1, $d_{1t=15/7/1997} = 1$ for 15 July 1997 and $d_{1t=15/7/1997} = 0$, otherwise. For country 2, $d_{2t=15/7/1997} = 1$ for 15 July 1997 and $d_{2t=15/7/1997} = 0$, otherwise.

the coefficients on the dummies. FG interpret the coefficients in the A matrix as measuring the propagation of financial shocks across markets (countries)[4].

FG argue that the block diagonal of the A matrix defines the extent to which the normal structural shocks get amplified within markets. The block diagonal of the A matrix allows for non-linearities in the propagation of shocks across countries. A modification of the coefficients in the A matrix during a period of market turbulence indicates that a change in the transmission of the shock occurred. Therefore, the A matrix has become the focus of this approach. The test for the absence of non-linearity of coefficient in the A matrix is given by

$$\text{Ho:} \quad a_{ij} = 0, \text{ for each } i \neq j.$$

In performing the non-linearity test of the transmission of a financial disturbance, however, we need to identify the parameter of structural interdependence (i.e. the B matrix). According to Favero and Giavazzi [21], imposing the own lagged dependent variable and restricting the lag structure in each equation, a condition of just-identification of the structural interdependence is met. The model is given by :

$$\begin{pmatrix} 1 & -\beta_{12} \\ -\beta_{21} & 1 \end{pmatrix} \begin{pmatrix} S_{21,t} \\ S_{31,t} \end{pmatrix} = \begin{pmatrix} \gamma_{11} & 0 \\ 0 & \gamma_{22} \end{pmatrix} \begin{pmatrix} S_{21,t-1} \\ S_{31,t-1} \end{pmatrix} +$$

$$\left(I + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} d_{1t} & 0 \\ 0 & d_{2t} \end{pmatrix} \begin{pmatrix} \epsilon^l_{1t} \\ \epsilon^l_{2t} \end{pmatrix} \right) \tag{2.7}$$

[4]In a recent study, Caporale *et al.* [5] criticised this interpretation. They argued that contagion should refer to the change in the parameters of structural interdependence rather than the change in the intercept. Chapter 3 of this thesis extends this approach where changes in the transmission mechanisms are captured by a change in the error-correction mechanism.

with $u_t = \left[\begin{matrix} \epsilon_{1t} \\ \epsilon_{2t} \end{matrix} \mid \Phi_{t-1} \right] \sim \left[N \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2_{\epsilon 1} & 0 \\ 0 & \sigma^2_{\epsilon 2} \end{pmatrix} \right]$

Where β_{12} and β_{21} are the parameters of the structural interdependence between the two markets. The vector of parameters a_{12} and a_{21}, the coefficients of the dummy variables, allow for non-linearities. $\gamma_{12} = \gamma_{21} = 0$ is the imposed restriction on the structural interdependence (i.e. equation (2.7)) to ensure that the just identification condition is met[5].

The final step is to perform a test for contagion. Within this framework, contagion happens when either $a_{12} \neq 0$ and $a_{21} \neq 0$. The presence of contagion then can be tested by applying a Hausman test [34].

2.4 Empirical Results

2.4.1 Preliminary Data Analysis

The data used in this study consists of time series of daily composite stock market indexes and daily observations on monthly nominal deposit interest rates for Indonesia, Malaysia, Singapore, Thailand, Korea and the Philippines. Since there is no information on the precise date at which the Asian crisis actually began, the data periods in this study are chosen to encompass all possible starting points. We begin by looking at the volatility in both of the series during the Asian crisis in 1997. Due to limitations on the the availability of the data for both of the series, we use different time periods for stock market and daily interest rates. The data periods capture all

[5]This arbitrary zero exclusion on the lags to achieve identification has been the subject of criticism (see: Caporale G, *et al.* [5]).

possible dates of the Asian crisis. For stock market indexes, the sample covers the period from 15 January 1996 to 31 December 1999. For daily interest rates, the data cover the period from 1 January 1995 to 31 December 1998. The data were extracted from Datastream International. A detailed description of the data on interest rates can be found in Table 2.29 (Appendix).

The daily observations have several advantages. First, they provide enough observation for estimation so that any problem with degrees of freedom can be minimized. Second, in fact, the evidence of market turbulence in Asia occured in a short period of time so that the use of daily observation data should be able to capture the magnitude of the crisis.

Figure 2.1 shows the plots on the daily interest rate data for Indonesia, Malaysia, Philippines, Thailand, and Singapore. Visually, the interest rate tends to increase in all countries. The interest rate increased dramatically in Indonesia after 16 April 1998, peaking at 64 % in 13-19 October 1998. It has fallen sharply since then. Officially, the Asian crisis began on 14 July 1997 when the Thai Baht was allowed to float. In general, there was a dramatic increase in all countries in the region around 1997, i.e. the period of crisis.

Table 2.1 provides some stylized evidence on the behaviour of nominal daily interest rates in these countries in the pre-crisis and crisis period. The Table displays for each country the mean, standard deviation, minimum and maximum of daily interest rate. As can be seen from the Table, in most countries except Korea, the average interest rates increased dramatically in the period of crisis compared to the

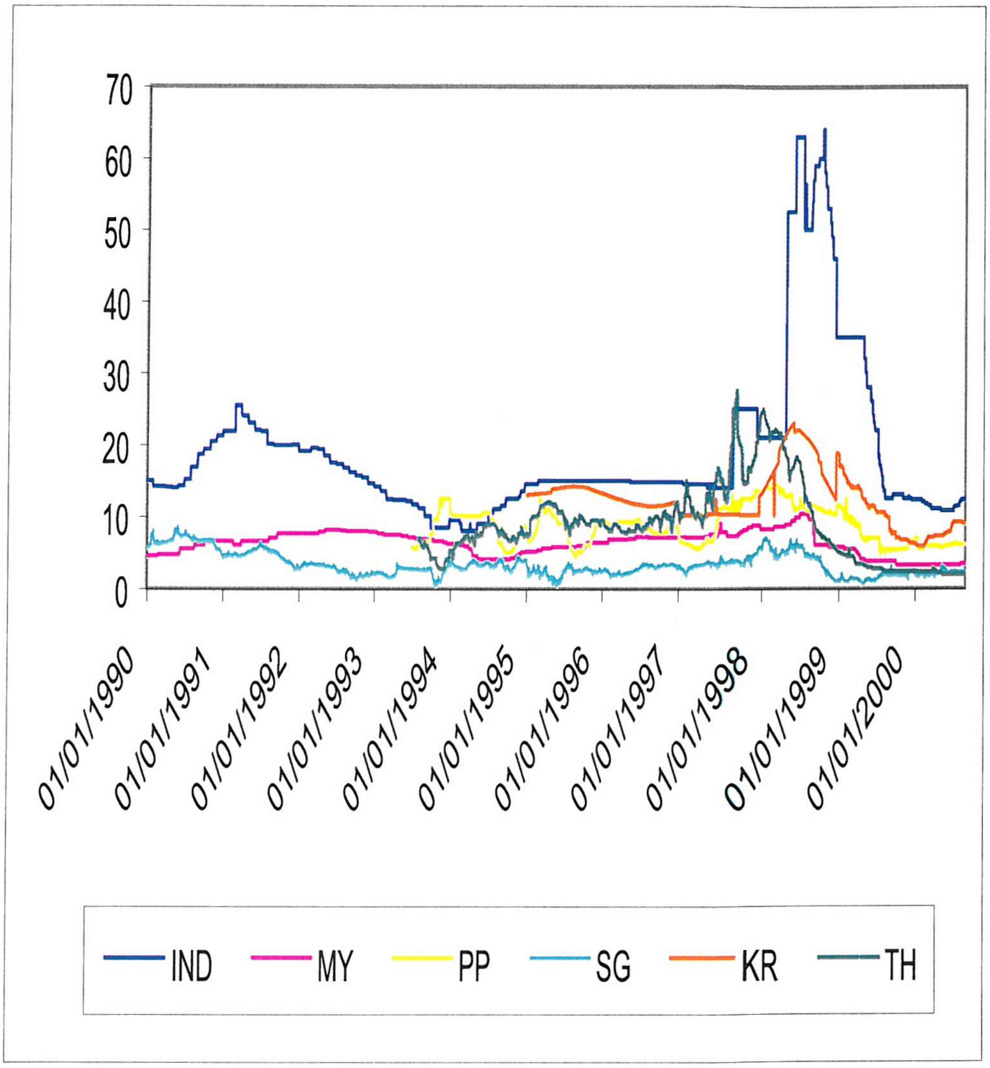


Figure 2.1: Daily Nominal Interest Rate in the 6 Asian countries

	Pre-Crisis 1/1/1996-14/7/1997						Crisis 15/7/1997-30/11/1998						
Country	Mean	Std	Min	Max	Skew	Kurt	Mean	Std	Min	Max	Skew	Kurt	%Δ (mean)
Malaysia	7.03	0.227	6.4	7.6	-0.306	-1.330	8.1681	1.260	5.7	10.3	0.25	-1.41	16.1
Singapore	2.83	0.539	1.56	3.75	-0.641	0.291	4.558	1.259	1.5	7.0	0.73	-0.23	61.0
Thailand	9.76	1.732	7.75	16.75	0.599	-0.505	16.301	5.497	6	27.5	0.16	-1.19	67.0
Indonesia	14.72	0.219	14	15	-1.011	-0.067	36.285	17.82	14	64	0.26	6.53	246.5
Philippines	7.86	1.245	5.5	9.5	-0.464	0.182	12.108	1.260	10	14.25	-0.32	10.76	54.0
Korea	11.35	0.932	10.06	13.23	2.079	0.314	7.653	2.27	4.81	21.5	1.67	-1.31	-32.6
Average	8.92	0.815	7.54	10.97	0.042	-0.185	14.17	4.89	7.01	24.09	0.46	2.19	58.96

Table 2.1: Daily Nominal Interest Rate (in percent): summary statistics

	Pre-Crisis 1/1/1996-31/12/1997						Crisis 1/1/1997-25/05/1998					
Country	Mean	Std	Min	Max	Skew	Kurt	Mean	Std	Min	Max	Skew	Kurt
Malaysia	0.06	0.78	-3.17	2.26	-0.52	2.04	-0.21	2.57	-11.74	20.82	0.62	14.90
Singapore	0.01	0.81	-4.35	2.25	-0.40	1.94	-0.13	1.91	-9.67	14.87	0.98	7.68
Thailand	0.01	1.30	-6.18	4.76	0.64	3.86	-0.23	2.40	-10.03	11.35	0.95	2.75
Indonesia	0.05	0.94	-4.24	2.95	-0.49	2.03	-0.10	2.51	-12.73	13.13	0.60	3.11
Philippines	0.05	0.95	-3.80	2.62	0.38	6.10	-0.11	1.99	-9.74	9.67	0.17	2.43
Korea	-0.11	1.16	-3.11	4.38	0.14	0.65	-0.19	2.71	-11.60	9.71	0.25	1.13
Average	0.01	0.99	-4.97	3.20	-0.40	2.77	-0.16	2.34	-10.91	13.23	0.60	5.33

Table 2.2: Stock Market Returns (in local currency): summary statistics

pre-crisis period. The increase (in percent) ranges from a relatively low 16.1 percent in Malaysia and to a high of 246.5 percent in Indonesia. Overall, the average of interest rates in these countries increased by around 60 percent in the period.

Figure 2.2 shows the plots of the composite stock market prices in the Southeast Asian countries. Visual inspection suggests that the behaviour of the series seems to change dramatically in the period of the East Asian crisis in 1997-98.

Table 2.2 summarises daily stock market returns in the pre-crisis and crisis period for the same countries. The stock market returns are computed by using the formula $ln\left[\frac{Pt}{P_{t-1}}\right]$ where P_t is the value of the stock market index at time t. The stock

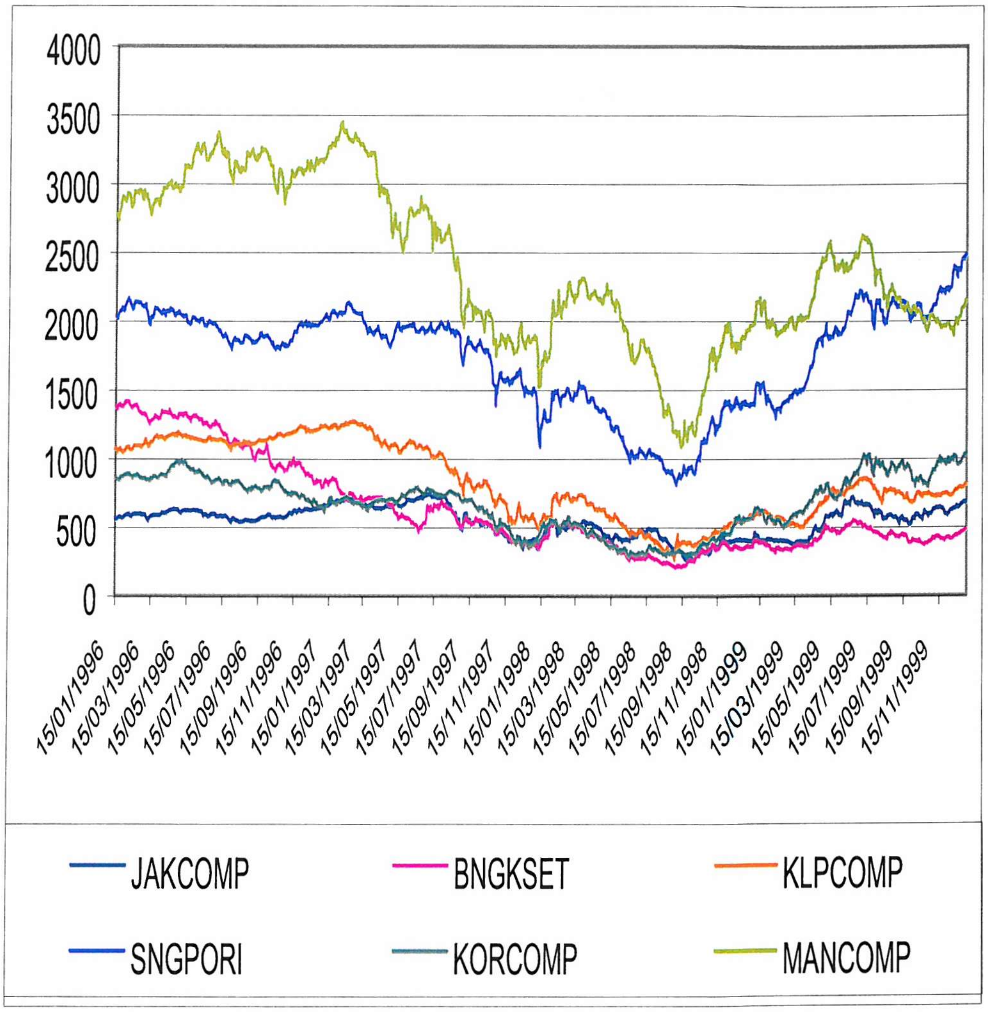


Figure 2.2: Daily Stock Market Index in the 6 Asian-countries

market indices used in our sample are : Jakarta Composite Index (Indonesia), Kuala Lumpur Index(Malaysia), Stock Exchange of Singapore All Index (Singapore), Korea Composite Index (Korea), the Stock Exchange of Thailand index (Thailand). It can be seen from Table 2.2 that the average of the stock market returns in all markets are still positive about 0.01 percent per day in the pre-crisis period, except for Korea, while in the period of crisis the average the stock market returns is negative at -0.16 per cent per day. All of these features would appear to offer some preliminary support for the hypothesis of the existence of contagion according to our definition.

Stationarity of the data

In order to examine the properties of the series, we perform both unit root tests and tests for cointegration among variables. The first test is to investigate whether our series are stationary and, if not to what is their order of integration. In the literature, there are a number of procedures with different properties which can be used to test for the presence of unit roots in the data[6]. It has been argued that the traditional unit root test (i.e. Dickey and Fuller [14]) appears to be of low power. However, since the test of the presence of contagion adopted in the study is not affected by the stationary of the variables under consideration, the issue of the power of the unit root test may be less important in our study. For simplicity, therefore, we use the unit root test as suggested by Dickey and Fuller [14].

[6] see, for example, Phillips and Perron [48], Dickey and Fuller [14]), Kwiatkowski *et al.* [45], Elliot *et al.* [17]. The discussion of the properties of these tests can found in elsewhere (see:, e.g. Masih and Masih [46]).

The test is generated from the following regression :

$$\Delta y_t = \alpha + \gamma y_{t-1} + \Sigma_{i=1}^{p} \theta \Delta y_{1-i} + \varepsilon_t \tag{2.8}$$

Where p is the additional lag to warrant that the error term ε_t is white noise. We are testing the null hypothesis $Ho : \gamma = 0$ (a unit root present, we have non-stationary series) against the alternative hypothesis , $H_a : \gamma < 0$(there is no unit root present, we have stationarity). The Dickey-Fuller test statistic is the ratio of $\widehat{\gamma}$ to its standard error obtained from OLS regression. This is a one-tailed test, so we reject the null if the test statistic(s) are outside (smaller/more negative than) the critical value calculated by Dickey-Fuller [14]. To decide which model is best (plain DF as above, or with p lags), we look for the (first) peak value of the AIC/SBC statistic. The tests were conducted on the level and on the first-differenced series. The results of tests estimated from daily interest rate and stock market index are presented in Table 2.3-2.4 and 2.5-2.6, respectively.

The results in Table 2.3-2.4 and 2.5-2.6 show that we generally cannot reject the null hypothesis of a unit root being present, with and without a trend in all of the countries (Thailand, Philippines, Malaysia, Singapore, Indonesia, and Korea). So we conclude that the daily series on interest rate data and stock market index are not stationary. In the case of the first difference of these series, however, the test statistic, with and without trend, lies clearly in the rejection region (see Table

Country	Level					
Sample Periods :	1/1/95-31/12/98	LagOrder* (p)	95% CV	ADF statistic	AIC	SBC
Thailand	DF reg. with no trend	1(0)	-2.8648	-89090	-363.4988	-368.4371
	DF reg. with trend	1(0)	-3.4165	-.16222	-363.2224	-370.6299
Philippines	DF reg. with no trend	3(12)	-2.8648	-1.8066	-36.0085	-70.5765
	DF reg. with trend	3(12)	-3.4165	-2.0491	-36.5158	-73.5530
Malaysia	DF reg. with no trend	1(0)	-2.8648	-1.6545	843.1279	832.6031
	DF reg. with trend	1(0)	-3.4165	-.69177	842.4797	835.7205
Singapore	DF reg. with no trend	12(2)	-2.8648	-1.5158	291.1760	257.5183
	DF reg. with trend	12 (5)	-3.4165	-.99920	291.0024	254.0664
Indonesia	DF reg. with no trend	12	-2.8648	-1.3718	-1738.7	1773.3
	DF reg. with trend	12	-3.4165	-2.1305	-1738.3	-1775.4
Korea	DF reg. with no trend	4	-2.8647	-.84914	-428.0	-440.4
	DF reg. with trend	4	-3.4165	-1.2798	-428.19	-443.0
** Based on AIC and SBC. (...) indicates a number of lag length chosen from SBC						

Table 2.3: DF and ADF test results for Daily Interest Rate (in level)

Country	First-differenced					
Sample Periods :	1/1/95-31/12/98	LagOrder (p)	95% CV	ADF statistic	AIC	SBC
Thailand	DF reg. with no trend	12	-2.8648	-7.1967	-295.8740	-330.4352
	DF reg. with trend	12	-3.4165	-7.2588	-296.4158	-333.4456
Philippines	DF reg. with no trend	12	-2.84648	-8.1236	-37.9203	-72.4815
	DF reg. with trend	12	-3.4165	-8.1212	-38.9077	-75.9376
Malaysia	DF reg. with no trend	0	-2.8648	-32.0702	841.4379	836.5006
	DF reg. with trend	0	-3.4165	-32.1471	841.923	834.5179
Singapore	DF reg. with no trend	12	-2.8648	-9.7634	294.1179	259.5567
	DF reg. with trend	12	-3.4165	-9.8516	294.0130	256.9831
Indonesia	DF reg. with no trend	12	-2.8648	-8.4722	-1738.5	-1773.0
	DF reg. with trend	12	-3.4165	-8.4690	-1739.5	-1776.5
Korea	DF reg. with no trend	12	-2.8648	-6.5822	-436.0	-470.5
	DF reg. with trend	12	-3.4165	-6.6112	-436.5	-473.5
** Based on AIC and SBC. (...) indicates a number of lag length chosen from SBC						

Table 2.4: DF and ADF test results for Daily Interest Rate (in first difference)

Country	Level					
Sample Periods :	15/1/95-31/12/99	LagOrder* (p)	95% CV	ADF statistic	AIC	SBC
Thailand(BNGKSET)	DF reg. with no trend	2(1)	-2.8647	-1.9046	-4062.7	-4070.2
	DF reg. with trend	3(1)	-3.4165	-.62564	-4063.7	-4073.6
Philippine(MANCOMP)	DF reg. with no trend	2(1)	-2.8647	-1.1531	-5224.3	-5233.7
	DF reg. with trend	12*	-3.4165	-1.7168	-5224.5	-5236.2
Malaysia(KLPCOMP)	DF reg. with no trend	5(4)	-2.8647	-.99940	-4256.8	-4272.1
	DF reg. with trend	6(3)	-3.4165	-.84394	-4257.3	-4276.1
Singapore(SINGPORI)	DF reg. with no trend	5(1)	-2.8647	-.37941	-4834.0	-4842.8
	DF reg. with trend	5(1)	-3.4165	.10464	-4833.4	-4845.0
Indonesia(JAKCOMP)	DF reg. with no trend	10(9)	-2.8647	-1.5227	-3903.3	-3933.0
	DF reg. with trend	10(9)	-3.4165	-1.4262	-3904.3	-3936.4
Korea(KORCOMP)	DF reg. with no trend	5(1)	-2.8647	-.71740	-4271.1	-4277.4
	DF reg. with trend	6(2)	-3.4165	-.21042	-4269.8	-4282.4
* Based on AIC and SBC. (...) indicates a number of lag length chosen from SBC						

Table 2.5: DF and ADF test results for Daily Stock Market Index (in level)

Country	First-differenced					
Sample Periods :	15/1/95-31/12/99	LagOrder* (p)	95% CV	ADF statistic	AIC	SBC
Thailand(BNGKSET)	DF reg. with no trend	3(1)	-19.9900	-2.8647	-4064.6	-4071.0
	DF reg. with trend	3(3)	-17.8299	-3.4165	-4062.9	-4075.3
Philippine(MANCOMP)	DF reg. with no trend	2(1)	-2.8647	-21.9116	-5224.0	-5231.4
	DF reg. with trend	2(1)	-3.4165	-21.9012	-5225.0	-5234.4
Malaysia(KLPCOMP)	DF reg. with no trend	5(1)	-2.8647	-13.6849	-4255.8	-4264.2
	DF reg. with trend	5(1)	-3.4165	-13.6900	-4256.6	-4267.6
Singapore(SINGPORI)	DF reg. with no trend	1(1)	-2.8647	-26.9589	-4834.5	-4839.5
	DF reg. with trend	3(1)	-3.4165	-16.1638	-4832.4	-4841.6
Indonesia(JAKCOMP)	DF reg. with no trend	10(2)	-2.8647	-8.6645	-3902.8	-3909.4
	DF reg. with trend	12(1)	-3.4165	-7.4611	-3900.0	-3912.7
Korea(KORCOMP)	DF reg. with no trend	1(1)	-2.8647	-22.1203	-4269.4	-4274.3
	DF reg. with trend	1(1)	-3.4165	-22.2322	-4269.1	-4276.0
* Based on AIC and SBC. (...) indicates a number of lag length chosen from SBC						

Table 2.6: DF and ADF test results for Daily Stock Market Index (in first difference)

2.2). Therefore, we can reject the null hypothesis in favour of the alternative hypothesis that there are no unit roots present, and conclude that all the daily interest rate series and stock market index are 1^{st} difference stationary, or integrated of order 1 (or $I(1)$). As all the series appear to be $I(1)$, the test for cointegration may thus be considered for all the series. We investigate whether two (or more) series are cointegrated. For this purpose, we conducted a cointegration test in both bivariate and multivariate frameworks. We present first the bivariate cointegration between the daily interest rate (stock market price) of each of the 6 Asian countries vs Thailand. Three alternative bivariate cointegration tests are applied, namely : Augmented Dickey-Fuller (ADF), Error Correction Model, and Johansen Maximum Likelihood-Ratio test. In the multivariate setup, we only use the Johansen test for cointegration.

Cointegration Analysis:

Augmented Dickey-Fuller Test

The unit root test for residuals calculated from a static regression can be used to determine if two variables are cointegrated. If individual series are non-stationary (and integrated of order (1)), but their error term (residuals) produces a stationary series, the series are cointegrated of order (1,1). Because the previous results from each of individual interest rate series indicate that they are $I(1)$, the next step is to estimate a static bivariate regression in the form :

$$R_{t,i} = \beta_0 + \beta_1 R_{t,Thailand} + \varepsilon_i$$

	ADF		ECM	
Country	Lag Order(p)	ADF TestStatistic	Lag Order(p)	T_{ECM}Statistic
Philippines	1	1.18227	1	-2.535[0.01]**
Indonesia	2	-1734.8	12	1.4507[0.25]
Malaysia	8	-2.8906	1	3.2286[0.00]**
Singapore	6	-3.4108*	6	-3.3797[0.01]**
Korea	5	-1.356	5	1.3457[0.36]
Sample periods : 1 January 1995 -31 December 1998				

Table 2.7: Unit Root Test for Residual of Static Regression for Daily Interest Rate

We specify the Thailand interest rate as the independent variable in each regression. This is primarily due to the fact that the Asian crisis officially started in Thailand. As we have five interest rate variables, there will be four static bivariate regressions to be estimated. In practice, we saved the residuals from the static regressions as *(egres)* and performed a Augmented Dickey-Fuller test on these residuals. More specifically, the test is generated from the following regression :

$$\Delta\widehat{\varepsilon} = \alpha + \phi\widehat{\varepsilon}_{t-1} + \sum_{i=1}^{n} \delta_{i+1}\Delta\widehat{\varepsilon}_{1-i} + \nu_t \qquad (2.9)$$

Results for the ADF test of the residuals from static regression estimated from daily interest and stock market index are presented in the second column of Table 2.7 and Table 2-8, respectively. In the case of daily interest rates, the result of these tests indicates that the hypothesis of the presence of a unit root cannot be rejected except for Singapore, while the hypothesis of the presence of a unit root in the stock market index cannot be rejected in all of the possible pairs. For cointegration we have to be able to reject the null hypothesis of a unit root - the test statistic must be higher than the critical value.

	ADF		ECM	
Country	Lag Order(p)	ADF TestStatistic	Lag Order(p)	T_{ECM}Statistic
Philippines	6	-1.6863	3	-1.8441[.066]
Indonesia	10	-1.3608	12	-1.4143 [.158]
Malaysia	2	-1.2107	1	-1.3332[.183]
Singapore	7	-.43062	6	-1.4127[.158]
Korea	2	-1.5186	8	-1.2202[.223]
Sample periods : 1 January 1996 -31 December 1999				

Table 2.8: Unit Root Test for Residual of Static Regression for Stock Market Index

Error Correction Model

Engle and Granger [19] propose a straightforward test of whether two I(1) variables are cointegrated of order $CI(1,1)$. The first step is to estimate the long-run relationship. We save the residual from static regression. We have done this step in the previous analysis. Next we do the second stage (of the Engle-Granger 2 step method) regression- the dynamic ECM. This involves regressing 1st differenced variables with as many lags as are required, and incorporating the lagged residual from the static regression. The estimate of the coefficient on the lagged residual tell us how much of the disequilibrium is corrected in any one period. The t-statistic for this coefficient gives us the t_{ECM}.

To estimate the ECM involves estimating and testing different possible models: first, we began with twelve lags on each differenced variable (because we have a large number of observations). This ECM has no problem of serial correlation, although it still has a non-normality problem. The coefficient estimate for the lagged residual from the static regression represents the speed of adjustment which has important implications for the dynamics of the system. It is known as the Error Correction

Term (ECT). Evidence that the series are cointegrated implies the existence of an underlying relationship. If we have a set of cointegrated variables, an ECT can express the relationship between them.

In our case, the coefficient of the lagged residual (i.e. *egres*) should be significantly different from zero if both interest rates are cointegrated. As shown in the fourth column of Table 2.7, the coefficient of the lagged residual is significantly different from zero except for Indonesia. Therefore, we conclude that daily interest rates in Thailand and Singapore, Thailand and Malaysia, and Thailand and in the Philippines are cointegrated. In terms of an economic relationship, we can interpret cointegration more intuitively, namely, there exists an equilibrium relationship between the time series variables that we are examining here. Moreover, the ECM can express the relationship between them. An error correction mechanism is a systematic disequilibrium adjustment process, through which daily interest rates in Thailand and Singapore, in Thailand and Malaysia, and in Thailand and Philippines are prevented from drifting too far apart. The estimate for the lagged residual from the static regression tells us how much of the disequilibrium is corrected in any one period. In the case of the stock market index, the results show that none of the coefficients of the lagged residuals are significant different from zero. We conclude that stock market indexes in the countries under investigation are not cointegrated.

Johansen Test for Cointegration

Even though the EG test for cointegration is easily implemented, the researcher needs to have prior knowledge to identify a dependent variable. This requirement

Countries: Thailand, Indonesia, Singapore, Malaysia,Phillipines, and Korea			
Max.EigenValue Test		Trace Test	
Hypothesis	Test Statistic	Hypothesis	Test Statistic
$H_o : r = 0$	54.5830*	$H_o : r = 0$	119.4220 *
$H_o : r \leq 1$	25.4102	$H_0 : r \leq 1$	64.8391
$H_o : r \leq 2$	19.2057	$H_o : r \leq 2$	39.4289
$H_o : r \leq 3$	13.2427	$H_o : r \leq 3$	20.2232
$H_o : r \leq 4$	5.6299	$H_o : r \leq 4$	6.9805
$H_o : r \leq 5$	1.3506	$H_o : r \leq 5$	1.3506
*, ** denotes significance at the 1%, 5%, respectively			

Table 2.9: Multivariate Cointegration Testing Results for Daily Interest Rate

is often viewed as an undesirable feature of the EG test since the test for cointegration should be invariant to the choice of the variable selected for normalization (Enders [18]). Problems arise in the implementation of the cointegration test based on the residuals because of efficiency and contradictory results, especially when there are more than two I(1) series under consideration. Since we have more than two variables, we therefore use the Johansen test for cointegration. Johansen's methodology provides a consistent maximum likelihood estimate of the whole cointegration matrix. We are testing to find the rank, that is the number of stationary components. Table 2.9 presents summaries of Johansen test result of the series we have. A long lag length is required to ensure white noise disturbance, and is selected using test statistics and choice criteria (AIC and SBC).

As can be seen in Table 2.9, for daily interest rates, the test result based on the maximum eigenvalue statistic and the trace statistic indicates that the hypothesis of zero cointegrating vectors ($H_0 : r = 0$), against the alternative of one or more cointegrating vector, is rejected. The hypothesis of at most one cointegrating vector

Countries: Thailand, Indonesia, Singapore, Malaysia, Philippine, and Korea			
Max.EigenValue Test		Trace Test	
Hypothesis	Test Statistic	Hypothesis	Test Statistic
$H_o : r = 0$	22.9393	$H_o : r = 0$	74.6141
$H_o : r \leq 1$	18.6924	$H_0 : r \leq 1$	51.6748
$H_o : r \leq 2$	17.4184	$H_o : r \leq 2$	32.9824
$H_o : r \leq 3$	7.6779	$H_o : r \leq 3$	15.5641
$H_o : r \leq 4$	5.8428	$H_o : r \leq 4$	7.8861
$H_o : r \leq 5$	2.0433	$H_o : r \leq 5$	2.0433
*,** denotes significance at the 1%, 5%, respectively			

Table 2.10: Multivariate Cointegration Testing Results for Stock Market Index

$(H_0 : r \leq 1)$ for this set of variables is not rejected.

The Johansen test result based on data from stock market index is presented in Table 2.10. The results show that both the maximum eigenvalue statistic and trace statistic do not reject any of the null hypotheses. This results suggest that the stock market index is not cointegrated.

2.4.2 Testing of Changes in the Transmission Channel

The next and most crucial investigation is to examine the transmission of economic disturbances in the market under investigation. Following FG, we construct two indicators: the interest rate differential and stock market returns. We calculate both the interest rate and stock markets return differentials in each country relative to Thailand. For the interest rate differential, we obtain five series, namely, S_IDTH, S_MYTH, S_KRTH, S_SGTH, S_PPTH where S_IDTH, S_MYTH, S_KRTH, S_SGTH, S_PPTH are the interest rate differentials between Indonesia and Thailand, Malaysia and Thailand, Korea and Thailand, Singapore and Thailand, and

Philippine and Thailand, respectively.

As stated earlier, we need to estimate a structural model of financial interdependence before examining the presence of non-linearity (i.e contagion). We start by estimating a first order VAR and plotting its residuals. Figures 2.3-2.4 and 2.9-2.6 plot the residuals estimated from interest rate and stock market data, respectively. We notice from the figures that there appears to be very high volatility around the end period of the sample in both interest rate and stock market indices. Visual inspection suggests that the residuals suffer from heteroskedasticity. We confirm this suspicion by looking at the vector heterokedasticity and non-normality tests. We then need to 'whiten' the residuals by introducing a set of dummy variables into the equations. As described in the methodology, instead of 'whitening' the residual, we need to introduce a set of dummies in the reduced form in order to identify the transmission of the shock during the period of market turmoil. In doing this, we construct dummy variables which are defined as 'a large residual' with absolute value 4 times larger than the estimated standard deviation. From here, we obtain 53 and 54 dummies from daily interest rate and stock markets, respectively.

We focus on these dummies in the further step. The coefficients of the dummies are measuring the propagation of shocks from one country to others. Using qualitative information (i.e. a piece of relevant news which is associated with market turbulence) collected from news and reports, we associate each of the dummies and classify them arbitrarily into two groups: global shocks and local shocks. A global shock is a shock which emanates from policies in developed countries. Naturally, these shocks affect over all developing countries to a greater or lesser extent (Masson [47]). A local shock is a shock resulting from policy or events from a developing country which affects only one country. For example, the shock that occurred in 19-20 June 1997 was associated with the resignation of Annuay Viravan, Thailand's finance minister who supported the peg system. We classify this as a country-specific shock. However, another example, the shock which occurred on 5 January 1998 in which US and German banks agreed to help Korea manage its short term debt, is classified as a global shock since it was a result of policy from developed/industrial countries.

Interest Rate

Table 2.11 (page 59) presents the results of the first order of the reduced form (Equation 2.4) which includes all the dummies estimated from daily interest rates. We present the dummies of equations in Tables 2.12-2.14 (page 60-62). The first column of Tables 2.12-2.14 indicates the date when the shocks associated with the dummies occur. Columns 3-7 indicate all coefficients in the A matrix that allow us to test if they change during a period of market turbulence. In particular, coefficients in the A matrix which are associated with country-specific shocks.

It can be seen from the Tables that a number of local shocks are statistically significant in more than one country. For example, the coefficient of the dummy associated with a local shock that occurred on 18 August 1997 (which is when Indonesia abolished its system of managing the exchange rate through a band and allowed it to float) is also significant in Singapore and Malaysia. According the approach adopted in this study, however, the evidence of country-specific shocks are significant in more than one country does not necessarily indicate contagion, since it could be the result of spurious correlation. In order to test if the significant change in coefficient in the A matrix can be classified as the evidence of contagion, we need to identify the structural model interdependence.

Before we move to identify the structural model interdependence, we note from Table 2.11 (first panel) that only a few coefficients of the lagged variables of the reduced form model of 6 Asian countries interest rate differential (i.e.R^{Ind}_{t-1}, R^{Sng}_{t-1}, R^{Kor}_{t-1}, R^{Mal}_{t-1}, R^{Mal}_{t-1}, R^{Phi}_{t-1}) are significantly different from zero. For example, in the equation of reduced form of the interest rate for Korea (i.e. third row in the Table 2.11), the R^{Sng}_{t-1} is the only lagged variable whose coefficient is not significantly different from zero. We also note that majority of dummies coefficient of the reduced form interest rate differential (presented in Table 2.12) are significantly different from zero. In the case of Indonesia, however, the coefficients of the dummies of the reduced form for this country (which is presented in the third column of Table 2.12-14) are not significantly different from zero except for dummies number 34 and 53.

Following the methodology described in Section 2.3.2, we proceed this by restricting zero on all of the contemporaneous effects (Table 2.11) and all their dummies (Table 2.12) that are not significantly different from zero. The model was then re-estimated using full information maximum likelihood.

Tables 2.15-2.19 (page 63-67) are the result of the application of zero restrictions on all contemporaneous effects and all dummies that are not significantly different from zero.

As can be seen from Table 2.15-2.19 (column 3-7), 71 percent (25 of 35) of the dummies coefficients associated with local shocks are significant in more than one country. These findings suggest that the transmission of financial disturbances in the market under investigation is generally modified by local shocks. We classify all these events as financial contagion. The results also show that not all of the dummies associated with global shocks are significantly rejected in each country in our structural model. It can be argued that the coefficients on dummies associated with global shocks can be interpreted as a measure of vulnerability in terms of how sensitive a country (market), say Malaysia, is with respect to global shocks. Interestingly, we find only 15 percent (3 of 19) of the coefficients of the dummies classified as global shocks are significant in all countries.

Stock Market

In principle, contagion could be different depending on the indicator under study. Table 2.20-2.23 (page 68-71) and Table 2.24-28 (page 71-75) present results corresponding to those in Table 2.12-2.14, but estimated from daily stock market returns. As can be seem from the tables, 77 percent (28 of 36) of the coefficient of the dummies associated with country specific shocks are significantly different from zero in more than one country. According to the framework discussed in Section 2.3.2, contagion is said to be present when the coefficients in the A matrix (i.e. coefficients on the dummies associated with country-specific shocks) change during a period of market turbulence. We therefore conclude that contagion was present in the stock market data. We also noted that contagion appears to be more frequent in the stock market data than in the interest rate data.

The results from Tables 2.24-2.28 also show that vulnerability with respect to global shocks seems different in every market. Interestingly, the effect of these global shocks is stronger in interest data than stock market data. For example, the effect of the global shock that occurred on 28 August 1997 (which was a result of a leading international firm's threat to pull back from Thailand in response to capital controls imposed by the government) is only significant in the Philippines. By contrast, in the results based on interest rate data, the effects of this global shock are significant in Singapore, Korea, Malaysia,and the Philippines. There is no single explanation for this finding. One potential explanation for this result is the existence of a difference in the degree of asymmetric information between the money market and the stock market as predicted in the theoretical literature (e.g. Kodres and Pritsker [44]).

2.5 Conclusion

This chapter provides additional evidence on contagion by examining the transmission of financial disturbances in the financial markets of six Asian countries (Indonesia, Malaysia, Philippines, Singapore,Thailand, and Korea). Daily data on stock market indices and nominal interest rate were used to measure the change in the transmission of international shocks during the East Asian crisis 1997-98. The data analysis in this study shows that all of the series are not stationary. They are first differenced stationary. Generally, the series are not cointegrated.

Following the methodology suggested by Favero and Giavazzi [21], the results show that the transmission mechanism of the financial shock in both of the series changed during the period of crisis. We interpret this as indicating that contagion was present in both interest rate and stock market data. Our empirical results have also shown that given the sample period that we use in this study, vulnerability with respect to the global shocks differs across the country under examination. Overall, the empirical findings seem to support the conclusion that has been reported in a number of empirical studies (Baig and Goldfajn [1], Caporale *et.al* [5]) that contagion was present.

2.6 Section Two Tables

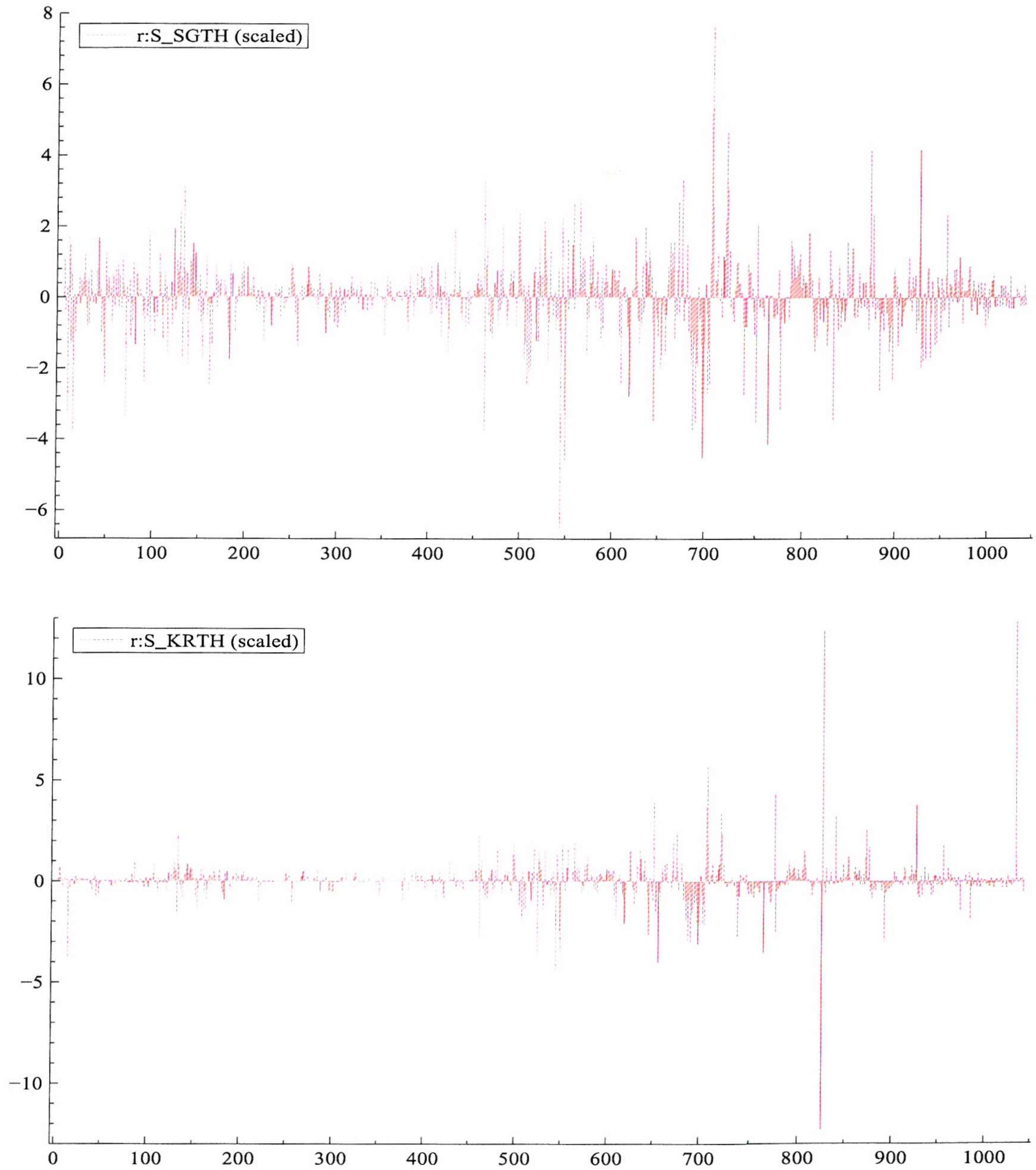


Figure 2.3: Residual from the reduced form for Daily interest rates

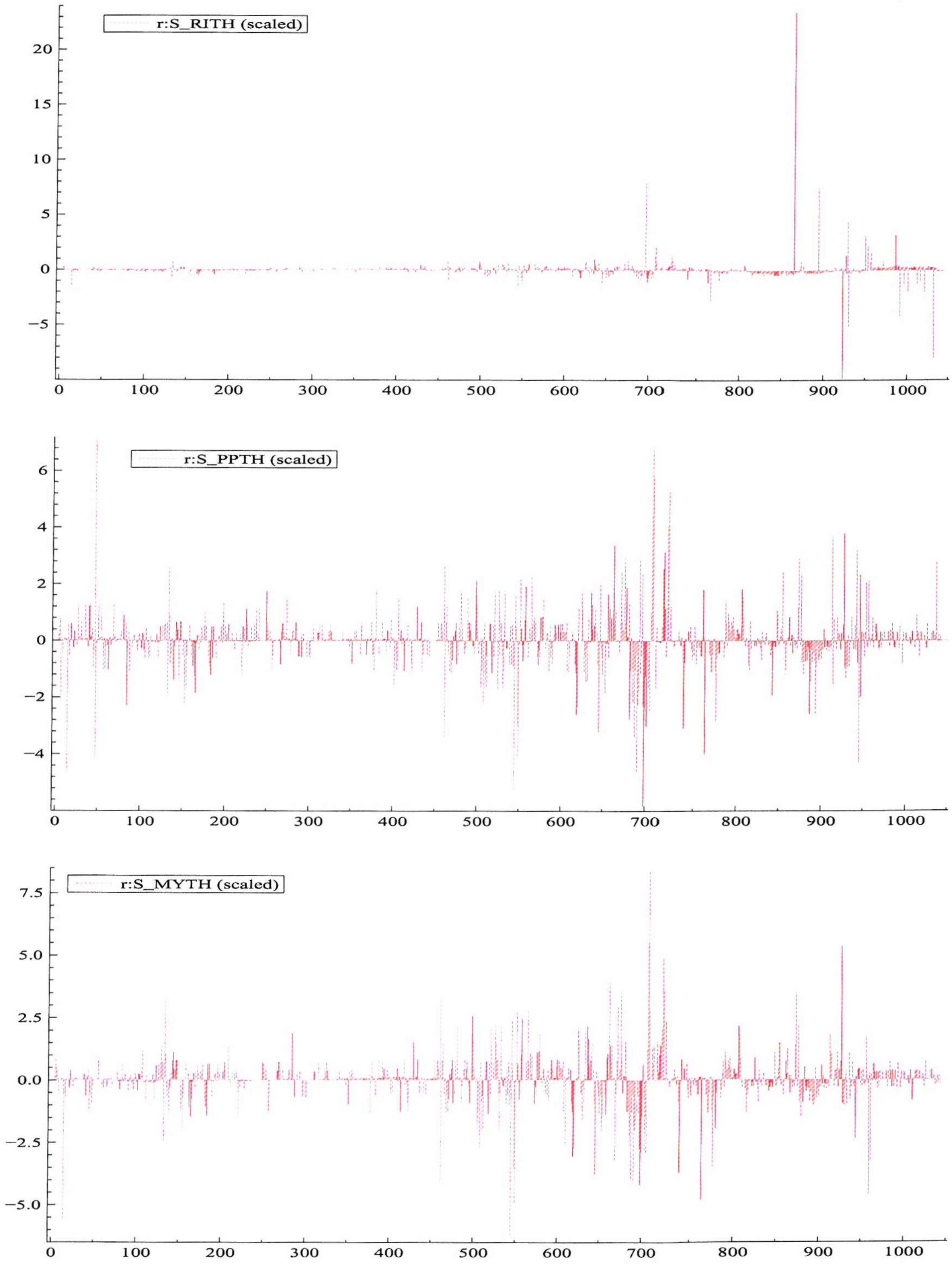


Figure 2.4: Residual from the reduced form for Daily interest rates (continued)

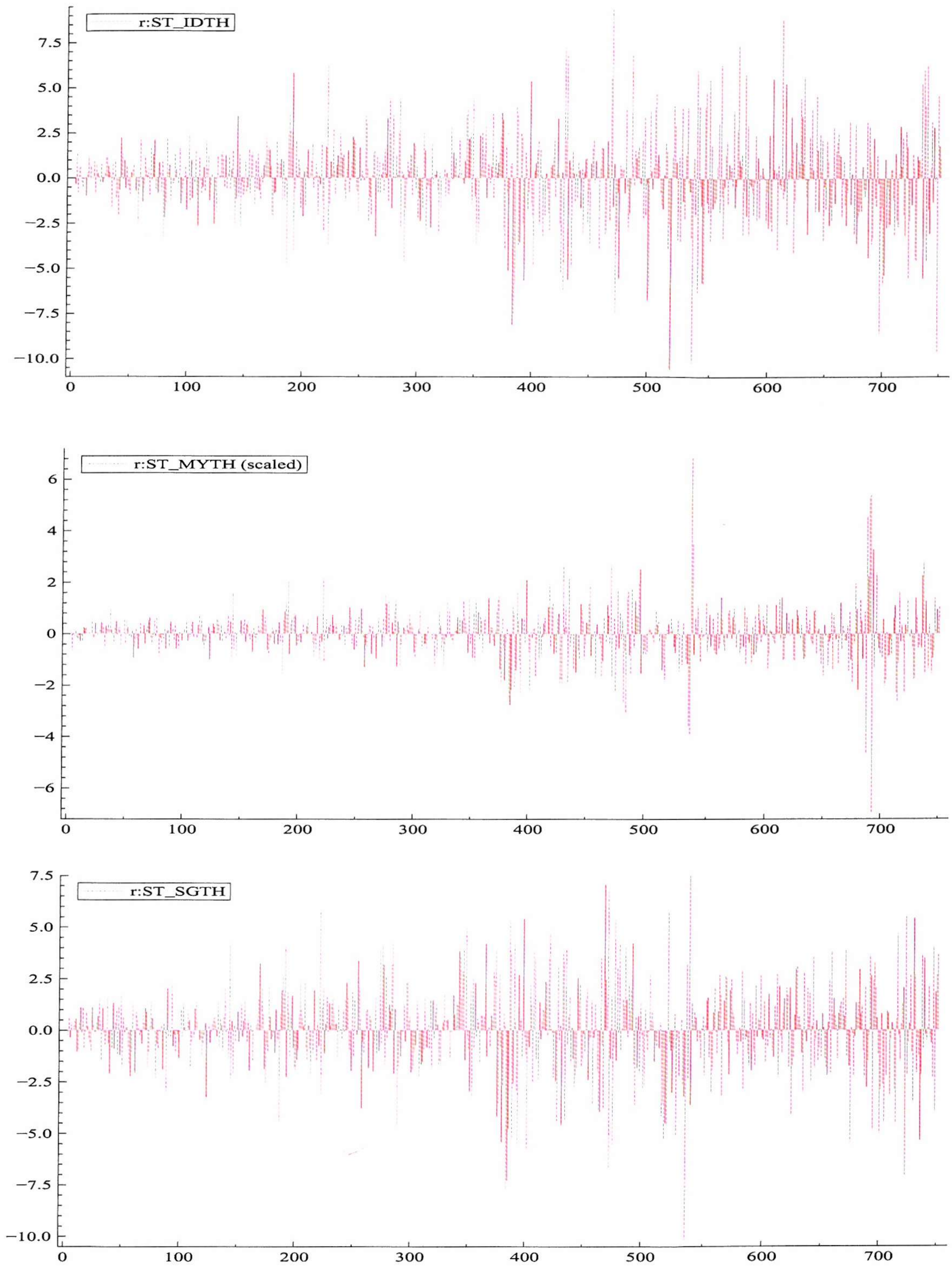
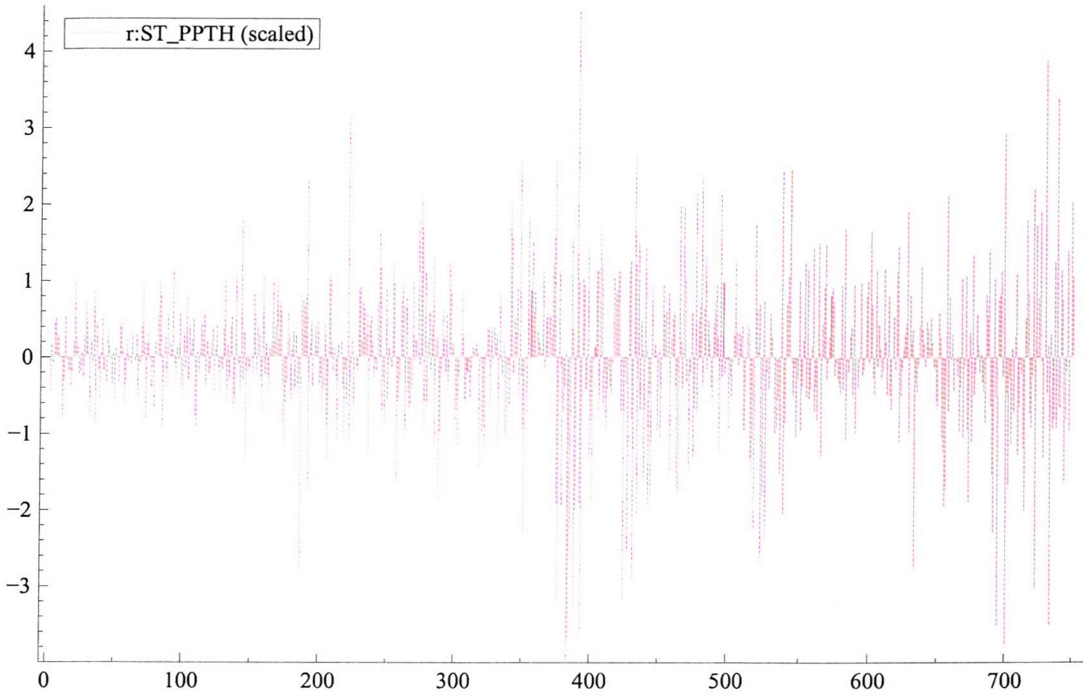


Figure 2.5: Residual from the reduced form for Stock Market Index



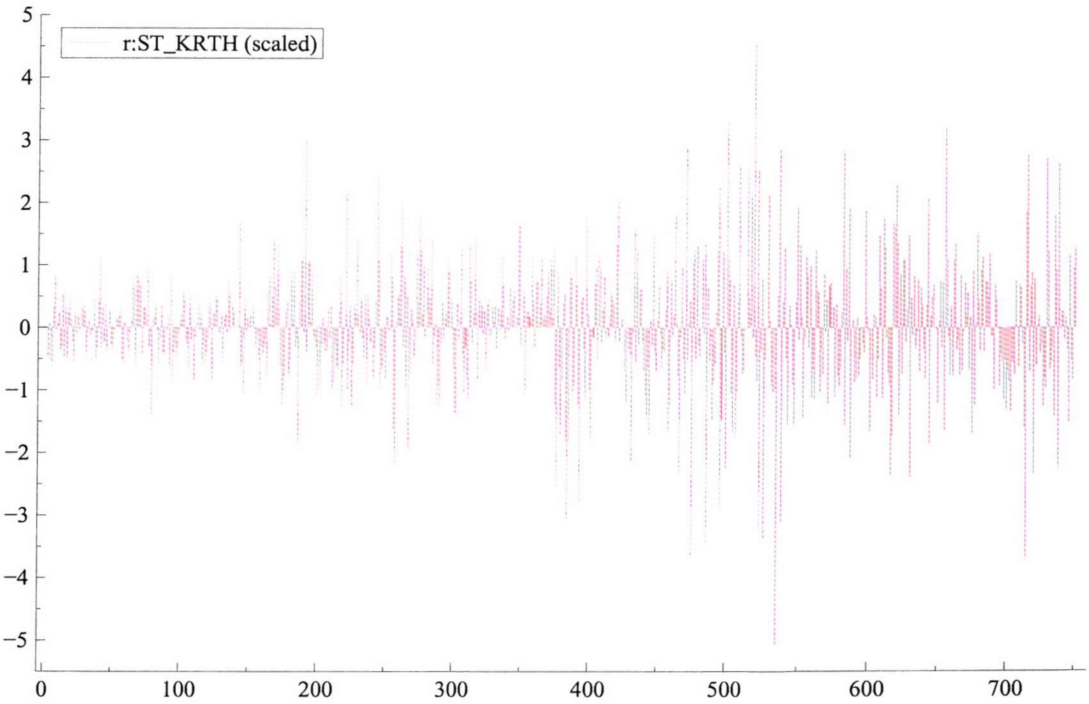


Figure 2.6: Residual from the reduced form for Stock Market Index (continued)

VariableDependent.	Constant	R^{Ind}_{t-1}	ER^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}	1.8765[0.00]	0.996[0.00]**	0.0198[0.74]	-0.0319[0.46]	-0.00584[0.80]	0.00506[0.89]
R^{Sgn}	0.07686[0.87.]	0.000356[0.56]	0.975[. 0.00]	0.0118[0.13]	0.14[.2032]	-0.00204[0.67]
R^{Kor}	154325[0.77]	0.00230[0.03]*	-0.00589[0.76]	0.975[0.00]**	0.0386[0.00]**	-0.00927[0.29]
R^{Mal}_{t-1}	1.564[.65]	0.00145[0.00]**	0.00645[.0.49]	-0.00849 [0.21]	1.00[0.00]**	-0.00406[0.33]
R^{Phi}_{t-1}	1.3565[.632]	. 0.00115[.132]	0.00253[.2332]	0.000822[.002]*	0.00721[.1032]	0.983[.002]*
Testing for vector autocorretion of residuals (lag 1-9) : F-form (32, 3778)= 0.876[0.736]						
Testing for vector Heteroschedasticity of the residuals : F-form F(1170,13002)= 8.17[0.321]						
Standard deviations and correlation matrix of URF residuals :						
	σ	R^{Ind}_{t-1}	R^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}_{t-1}	0.31	1	.45	0.23	0.33	0.43
R^{Sgn}_{t-1}	0.26	0.45	1	0.36	0.39	0.37
R^{Kor}_{t-1}	0.55	0.23	0.35	1	0.57	0.56
R^{Mal}_{t-1}	0.46	0.33	0,39	0.47	1	0.44
ER^{Phi}_{t-1}	0.24	0.43	0.37	0.56	0.44	1

Table 2.11: Reduced form model of 6 Asian-countries interest rate differentials

Dummies Variable		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}
07/10/1996	1	1.085[0.42]	1.24[0.00]**	0.943 [0.03]	1.11 [0.00]**	1.10 [0.00]**
08/10/1996	2	-1.52[0.26]	-1.50 [0.00]**	-1.55 [0.00]**	-1.51[0.00]**	-1.51 [0.00]**
31/10/1996	3	-1.04 [0.44]	-0.999 [0.00]**	-1.16[0.00]**	-1.00 [0.00]**	-1.00 [0.00]**
Global	International Bank have agreed to roll over of Korea short term debt					
06/02/1997	5	-1.31 [0.33]	-1.22 [0.00]**	-1.31 [0.00]**	-1.26 [0.00]**	-1.30 [0.00]**
07/02/1997	6	-1.84 [0.17]	-1.78 [0.00]**	-1.81 [0.00]**	-1.76 [0.00]**	-1.80 [0.00]**
11/02/1997	7	0.876 [0.51]	0.642 [0.00]**	0.871 [0.04]	0.979 [0.00]**	0.935 [0.00]**
19/02/1997	8	0.777 [0.56]	1.02 [0.00]**	0.815 [0.06]	0.856[0.00]**	0.815 [0.00]**
28/02/1997	9	0.921 [0.49]	1.03[0.00]**]	0.881 [0.04]	0.980 [0.00]**	0.940 [0.00]**
02/05/1997	10	-1.02 [0.45]	-1.00 [0.00]**	-1.05 [0.01]	-1.01 [0.00]**	-0.549 [0.00]**
15/05/1997	11	-1.17 [0.38]	-1.14[0.00]**	-1.17[0.00]**	-1.14 [0.00]**	-1.17 [0.00]**
16/05/1997	12	-1.07 [0.43]	-1.01 [0.00]**	-0.674 [0.12]	-1.01[0.00]**	-1.05 [0.00]**
20/06/1997	13	-1.92 [0.15]	-1.39[0.00]**	-1.54[0.00]**	-1.39[0.00]**	-1.42 [0.00]**
Local	Amnuay Viravan resigns as Thailand's finance minister					
23/06/1997	14	-0.950 [0.48]	-1.39 [0.00]**	-1.67 [0.00]**	-1.39[0.00]**	-1.43 [0.00]**
15/07/1997	15	-0.148 [0.91]	-0.0385 [0.87]	0.0394 [0.92]	1.39 [0.00]**	0.476 [0.14]
Local	*Thailand's currency is under attacked by speculators,* Thai central bank suspends operation of 16 cash strapped finance company					
24/07/1997	16	-0.126 [0.92]	-0.0324 [0.89]	0.451 [0.30]	-1.20 [0.00]**	-0.00696 [0.98]
Local	Malaysian PM launces bitter attack on rogue speculators					
25/07/1997	17	-0.367 [0.78]	-0.274 [0.26]	-0.429 [0.32]	-0.247 [0.24]	-0.248 [0.44]
28/07/1997	18	0.122 [0.92]	0.226 [0.35]	0.321 [0.46]	0.250 [0.23]	0.250 [0.44]
Local	Thailand call in the IMF					
29/07/1997	19	0.878 [0.51]	0.976 [0.00]**	0.572 [0.19]	1.00 [0.00]**	1.00 [0.00]**
04/08/1997	20	1.14 [0.39]	1.22 [0.00]**]	1.18[0.00]**	1.25[0.00]**	1.26 [0.00]**
Global	Thailand follow the IMF programme by revamping its financial sector					

Table 2.12: Dummies in the reduced form Model of interest rate

VariableDummies		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}
18/08/1997	21	-1.07 [0.43]	-0.839 [0.00]**	-0.970 [0.02]	-0.988 [0.00]**	-0.985 [0.00]**
Local	Indonesia abolishes its system of managing the exch rate through a band and allow it to float					
19/08/1997	22	-0.591 [0.66]	-0.463 [0.06]	1.34[0.00]**	-0.491 [0.02]	-0.490 [0.13]
20/08/1997	23	-1.54 [ ]	-1.54 [0.00]**	-3.54 [0.00]**	-1.47 [0.00]**	-1.49 [0.00]**
22/08/1997	24	-0.381 [0.77 0.43]	-0.471 [0.05]*	0.165 [0.70]	-0.243 [0.25]	-0.250 [0.44]
28/08/1997	25	-1.61 [0.23]	-1.41 [0.00]**	-2.07 [0.00]**	-1.48 [0.00]**	-2.00 [0.00]**
Global	Leading international firm threat to pull back from Thailand in response to capital control imposed by Goverment					
03/09/1997	26	-1.16 [0.39]	-1.11 [0.00]**	-1.07 [0.01]**	-1.00 [0.00]**	-1.00 [0.00]**
04/09/1997	27	-1.68 [0.21]	-1.80 [0.00]**	-1.45 [0.00]**	-1.50 [0.00]**	-2.50 [0.00]**
05/09/1997	28	-1.19 [0.38]	-1.06 [0.00]**	-0.963 [0.02]	-1.00 [0.00]**	-1.02 [0.00]**
11/09/1997	29	-1.23 [0.36]	-1.06 [0.00]**	-0.858 [0.05]	-1.02[0.00]**	-1.05 [0.00]**
12/09/1997	30	-0.749 [0.58]	-0.567 [0.02]*	-0.484 [0.27]	-0.523 [0.01]	-0.562 [0.00]**
Global	Hokaido Bank and H Tokyshoku Bank of Japan postponed their planned to merger huge bad loan problems are sorted out					
15/09/1997	31	-1.25 [0.35]	-0.944 [0.00]**	-1.04 [0.01]	-1.02 [0.00]**	-1.06 [0.00]**
16/09/1997	32	0.220 [0.87]	0.368 [0.13]	0.516 [0.24]	0.473 [0.02]	0.430 [0.19]
Local	Indonesia says it will postpone project worth 39 trillion rupiah					
17/09/1997	33	1.73 [0.20]	1.99 [0.00]**	2.01 [0.00]**	1.97[0.00]**	1.93 [0.00]**
18/09/1997	34	2.76 [0.04]	2.93 [0.00]**	3.07 [0.00]**	2.97[0.00]**	2.94 [0.00]**
19/09/1997	35	0.815 [0.55]	0.948 [0.00]**	1.07 [0.01]**	0.980 [0.00]**	2.45 [0.00]**
08/10/1997	36	1.63 [0.23]	1.76 [0.00]**	1.80 [0.00]**	1.73 [0.00]**	1.73 [0.00]**
Local	Indonesia says it will ask the IMF for financial assistance					
10/10/1997	37	1.16 [0.39]	1.14 [0.00]**	1.23 [0.00]**	1.24 [0.00]**]	2.24 [0.00]**
27/10/1997	38	0.129 [0.92]	0.0216 [0.93]	0.644 [0.15]	0.0457 [0.83]	0.00686 [0.98]
28/10/1997	39	0.0182 [0.99]	-0.106 [0.67]	-0.967 [0.03]	-0.0757 [0.72]	-0.118 [0.72]
29/10/1997	40	0.106 [0.93]	-0.0916 [0.71]	-2.36 [0.00]**	0.0397 [0.85]	0.00610 [0.98]
31/10/1997	41	-0.348 [0.79]	-0.437 [0.07]	0.196 [0.65]	-0.356 [0.09]	-0.366 [0.26]
Global	IMF gives Indonesia a $23 billion financial support package					
04/12/1997	42	-1.89 [0.16]	-1.65 [0.00]**	-1.75 [0.00]**	-1.76[0.00]**	-1.74 [0.00]**
Global	IMF Managing Director Michel Camdesus signs letter of intents to provide Korea $ 57 billion to help dig it out its financial mess					

Table 2.13: Dummies in the reduced form Model of interest rate (continued)

VariableDummies		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}
23/12/1997	43	-1.53 [0.26]	-1.25 [0.00]**	-1.26 [0.00]**	-1.27[0.00]**	-1.25 [0.00]**
Global	Some US banks appear to be concern about theability of South Korean companies to repay their loans in the weak of the country's on going financial crisis					
12/01/1998	44	0.163 [0.90]	0.346 [0.16]	0.492 [0.26]	0.377 [0.00]**	0.362 [0.27]
Global	IMF and Indonesia appear to be near an agreement over IMF bailout					
12/03/1998	45	-0.355 [0.79]	-1.30 [0.00]**	-0.0816 [0.85]	-0.0884 [0.67]	-0.0543 [0.86]
07/05/1998	46	1.30 [0.33]	1.73 [0.00]**	2.68 [0.00]**	1.30 [0.00]**	1.34 [0.00]**
Local	Indonesia's President Suharto announces cabinet replete with cronies and relatives					
21/05/1998	47	-0.324 [0.81]	-0.973 [0.00]**	-0.469 [0.28]	0.175 [0.41]	-0.280 [0.39]
5/06/1998	48	0.0371 [0.97]	0.286 [0.25]	8.84 [0.00]**	-0.171 [0.42]	-0.217 [0.51]
16/06/1998	49	0.438 [0.76]	-0.183 [0.49]	-8.30 [0.00]**	0.0262 [0.90]	-0.101 [0.77]
Local	Indonesia student riot create political uncertainty					
17/06/1998	50	0.166 [0.90]	0.167 [0.50]	-3.01 [0.00]**	-0.0459 [0.83]	-0.0947 [0.77]
18/06/1998	51	0.378 [0.78]	-0.477 [0.05]	-0.774 [0.08]	0.239 [0.26]	0.220 [0.50]
22/07/1998	52	2.03 [0.13]	1.72 [0.00]**	2.10 [0.00]**]	1.93 [0.00]**	1.69 [0.00]**
10/08/1998	53	0.668 [0.63]	0.252 [0.31]	-2.87 [0.00]**	0.373 [0.08]	0.321 [0.33]
11/08/1998	54	0.195 [0.88]	0.167 [0.50]	1.67 [0.00]**	-0.0287 [0.89]	-0.0487 [0.88]
12/08/1998	55	0.246 [0.85]	0.0278 [0.91]	-1.03 [0.02]*	-0.0155 [0.94]	1.44 [0.00]**
25/08/1998	56	0.279 [0.83]	-0.100 [0.68]	0.972 [0.02]*	-0.0168 [0.93]	-0.174 [0.59]
26/08/1998	57	0.562 [0.68]	0.137 [0.58]	-0.00447 [0.99]	0.241 [0.26]	0.197 [0.55]
27/08/1998	58	3.30 [0.01]	-0.108 [0.66]	2.48 [0.00]**	-0.0106 [0.96]	0.948 [0.00]**
28/08/1998	59	0.394 [0.77]	-0.0120 [0.96]	4.80 [0.00]**	0.0102 [0.96]	-0.0406 [0.90]
31/08/1998	60	0.544 [0.71]	0.184 [0.39]	-0.579 [0.22]	0.0498 [0.82]	-0.0449 [0.89]
01/09/1998	61	1.51 [0.29]	0.827 [0.00]**	-5.34 [0.00]**]	0.741 [0.00]**	0.954 [0.00]**
02/09/1998	62	2.44 [0.07]	0.0366 [0.88]	-2.86 [0.00]**	0.112 [0.59]	0.0915 [0.78]
04/09/1998	63	0.315 [0.81]	0.208 [0.39]	1.76 [0.00]**	-1.62 [0.00]**]	0.0941 [0.77]
Global	The IMF postponed dissimburment of $3 billion from Indonesia's aid in implementing reform because the delay					
08/09/1998	64	0.517 [0.70]	0.121 [0.62]	0.797 [0.07]	-1.18 [0.00]**	0.358 [0.27]

Table 2.14: Dummies in the reduced form Model of interest rate (continued)

Dependent variables	Constant	R^{Ind}_{t-1}	ER^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}	1.3765[0.00**]	0.696[0.00]**				
R^{Sgn}	0.196[0.00]		0.945[. 0.00]**			
R^{Kor}	0.0210[0.01]*	0.0530[0.03]*		0.475[0.00]**	0.286[0.00]**	
R^{Mal}_{t-1}	1.564[.65]	0.0155[0.00]**			0.8970[0.00]**	
R^{Phi}_{t-1}	1.3565[.1032]			0.00123[.02]*		0.053[.012]*
LR test of over-identifying restrictions: Chi^2(195)= 5503.5 [0.00]**						
Standard deviations and correlation matrix of URF residuals :						
	σ	R^{Ind}_{t-1}	R^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}_{t-1}	0.56	1	0.61	0.06	0.45	0.58
R^{Sgn}_{t-1}	0.32	0.61	1	0.54	0.55	0.36
R^{Kor}_{t-1}	0.47	0.06	0.54	1	0.45	0.65
R^{Mal}_{t-1}	0.36	0.45	0.55	0.45	1	0.36
ER^{Phi}_{t-1}	0.72	0.58	0.36	0.65	0.36	1

Table 2.15: Structural Reduced form model of 6 Asian-countries interest rate

VariableDummies		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}	Contagion ?
07/10/1996	1		1.24[0.00]**	0.991[0.00]**	1.125[0.02]*	1.10[0.00**	
Local,Thailand							C
08/10/1996	2		-1.5[0.00]**	-1.400[0.00]**	.-1.45[0.00]**	-1.51[0.00]**	
Local,Indonesia							C
31/10/1996	3		-0.99[0.00]**	-1.1005[0.01]*	-.9875[0.00]**	-1.00[0.00]**	
Global							
06/02/1997	5		-1.22[0.00]**	-1.200[0.00]**	1.7625[0.00]**	-1.30[0.00**	
Global							
07/02/1997	6		-1.78[0.00]**	-1.720[0.00]**	-1.725[0.00]**	-1.80[0.00]**	
Local, Korea							C
11/02/1997	7		0.65[0.01]*	0.90[0.04]*	-.9725[0.00]**	-0.93[0.00**	
Global							
19/02/1997	8		1.02[0.00]**		.7025[0.03]*	-0.815[0.00]**	
Local,Thailand							C
28/02/1997	9		1.03[0.00]**	0.9225[.0.04]*	1.3225[0.00]**	0.940[0.00]**	
Local,Malaysia							C
02/05/1997	10		1.00[0.00]**	-1.17[0.00]*	-.7925[0.09]**		
Local,Thailand							C
15/05/1997	11		-1.14[0.00]**	1.0025[0.06]**	-1.115[0.00]**	-1.17[0.00]**	
Local,Thailand							C
16/05/1997	12		-1.01[0.00]**		-.8725[0.00]**	-1.05[0.00]**	
Local,Thailand							C
20/06/1997	13		-1.39[0.00]**	-1.54[0.00]*	-1.3025[0.00]**	-1.42[0.00]**	
Local,Thailand							C
23/06/1997	14		-1.39[0.00]**	1.0084[0.00]**	.-1.345[0.00]**	-1.43[0.00]**	
Global							
15/07/1997	15				12325[0.00]**		
Global							

Table 2.16: Dummies in the Structural Model of interest rate

VariableDummies		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}	Contagion?
15/07/1997	15				12325[0.00]**		
Local, Malaysia							NC
24/07/1997	16				-1.225[0.00]**		
Local, Malaysia							NC
25/07/1997	17		-1.475[0.00]**		-2.225[0.00]**	-1.635[0.00]**	
Global							
28/07/1997	18		1..345[0.00]**	3.4.85[0.00]**			
Global							
29/07/1997	19		. 0.976[.00]**		0.8825[.00]**	0.880[0.00]**	
Global							
04/08/1997	20		1.22[0.00]**	1.2325[0.01]**	1.2025[.00]**	1.26[0.00]**	
Local, Thailand							C
18/08/1997	21		-0.839[0.00]**	-0.970[0.00]*	1.995[0.00]**	-0.985[0.00]**	
Global							
19/08/1997	22				1-1725[0.00]**		
Global							
20/08/1997	23		-1.54[0.00]**	-3.54[0.00]*	0.9225[0.00]**	-1.495[0.00]**	
Local, Thailand							C
22/08/1997	24		-0.471[0.00]**				
Local, Thailand							C
28/08/1997	25		-1.41[0.00]**	-2.07[0.00]*	1.5025[0.00]**	-2.00[0.00]**	
Global							

Table 2.17: Dummies in the Structural Model of interest rate (continued)

Dummies Variable		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}	Contagion?
03/09/1997	26		-1.11[0.00]**	-1.073[0.05]*	-1..725[0.00]**	-1.00[0.00]**	
Local, Malaysia							C
04/09/1997	27		-1.80[0.00]**	-1.453[0.00]**	1.345[0.00]**	-2.50[0.00]**	
Local, Malaysia							C
05/09/1997	28		-1.06[0.00]**	-0.954[0.00]*	1.0625[0.00]**	-1.02[0.00]**	
Local, Malaysia							C
11/09/1997	29		-1.06[0.00]**	145025[0.00]**	1.25[0.00]**	-1.05[0.00]**	
Local, Indonesia							C
12/09/1997	30		-0.567[0.13]		-0.2905[0.00]**		
Global							
15/09/1997	31		-0.944[0.00]**	1.2225[0.00]**	-1.125[0.00]**	-1.06[0.00]**	
Local, Indonesia							C
16/09/1997	32				1.625[0.00]**		
Local, Indonesia							NC
17/09/1997	33		1.99[0.00]**	1.2325[0.00]**	1.925[0.00]**	1.93[0.00]**	
Global							
18/09/1997	34	2.76[0.44]*	2.93[0.00]**	1.4525[0.00]**	2.80025[0.00]**	2.94[0.00]**	
Global							
19/09/1997	35		0.948[0.00]**	1.4525[0.00]**	.93025[0.00]**	2.45[0.00]**	
Global							
08/10/1997	36		1.76[0.00]**	1.5625[0.16]	0.575[0.00]**]	1. 24[0.00]**	
Local, Indonesia							C
10/10/1997	37		1.14[0.00]**	1365025[0.00]**	1.2025[0.00]**	2.24[0.00]**	
Global							
27/10/1997	38						
Global							
28/10/1997	39			-0.0967[0.03]*			
Global							

Table 2.18: Dummies in the Structural interest rate (continued)

Dummies Variable		R^{Ind}	R^{Sgn}	R^{Kor}	R^{Mal}	R^{Phi}	Contagion?
29/10/1997	40			1.0565[0.00]**			
Local, Thailand							NC
31/10/1997	41			1.4425[0.00]**			
Global							
04/12/1997	42		-1.65[0.00]**	-1.75[0.00]*	1.7025[0.00]**	-1.74[0.00]**	
Local, Korea							C
23/12/1997	43		-1.25[0.00]**	-1.26[0.00]*	1.225[0.00]**	-1.25[0.00]**	
Local, Korea							C
12/01/1998	44				-1636[0.00]*		
Local,Malaysia							NC
12/03/1998	45		1.30[0.00]**				
Local,Thailand							NC
07/05/1998	46		1.68[0.00]**	2.68[0.00]*	1.225[0.00]**	1.34[0.00]**	
Local,Indonesia							C
21/05/1998	47		-1.173[0.00]**				
Local,Thailand							C
15/06/1998	48			8.30[0.00]*			
Local,Malaysia							NC
16/06/1998	49			-8.84[0.00]*			
Local,Malaysia							NC
17/06/1998	50			.8725[0.00]**			
Global							
18/06/1998	51					.455[0.00]**	
Local, Philippines							NC
22/07/1998	52		1.62[0.00]**	1.0235[0.00]**	1.970[0.00]**	1.69[0.00]**	
Global							
10/08/1998	53	1.5335[0.00]**		1.4935[0.00]**		1.7835[0.00]**	
Global							

Table 2.19: Dummies in the Structural interest rate (continued)

Dependent Variable	Constant	STR^{Ind}_{t-1}	STR^{Sgn}_{t-1}	STR^{Kor}_{t-1}	STR^{Mal}_{t-1}	STR^{Phi}_{t-1}
STR^{Ind}_{t-1}	0.00192148[0.00]**	0.9496[0.12]	-0.167054[0.00]**	0.9496[0.23]	0.9496[0.75]	0.9496[0.58]
STR^{Sgn}_{t-1}	0.00198[0.01]**	-0.0109873[0.51]	-0.0354[0.78]	-0.0368[0.78]	0.0326[0.37]	0.0404[0.78]
STR^{Kor}_{t-1}	1.89[0.01]**	-0.111[0.01]**	0.0504 [0.47]	0.0749[0.03]*	-0.0369[0.45]	-0.00927[0.29]
STR^{Mal}_{t-1}	0.00135 [0.05]	-0.00142 [0.97]	-0.148 [0.01]**	-0.00313 [0.91]	0.00493 [0.90]	0.124[0.00]**
STR^{Phi}_{t-1}	0.983[0.05]	0.983[0.87]	0.983[0.39]	0.983[0.65]	0.993307[0.78]	0.983[0.69]
Testing for vector autocorretion of residuals (lag 1-9) : F-form (47, 2766)= 0.436[0.736]						
Testing for vector Heteroschedasticity of the residuals : F-form F(1231,1523)= 21.49 [0.714]**						
Standard deviations and correlation matrix of URF residuals :						
	σ	R^{Ind}_{t-1}	R^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}_{t-1}	0.21	1	0.37	0.49	0.36	0.35
R^{Sgn}_{t-1}	0.41	0.37	1	0.59	0.47	0.34
R^{Kor}_{t-1}	0.35	0.49	0.47	1	0.43	0.67
R^{Mal}_{t-1}	0.33	0.38	0.21	0.45	1	0.55
R^{Phi}_{t-1}	0.15	0.29	0.37	0.67	0.55	1

Table 2.20: Reduced form model of 6 Asian countries Stock Market Return differentials

Dummies Variable		STR^{Ind}	STR^{Sgn}	STR^{Kor}	STR^{Mal}	STR^{Phi}
07/10/1996	1	0.0587[0.007]**	0.0420[0.02]*	0.0863[0.00]**	0.0592[0.00]**	0.0571[0.00] **
18/11/1996	2	0.0626[.0.004]**	0.0548[0.00]**	0.00647[0.01]*	0.0613[0.00]**	0.0728[0.00]**
14/05/1997	3	0.00781[. 0.68]	0.01738[0.29]	0.00647[0.76]	0.00857[0.65]	0.0232[0.20]
19/06/1997	4	0.03505[.0.109]	0.0426[0.02]*	0.03790[0.12]	0.0446[0.03]*	0.0649[0.00]**
23/06/1997	5	-0.1059[. 0.001]**	-0.0957[0.00]**	-0.135[0.00]**	-0.119[0.00]**	-0.150[0.00]**
26/06/1997	6	-0.06388[.0.001]**	-0.088[0.00]**	-0.0692[0.00]**	-0.0701[0.00]**	-0.0715[0.00]**
02/07/1997	7	-0.05347[. 0.025]*	-0.0651[0.00]**	-0.0205[0.44]	-0.0524[0.02]*	-0.0823[0.00]**
Local	The Bank of Thailand announces a managed float of the baht					
03/07/1997	8	-0.1182[.000]**	-0.1255[0.00]**	-0.130[0.00**]	-0.132[0.00]	-0.158[0.00]**
04/07/1997	9	0.03853[. 0.308]	0.03748[0.24]	0.0776[0.06]	0.0495[0.17]	0.0912[0.01]**
09/07/1997	10	.0.03843[. 0.05]*	0.0671[0.00]**	0.0592[0.01]**	0.0335[0.11]	0.0222[0.28]
11/07/1997	11	-0.01282[.0.474]	.-0.0158[0.29]	-0.0108[0.59]	0.00205[0.90]	0.0295[0.08]
16/07/1997	12	-0.04178[.0.05]*	-0.0255[0.20]	-0.0996[0.00]**	-0.0425[0.06]	-0.0402[0.07]
23/07/1997	13	0.05118[.0.01]**	0.0527[0.00]**	0.0496[0.04]*	0.0573[0.00 **	0.0340[0.10]
28/07/1997	14	-0.0523[. 0.017]*	-0.06074[0.00]**	-0.053[0.02]*	-0.0639[0.00]**	-0.0452[0.02]*
28/08/1997	15	-0.02625[.0.228]	-0.0243[.0.18]	0.00345[0.88]	-0.0215[0.30]	-0.0758[0.00]**
Local	Thai government impose a new capital control					
02/09/1997	16	0.05637[0.139]	0.0815[0.01]**	0.0981[0.02]*	0.0750[0.04]*	0.0989[0.00]**
03/09/1997	17	0.06654[. 0.002]**	0.0250[0.17]	-0.00413[0.86]	-0.0560[0.04]*	0.0236[0.25]
05/09/1997	18	0.02839[. 0.515]	-0.0346[0.35]	-0.0919[0.06]	0.0272[0.52]	-0.112[0.00]**
08/09/1997	19	.-0.05033[.0.02]*	-0.0462[0.01]**	-0.0516[0.04]*	0.0123[0.56]	-0.0636[0.00]**
09/09/1997	20	0.00614[. 0.78]	- 0.0324[0.08]	-0.00084[0.97]	0.0222[0.29]	0.0643[0.00]**
29/10/1997	21	0.05434[.0.013]*	0.0709[0.00]**	0.0276[0.26]	0.0249[0.24]	0.0455[0.46]
30/10/1997	22	0.04618[.0.00]**	-0.0119[0.36]	-0.0632[0.00]**	-0.0231[0.12]	-0.0107[0.46]
Global	IMF announces a $23 billion financial package to help Indonesia stabilize financial. system					
03/11/1997	23	-0.04398[. 0.02]*	-0.0337[0.03]*	0.00276[0.89]	0.0244[0.18]	-0.0447[0.01]**

Table 2.21: Dummies in the reduced form Model of Stock Market Return

Dummies Variable		STR^{Ind}	STR^{Sgn}	STR^{Kor}	STR^{Mal}	STR^{Phi}
04/11/1997	24	-0.02605[.0.14]	0.000732[0.96]	0.0333[0.09]	-0.00808[0.64]	0.0133[0.43]
07/11/1997	25	0.02044[. 0.29]	0.000934 [0.95]	.0324[0.14]	0.00667[0.72]	0.0458[0.01]**
Local	Indonesia:Andromeda bank take legal action					
11/11/1997	26	.-0.04708[0.00]**	-0.0265[0.04]*	-0.0105[0.54]	-0.0181[0.22]	-0.0195[0.18]
Local	South Korea announce to put effort to stabilize won against US					
18/11/1997	27	-0.0299[.0.05]*	.-0.0426[0.00]**	-0.0357[0.04]*	-0.0679[0.00]**	-0.0475[0.00]**
19/11/1997	28	-0.0333[0.13]	-0.00241[. 0.89]	0.0239[0.33]	-0.0182[0.39]	0.0115[0.58]
20/11/1997	29	-0.02149[.0.32]	0.0153[0.40]	-0.00802[0.74]	-0.0918[0.00]**	0.0289[0.16]
Local	Korea asks for a rescue package from the IMF					
24/11/1997	30	.0.01904[0.54]	-0.0126[0.62]	-0.147[0.00]**	-0.0148[0.62]	-0.0215[0.46]
08/12/1997	31	0.03516[0.25]	0.0486[0.06]	-0.0258[0.46]	0.132[0.00]**	0.0387[0.18]
12/12/1997	32	-0.07040[0.00]**	-0.00532[0.77]	-0.0678[0.00]**	-0.0149[0.48]	-0.00166[0.93]
15/12/1997	33	-0.04275[0.16]	-0.00602[0.81]	0.0884[0.01]**	-0.00757[0.80]	0.0565[0.05]*
Local	Korea announce to sell off two trouble banks					
26/12/1997	34	0.007136[. 0.74]	0.00451[0.80]	0.0720[0.00]**	0.0262[0.21]	0.00727[0.72]
05/01/1998	35	0.01416[.0.51]	0.00321[0.86]	0.0693[0.00]**	-0.0311[0.14]	0.00667[0.74]
Global	US and German Banks agree to help Korea manage its short term debt					
08/01/1998	36	-0.1629[0.00]**	-0.138[0.00]**	-0.0390[0.43]	-0.0763[0.07]	-0.127[0.00]**
09/01/1998	37	0.01101[0.62]	-0.0457[0.01]**	-0.00944[0.70]	-0.00779[0.71]	-0.0597[0.00]**
12/01/1998	38	0.04210[.0.05]*	-0.0514[0.00]**	0.128[0.00]**	0.00101[0.96]	0.0371[0.07]
13/01/1998	39	0.03936[.0.08]	0.0627[0.00]**	-0.0146[0.57]	0.0117[0.59]	0.00400[0.37]
global	IMF said that Indonesia will implement its economic reform					
15/01/1998	40	-0.03504[0.10]	-0.00932[0.61]	0.0740[0.00]**	-0.0147[0.48]	0.00182[0.37]
16/01/1998	41	-0.05438[. 0.07]	.-0.0537[0.04]*	-0.0932[0.00]**	0.0280[0.35]	-0.0916[0.00]**
21/01/1998	42	-0.01010[. 0.64]	-0.0500 [0.00]**	-0.0961[0.00]**	-0.0388[0.06]	-0.0571[0.05]*
30/01/1998	43	-0.13447[0.01]**	-0.0702[0.09]	0.0609[0.27]	-0.132[0.00]**	0.0889[0.05]*
02/02/1998	44	0.05466[0.08]	0.0766[0.00]**	-0.0985[0.00]**	-0.139[0.00]**	0.0412[0.13]
Local	Bank of Thailand announces lifting of capital controls imposed last may to defend the baht					

Table 2.22: Dummies in the reduced form Model of Stock Market Return (continued)

Dummies Variable		STR^{Ind}_{t-1}	STR^{Sgn}_{t-1}	STR^{Kor}_{t-1}	STR^{Mal}_{t-1}	STR^{Phi}_{t-1}
03/02/1998	45	-0.03287[0.15]	-0.0328[0.09]	0.00886[0.73]	0.206[0.00]**	-0.0327[0.89]
04/02/1998	46	0.06134[.0.05]*	0.0471 [0.08]	0.0977[0.00]**	0.0602[0.05]*	0.00397[0.89]
05/02/1998	47	-0.05754[0.00]**	-0.0294[0.11]	-0.0866[0.00]**	-0.0159[0.45]	-0.0433[0.03]*
11/02/1998	48	-0.0588110 [.001]**	.0.00871[0.63]	-0.0421[0.08]	-0.00646[0.76]	0.0622[0.00]**
05/03/1998	49	0.0619727[.001]**	0.0199[0.28]	-0.0359[0.14]	0.0230[0.27]	0.0321[0.12]
26/03/1998	50	0.0752701[.001]**	0.0113[0.53]	0.001[0.96]	0.0149[0.48]	0.0190[0.35]
Local	Indonesia and US has different view on implementing currency board system					
07/04/1998	51	0.0281741[0.19]	0.0277[0.13]	0.0786[0.00]**	0.0287[0.17]	0.0393[0.05]*
19/05/1998	52	-0.00786[0.71]	0.00294[0.87]	0.0514[0.03]*	0.00420[0.84]	0.0308[0.13]
Global						
17/06/1998	53	0.0015[0.94]	0.00281[0.87]	-0.00261[0.91]	-0.0152[0.47]	0.00943[0.64]
20/07/1998	54	-0.0246[0.25]	-0.0263[0.15]	-0.0522[0.03]*	-0.0113[.59]	-0.0509[0.01]*

Table 2.23: Dummies in the reduced form Model of stock return (continued)

Dummies Variable	Constant	STR^{Ind}_{t-1}	STR^{Sgn}_{t-1}	STR^{Kor}_{t-1}	STR^{Mal}_{t-1}	STR^{Phi}_{t-1}
STR^{Ind}_{t-1}	0.3235[0.00]**		0.09163[0.62]			
STR^{Sgn}_{t-1}	0.431[0.00]*		0.995039[. 0.00]**			
STR^{Kor}_{t-1}	1.545[0.22]	-0.0109873[0.00]**		-0.0798786 [0.00]**		
STR^{Mal}_{t-1}	2.635[0.02]		- 0.993030[0.00]**			-0.07657[0.11]
STR^{Phi}_{t-1}	1.2234[0.04]*				0.7689[0.00]**	
LR test of over-identifying restrictions: Chi^2(317)= 595.85 [0.0000]**						
Standard deviations and correlation matrix of URF residuals :						
	σ	R^{Ind}_{t-1}	R^{Sgn}_{t-1}	R^{Kor}_{t-1}	R^{Mal}_{t-1}	R^{Phi}_{t-1}
R^{Ind}_{t-1}	0.11	1	0.59	0.36	0.51	0.56
R^{Sgn}_{t-1}	0.27	0.51	1	0.47	0.66	0.69
R^{Kor}_{t-1}	0.31	0.36	0.47	1	0.42	0.42
R^{Mal}_{t-1}	0.14	0.59	0.66	0.42	1	0.42
R^{Phi}_{t-1}	0.27	0.56	0.69	0.42	0.42	1

Table 2.24: Structural form model of 6 Asian-countries Stock Market Return differentials

Dummies Variable		STR^{Ind}	STR^{Sgn}	STR^{Kor}	STR^{Mal}	STR^{Phi}	Contagion?
07/10/1996	1	0.0583[0.00]**	0.0427[0.02]*	0.0863[0.00]**	0.0592[0.00]**	0.0571[0.00] **	
Global							
18/11/1996	2	0.0510[.0.00]**	0.0416[0.00]**	0.00647[0.01]*	0.0613[0.01]**	0.0728[0.00]**	
Local,Malaysia							C
14/05/1997	3	0.0283[0.00]**			0.0383[0.00]**		
Local,Indonesia							C
19/06/1997	4		0.0426[0.23]		0.0446[0.57]	0.0649[0.00]**	
Local,Malaysia							
23/06/1997	5	-0.0820[. 0.00]**	-0.0957[0.00]**	-0.135[0.00]**	-0.119[0.00]**	-0.150[0.00]**	
Global							
26/06/1997	6	-0.0540[.0.00]**	-0.0775[0.00]**	-0.0692[0.00]**	-0.0701[0.00]**	-0.0715[0.00]**	
Local, Thailand							C
02/07/1997	7	-0.0574[. 0.00]*	-0.0651[0.00]**		-0.0524[0.02]*	-0.0823[0.00]**	
Local, Thailand							C
03/07/1997	8	-0.0727[.000]**	.-0.1255[0.00]**	-0.130[0.00**]		-0.158[0.00]**	
Global							
04/07/1997	9					0.0912[0.01]**	
Global							
09/07/1997	10		0.0671[0.00]**	0.0592[0.01]**		0.0222[0.28]	
Global							
11/07/1997	11				0.0341[0.00]**		NC
Local, Malaysia							
16/07/1997	12	-0.0491[.0.72]		-0.0996[0.00]**			
Global							
23/07/1997	13	0.0458[.0.00]**	0.0527[0.00]**	0.0496[0.04]*	0.0573[0.00 **		
Local, Malaysia							C
28/07/1997	14	-0.0523[. 0.16]	-0.06074[0.04]*	-0.053[0.02]*	-0.0639[0.00]**	-0.0452[0.02]*	
Local,Thailand							C

Table 2.25: Dummies in the structural reduced form Model of Stock Market Return

Dummies Variable		STR^{Ind}	STR^{Sgn}	STR^{Kor}	STR^{Mal}	STR^{Phi}	Contagion?
28/08/1997	15					-0.0758[0.00]**	
Global							
02/09/1997	16		0.0815[0.09]	0.0981[0.02]*	0.0750[0.04]*	0.0989[0.04]*	
Local, Malaysia							C
03/09/1997	17	0.06654[. 0.03]*			-0.0560[0.04]*		
Local, Malaysia							C
05/09/1997	18					-0.112[0.00]**	
Local,Philippines							NC
08/09/1997	19	.-0.05033[.0.06]	-0.0462[0.00]**	-0.0516[0.04]*		-0.0636[0.00]**	
Local, Indonesia							C
09/09/1997	20					0.0643[0.00]**	
Local, Indonesia							NC
29/10/1997	21	0.05434[.0.03]**	0.0709[0.00]**				
Local, Indonesia							C
30/10/1997	22	0.04576[.0.00]**		-0.0632[0.00]**			
Global							
03/11/1997	23	-0.0553[0.002]*	-0.0337[0.03]*			-0.0447[0.01]**	
Global							
04/11/1997	24			-0.0353[0.01]*			
Local, Korea							NC
07/11/1997	25					0.0458[0.01]**	
Local, Korea							NC
11/11/1997	26	.-0.0336[0.00]**	-0.0683[0.15]**				
Local, Korea							C
18/11/1997	27	-0.0299[.0.07]	.-0.0426[0.00]**	-0.0357[0.04]*	-0.0679[0.00]**	-0.0475[0.00]**	
Local, Korea							C
19/11/1997	28			-0.0346[0.00]**			
Global							

Table 2.26: Dummies in the structural reduced form Model of Stock Market Return (continued)

Dummies Variable		STR^{Ind}_{t-1}	STR^{Sgn}_{t-1}	STR^{Kor}_{t-1}	STR^{Mal}_{t-1}	STR^{Phi}_{t-1}	Contagion?
20/11/1997	29				-0.0918[0.00]**		
Local,Korea							C
24/11/1997	30			-0.147[0.00]**	-0.0148[0.62]		
Local,Malaysia							C
08/12/1997	31				0.132[0.00]**		
Global							
12/12/1997	32	-0.06540[0.00]**		-0.0678[0.00]**			
Global							
15/12/1997	33			0.0884[0.01]**		0.0565[0.05]*	
Local,Philippines							C
26/12/1997	34			0.0720[0.00]**			
Global							
05/01/1998	35			0.0693[0.00]**			
Global							
08/01/1998	36	-0.1629[0.00]**	-0.138[0.00]**			-0.127[0.00]**	
Global							
09/01/1998	37		-0.0457[0.00]**			-0.0597[0.00]**	
Global							
12/01/1998	38	0.04210[.0.05]*	-0.0514[0.00]**	0.128[0.00]**			
Global							
13/01/1998	39		0.0627[0.00]**				
Local, Indonesia							C
15/01/1998	40			0.0740[0.00]**			
Local, Indonesia							C
16/01/1998	41		.-0.0537[0.01]*	-0.0932[0.00]**		-0.0916[0.00]**	
Local, Indonesia							C
21/01/1998	42		-0.0500 [0.01]**	-0.0961[0.00]**		-0.0571[0.05]*	

Table 2.27: Dummies in the Structural reduced form Model of Stock Market Return (continued)

Dummies Variable		STR^{Ind}_{t-1}	STR^{Sgn}_{t-1}	STR^{Kor}_{t-1}	STR^{Mal}_{t-1}	STR^{Phi}_{t-1}	Contagion?
16/01/1998	41		.-0.0537[0.01]*	-0.0932[0.00]**		-0.0916[0.00]**	
Local,Indonesia							C
21/01/1998	42		-0.0500 [0.01]**	-0.0961[0.00]**		-0.0571[0.05]*	
Global							
30/01/1998	43	-0.378[0.03]**			-0.132[0.00]**	0.0889[0.05]*	
Local,Korea							C
02/02/1998	44		0.0766[0.00]**	-0.0985[0.00]**	-0.139[0.00]**		
Local,Thailand							C
03/02/1998	45				0.206[0.00]**		
Local, Thailand							C
04/02/1998	46	0.06134[.0.59]		0.0977[0.00]**	0.0229[0.15]		
Local,Indonesia							C
05/02/1998	47	-0.05754[0.05]*		-0.0866[0.00]**		-0.0245[0.10]	
Local,Indonesia							C
11/02/1998	48	-0.0588110 [.000]**			-0.00646[0.76]	0.0622[0.00]**	
Local, Indonesia							C
05/03/1998	49	0.0619727[.000]**					
Local,Korea							NC
26/03/1998	50	0.0752701[.001]**					
Global							NC
07/04/1998	51			0.0786[0.00]**		0.0393[0.31]	
Local,Korea							C
19/05/1998	52			0.0514[0.03]*			
Local,Malaysia							NC
17/06/1998	53						
Local,Malaysia			-0.2509[0.01]*				NC
20/07/1998	54			-0.0522[0.03]*		-0.0509[0.01]*	
Local,Malaysia							C

Table 2.28: Dummies in the Structural reduced form Model of stock return (continued)

2.7 Appendix Section Two: Data and Sources

Country	Descriptions	Sources
INTEREST RATES		
Malaysia	Daily average of Interbank at the Interbank Money Market Rate in Kuala Lumpur(1 Month)	Bank Negara Malaysia
Singapore	1 Month Interbank Domestic Interest Rate (middle rate)	Monetary Authority of Singapore
Indonesia	The end-period 1 Month Money Market Interbank Call Money Rates.	Weekly Report of Bank Indonesia.
Thailand	Thai Baht Implied Interest Rates.	Bank of Thailand.
Korea	Short Term BEN. CERT. 180D - Middle Rate	Bank of Korea
Phillipine	Peso Time Deposit 30-60 day	Weekly Report on Key Statistical Indicators, Bangko Sentral Pilipinas
STOCK MARKET		
Malaysia	Kuala Lumpur Composite - Price Index	Kuala Lumpur Stock Exchange(KLSE)
Singapore	Singapore Straits Times (New) - Price Index	Singapore Stock Exchange(SGXS)
Indonesia	Jakarta Stock Exchange Composite - Price Index	Jakarta Stock Exchange(JSX)
Thailand	Bangkok S.E.T. - Price Index	Stock Exchange of Thailand (SET)
Korea	Korea SE Composite (KOSPI) - Price Index	Korea Stock Exchange (KSE)
Phillipine	Philippines SE Composite - Prince Index	The Philippine Stock Exchange(PSE)

Table 2.29: Data Descriptions and Sources

Chapter 3

Contagion and Interdependence in the Asian crisis: A cointegrated approach*

3.1 Introduction

In the aftermath of the recent Asian crisis a lot of research effort has gone into identifying in which way the crisis spread between financial centres. In particular, it is important to understand whether the transmission mechanisms between markets change during crisis periods. While there is a plethora of good theoretical reasons for such state-contingent transmission mechanisms, identifying their presence is econometrically rather difficult.

In this chapter, we propose an alternative procedure that allows us to test for the presence of contagion (i.e. a crisis-specific transmission mechanism). The advantage of our method is that it does not require any -potentially implausible - identifying

[0] *This chapter was written in close collaboration with Professor Mathias Hoffmann

assumptions. Rather, it is entirely data based and can be implemented using a simple cointegrated VAR.

Our study ties in with a number of recent studies (Rigobon [53] and Forbes and Rigobon [24], Favero and Giavazzi [21] [25]) that have suggested new empirical approaches to the detection of contagion. Rigobon [53] and Forbes and Rigobon [24], [25] have forcefully argued that simple changes in the comovement of markets (as measured by conditional correlations) are not useful as tests of contagion. The reason for this is that increases in correlation can come about as the result of a changed, i.e. more immediate, transmission mechanism but could also be the result of increased turbulence in factors that affect all markets jointly through a transmission mechanism that remains, however, unchanged. Forbes and Rigobon then move on to suggest a Hausman-type specification test for the constancy of the transmission mechanism. Their method, does, however, require a few identification assumptions that can sometimes be implausible.

In the Favero and Giavazzi [21] study, the authors estimate a VAR representation of the return processes in the different markets. Their approach used a set of dummies as a measure of the transmission mechanism across markets. This technique,however, is the subject of criticism as the dynamic interaction between the variables is effectively unchanged.

Our approach extends the framework of Favero and Giavazzi [21] to recognize the inherent non-stationarity of financial data. We exploit this non-stationarity as an important identification device that allows us to identify a data-dependent transmission mechanism without having to resort to a-priori restrictions. Admittedly, our test for contagion relies on the presence of cointegration between the markets under investigation. While one may be inclined to view this as a disadvantage, we argue that the presence or absence of cointegration in itself is a measure of whether there is a structural linkage between markets at all. In fact, we show analytically how the presence of cointegration determines the economy's response to transitory shocks. Changes in the transmission mechanism are then nothing else but a change in the error-correction mechanism.

The gist of our approach is to apply Hansen and Johansen's [33] recursive eigenvalue tests to detect the presence of changes in regime: the non-zero eigenvalues arising from the reduced-rank (i.e. cointegrating) regression problem can be interpreted as a generalized correlation measure. We show that changes in the eigenvalue can come about either as changes in the variance of the reduced-form residuals or as changes in the factor loadings of the error-correction term. The latter can be shown to determine the impulse-response of the markets to transitory shocks. We can therefore interpret changes in these coefficients as changes in the transmission mechanism, i.e. as contagion.

Our approach also bears some interesting similarities with the recent work by Corsetti, Pericoli and Sbracia [12]. These authors argue convincingly that increases in correlation are neither necessary nor sufficient for the presence of contagion. They argue that the method advocated by Rigobon and Forbes is biased against finding contagion since it has to assume that the variance in country-specific idiosyncratic shock remains constant. Very much like Corsetti *et al.* [12], we do not have to impose any restrictions on the form of the heteroskedasticity in country-specific or common disturbances. The only information we have to exploit for identification is the non-stationarity of and potential cointegration between financial market indexes.

Applying our approach to four data sets (daily stock market price indexes, daily interest rate, money market interest rate and monthly deposit rate) for 6 Asian countries (Indonesia, Singapore, Thailand, Malaysia, Philippines, Korea) over the 1990-1999 period, we evaluate the time path of the speed of error correction (reflected by the estimated largest eigenvalue of the system). We find that the eigenvalue measure does indeed become unstable around the onset of the crisis, sometimes even a bit earlier. However, we find that contagion was present only in a limited number of cases. Whereas contagion may have been important in speeding up the spread of the crisis, changes in transmission mechanisms can in no way explain the occurrence and extent of the Asian collapse.

The remainder of this chapter is organized as follows. Section 3.2 explains how the error-correction framework can be employed to test for the presence of a crisis-contingent transmission mechanism, i.e. contagion. In Section 3.3 we apply our approach to the various data sets from 6 Asian emerging markets and we discuss our results. The final section of the chapter concludes.

3.2 Measuring Contagion

3.2.1 An error correction approach

We consider the log-returns in two markets x and y which are jointly distributed with constant mean and time-varying variance:

$$\Delta \mathbf{Z}_t = \begin{bmatrix} \Delta x \\ \Delta y \end{bmatrix} \sim D\left(\begin{bmatrix} \overline{\Delta x} \\ \overline{\Delta y} \end{bmatrix}, \mathbf{\Sigma}_t \right) \tag{3.1}$$

The earlier literature (for example King and Wadhwani [43]) focused on changes in correlations between the two markets as an indication of crisis-contingent transmission mechanisms. As the recent work by Rigobon [53],[52] and Forbes and Rigobon [24],[25] has shown, correlations are not informative about contagion. The reason for this is that an increase in correlation can come about as the result of increased volatility in the shocks that are common to the two markets or could be due to a generic change in the transmission mechanism. In order to disentangle these effects,Forbes and Rigobon [53] assume that the contemporaneous interaction between the two markets is described by a linear system of the form

$$\Delta \mathbf{Z}_t = \mathbf{A}\mathbf{e}_t$$

where $\mathbf{A}$ is a non-singular (2×2)-matrix and $\mathbf{e}_t$ is a two-dimensional vector of structural shocks. Of course, the identification of the structural shocks and of $\mathbf{A}$ requires further identifying assumptions. A test for contagion is then essentially a test for the stability of $\mathbf{A}$.

Our approach does not require identifying assumptions along the lines of Rigobon. Rather, we exploit the presence of cointegration between non-stationary variables to identify permanent and transitory shocks to the two markets. In keeping with most of the literature, we then interpret contagion as a change in the transmission mechanism of what are high-frequency, i.e. transitory shocks.

In our analysis, we interpret the long-run adjustment coefficients of the cointegrated system as measures of the transmission mechanism. At first, it may seem odd to focus on the error-correction mechanism in studying contagion - a notion that pertains to the transmission of temporary shocks. However, we demonstrate that the within-period response of a cointegrated system to transitory shocks does only depend on the long-run adjustment coefficients. In this sense, the correction of past disequilibria and the high-frequency response are intimately linked in a cointegrated VAR. We argue that this captures the very essence of what the empirical and theoretical literature aims to get at when discussing contagion.

To demonstrate our point, we assume that returns in the two markets are generated by an error-correction mechanism of the form

$$\mathbf{\Delta Z}_{t=}\begin{bmatrix}\Delta x\\ \Delta y\end{bmatrix}=\begin{bmatrix}\alpha_1\\ \alpha_2\end{bmatrix}[x_{t-1}-\beta y_{t-1}]+\begin{bmatrix}\varepsilon_{1t}\\ \varepsilon_{2t}\end{bmatrix}=\alpha\beta'\mathbf{Z}_{t-1}+\varepsilon_t \qquad (3.2)$$

In this setup, we are going to interpret the vector $\alpha=\begin{bmatrix}\alpha_1 & \alpha_2\end{bmatrix}'$ as embodying the transmission mechanism between the two markets. The covariance matrix of shocks to the two markets is given by $\mathbf{\Omega}_t$ where the subscript t indicates the presence of heteroskedasticity in the error-process.

In a cointegrated system it is straightforward to identify permanent and transitory shocks (for a complete analytical exposition see Johansen [37]). Let $\alpha_\perp$ denote the orthogonal complement of α. Then premultiplying the error correction model with $\alpha_\perp$eliminates the stationary part of the process and we have

$$\alpha'_\perp \mathbf{\Delta Z}_t = \alpha'_\perp \varepsilon_t$$

Hence, $\alpha'_\perp \mathbf{Z}_t$ is the random walk component of $\mathbf{Z}_t$ and the permanent shocks must be given by $\pi_t = \alpha'_\perp \varepsilon_t$. If we now require that transitory shocks should be orthogonal to the permanent disturbances, we find that the transitory shocks must be given by

$$\tau_t = \alpha' \mathbf{\Omega}^{-1} \varepsilon_t$$

In a bi-variate system with one cointegrating restriction, such as the one we are considering here, this simple reasoning achieves just-identification. We only need to normalize the two shocks to have unit variance. Then the mapping between the vector of reduced-form residuals, ε_t , and the permanent and transitory shocks is given by a matrix $\mathbf{P}$ that has the following form

$$\mathbf{P} = \begin{bmatrix} [\alpha'_\perp \mathbf{\Omega} \alpha_\perp]^{-1} \alpha'_\perp \\ [\alpha' \mathbf{\Omega}^{-1} \alpha] \, \alpha' \mathbf{\Omega}^{-1} \end{bmatrix}$$

and

$$\begin{bmatrix} \pi_t \\ \tau_t \end{bmatrix} = \mathbf{P} \varepsilon_t$$

The period-zero impulse response to the permanent and transitory shocks is then given by the inverse of $\mathbf{P}$ which according to Hoffmann [35] has the following form

$$\mathbf{P}^{-1} = \begin{bmatrix} \mathbf{\Omega} \alpha_\perp, & \alpha \end{bmatrix}$$

Hence, the impulse response of the two returns to a transitory shock is given by the vector α. Therefore, $\chi = \alpha_1 / \alpha_2$, the relative response of the two variables to a common shock, can naturally be interpreted as the transmission mechanism.

Now let $\mathbf{\Sigma}_t$ denote the conditional variance of observed market returns. As we have mentioned at the outset, Rigobon and Forbes have argued that correlation or other tests based on the elements of $\mathbf{\Sigma}_t$ are misleading. In the context of our setup, we can write $\mathbf{\Sigma}_t$ as

$$\mathbf{\Sigma}_t = \sigma_{ECM}(\mathbf{\Omega}_t)\alpha\alpha' + \mathbf{\Omega}_t$$

where σ_{ECM} is the variance of the error-correction term (which is in itself a function of $\mathbf{\Omega}_t$). Changes in $\mathbf{\Sigma}_t$ can now come about as the result of either changes in the covariance structure of the shocks or as changes in α or both. In the case of a change in α, we would then talk of 'contagion'.

A convenient way to assess the stability of $\mathbf{\Sigma}_t$ over time is to estimate the maximum eigenvalue in a cointegrated system recursively. Hansen and Johansen [33] demonstrate that, if the estimated cointegrating vectors are suitably normalized, the estimates of the non-zero eigenvalues associated with the reduced-rank regression problem are given by

$$\widehat{\Lambda} = \widehat{\alpha}'\widehat{\mathbf{S}}_{00}^{-1}\widehat{\alpha} = \widehat{\beta}'\mathbf{S}_{10}\mathbf{S}_{00}^{-1}\mathbf{S}_{01}\widehat{\beta} \qquad (3.3)$$

where $\widehat{\mathbf{S}}_{00}$, $\widehat{\mathbf{S}}_{10}$ and $\widehat{\mathbf{S}}_{01}$ are the variance, and covariance of the first and second stage regression residuals in the Johansen procedure: $\widehat{\mathbf{S}}_{ij} = T^{-1}\sum_{t=1}^{T}\mathbf{R}_{it}\mathbf{R}_{jt}'$, $i,j = 0,1$ where $\mathbf{R}_i$ are the residuals of the auxiliary regressions and $\widehat{\mathbf{\Lambda}} = diag\{\lambda_1....\lambda_N\}$ is the diagonal matrix of eigenvalues.

It can furthermore be shown that

$$\widehat{\mathbf{\Lambda}}(\mathbf{I}-\widehat{\mathbf{\Lambda}})^{-1}=\widehat{\alpha}'\widehat{\mathbf{\Omega}}^{-1}\widehat{\alpha}=\widehat{\beta}'\mathbf{S}_{10}\widehat{\mathbf{\Omega}}^{-1}\mathbf{S}_{01}\widehat{\beta}. \qquad (3.4)$$

This shows that, indeed, changes in the eigenvalues are associated with either changes in the transmission mechanism, i.e. in α, or with changes in the size and correlation of shocks that hit the economy, i.e. in $\mathbf{\Omega}$. Hansen and Johansen [33] also derive an approximation for the 95 % confidence interval of the non-zero eigenvalues which is given by

$$\frac{\widehat{\lambda}_i}{\widehat{\lambda}_i + (1-\widehat{\lambda}_i)e^{1.96\widehat{\sigma}_{ii}}} < \lambda_i < \frac{\widehat{\lambda}_i}{\widehat{\lambda}_i + (1-\widehat{\lambda}_i)e^{-1.96\widehat{\sigma}_{ii}}} \tag{3.5}$$

We note that the diagonal elements of $\mathbf{\Lambda}$, the λ_i, are always between zero and one. In particular, in a VAR with just one cointegrating restriction, $\widehat{\mathbf{\Lambda}} = \lambda_1$ is a scalar random variable. It can therefore be thought of as a generalized correlation measure for non-stationary time series. A value of $\mathbf{\Lambda}$ equal to zero implies that the series are difference stationary but do not cointegrate. For $0 < \mathbf{\Lambda} < 1$, the two markets are cointegrated. We then interpret the presence of a cointegrating relationship as evidence of structural cross-market linkages. Changes in Λ would then suggest the presence of market turbulence.

We use recursive estimates of $\mathbf{\Lambda}$ as our main tool to identify periods of market turmoil. We can then distinguish between interdependence and transmission by looking at recursive estimates of α; if contagion is present, the transmission of transitory shock should change and this, in turn, should be reflected in changes in the coefficients of α.

Implicit in this approach is that the presence of a transmission mechanism between two markets requires these markets to be cointegrated. Consequently, the rejection of the null of no-cointegration implies the rejection of the hypothesis of structural cross-market linkages between two financial centers. In our view, this is actually an advantage of our approach because it does not require us to hypothesize structural links between markets that may not actually have any. Rather, a structural link between markets is assumed only if the markets display at least some tendency to move together in the long run. In this respect, our approach is imposing only very weak restrictions on the identification of the data.

In this chapter, we restrict our attention to bivariate, (potentially) cointegrated VARs. This offers the advantage that we can express changes in the transmission mechanism as a single variable given by the ratio of the coefficients of $\alpha = \begin{bmatrix} \alpha_1 & \alpha_2 \end{bmatrix}'$, i.e. $\chi = \alpha_1/\alpha_2$. We make this choice deliberately in order to demonstrate the usefulness of our approach and in order to facilitate comparison to what other authors have done. We note, however, that it is straightforward to extend our approach to a setting with many markets and several cointegrating restrictions. While this may make the exposition of the results less straightforward, we would not require any additional identifying assumptions for this.

We also note that emerging markets differ from those in developed countries in terms of institutional structure, market size and liquidity. The effects of a speculative attack may therefore spread through various channels such as international trade and international asset and debt relationships. The benefit of our framework is that it provides a simple reduced-form tool that allows us to detect the presence of alternative transmission channels without having to identify a detailed structural model.

3.3 Econometric Implementation

This study uses four different sets of financial data: a daily composite price index (DCPI)[1], daily observations on monthly interest rates (DMIR), monthly money market interest rates (MMMI), a monthly deposit rate (MDR). All data are available for six Asian countries, namely : Indonesia, Singapore, Malaysia, Philippines, Thailand, Korea. For the daily composite price index, the sample begins on January 1^{st} , 1996 and ends on August 1999. The composite price index and daily interest rates are from Datastream. The data on monthly money market interest rate and monthly deposit rates are extracted from the International Financial Statistics CD-ROM, published by the IMF. The series runs from 1986:5 to 1999:8. The end dates being determined by data availability.

Figures 3.1-3.4 (see pages 106-109) display the plots of these series in logarithmic form. Summary statistics corresponding to these variables are given in Table 3.1 on page 95. From visual inspection, it appears that all six stock market indexes move very closely together throughout the period. All six stock markets also clearly show distinctly higher volatility during the Asian crisis from June 1997 to January 1997. Kaminsky and Schmukler [39] documented that during this period stock markets in Indonesia, Thailand, Malaysia, Korea declined on average by 0.53, 0.32 and 0.27 percent per day, respectively. In October 1997 alone, the Hang Seng Index lost around 30 percent.

[1]Jakarta Composite Index (Indonesia), Phillipine Stock Exchange Index (Philipines), Phillipines, Singapore Straits Times (New) Price Index (Singapore), Bangkok SET index (Thailand), Malaysia,Kuala Lumpur Composite Index(Malaysia) and Korea Stock Exchange Composite(KOSPI) Index (Korea).

In our analysis we first focus on the incidence of structural breaks to see how they affect the transmission mechanism between pairs of markets. Before we proceed to evaluate the cointegrating relationship, a preliminary analysis of the stochastic properties of the data series is required. ADF unit roots test are used to establish the order of integration. The results of these tests for all four data sets are presented in Table 3.5 on page 97.

As can be seen in the table, the hypothesis of a unit root is not rejected at a 5 % significance level for any of the series. We therefore conclude that all data series are non-stationary. We therefore proceeded to test for cointegration, using Johansen's test. Standard criteria and tests for lag length suggested that the VAR specification should include 1-2 lags and we decided to use 2 lags throughout.

Tables 3.6-3.9 report the cointegration test results for all possible pairs from the four different data sets (i.e. stock market index, daily interest rate, money market interest rate, and monthly deposit interest rate, respectively). A summary of cointegration test results estimated from different data sets is presented in Table 3.10-3.13 on pages 102-105. As can be seen from the first panel of Table 3.10-3.11, both the maximum and trace eigenvalue statistics do not reject the hypothesis that there is one cointegrating relation in all bivariate VARs, with Indonesia and the Phillipine and Singapore and Korea being exceptions.

The results of the cointegration tests based on daily interest rate data are shown in Table 3.7. The hypothesis of zero cointegrating vectors ($H_0 = 0$) against the alternative of one or more cointegrating vector, is accepted in all cases except for pairing involving Korea. the two pairs Malaysia-Singapore and Singapore-Thailand.

It become apparent that the tests on daily stock market composite indexes for all possible pairs of countries indicates that only 2 out of 15 pairs (i.e. Singapore and Philippines-Indonesia) are cointegrated (see the first panel of Table 3.10 and 3.11). For daily interest rate data, we find that only five pairs are cointegrated. Turning to monthly data, however, we find a lot more evidence for cointegration. For both money market interest rate and monthly deposit rates, the results show that, respectively, 8 and 9 out of 15 markets are cointegrated.

Upon eyeballing the daily series in Figures 3.1-3.4, it would seem that there is a long-term link between, in particular, the stock markets and that their downswing during the Asian crisis does have an important common element. It could be the case that high-frequency volatility in daily stock market data creates so much noise that error-correction may simply not be picked up by conventional cointegration tests. Here, our method offers an important advantage: while we impose cointegration in the estimation, we can see whether or not it is actually present by following the evolution over time of the largest eigenvalue and the 'transmission' parameters α.

3.3.1 Interdependence or contagion

We now use the framework suggested in the previous sections to analyse to what extent volatility spillovers in the Asian crisis are due to contagion or to interdependence. In each pair of countries found to be cointegrated in the earlier analysis, the recursive maximum eigenvalue, Λ, and the impulse response to transitory shocks, $\chi = \alpha_1/\alpha_2$ are estimated.

As we have argued earlier, $\boldsymbol{\Lambda}$ is a measure of comovement that can change over time due to either the changes in the volatility of the underlying shocks, i.e. Σ, or to changes in the transmission mechanism, i.e. in the vector α.

Figures 3.5-3.18 on pages 110-123 present the plots of the maximum eigenvalue estimated recursively from the daily stock market index, daily interest rates, monthly money market interest rate, and monthly deposit rate, respectively. The recursive estimate of the maximum eigenvalue seems to be a good indicator of the crisis period. In most countries and in virtually all data sets, the maximum eigenvalue starts to display considerable variation around July 1997, the onset of the crisis. In particular, we find a marked drop in the maximum eigenvalue in daily stock market data for many countries. Bearing in mind that an increase in volatility, i.e. in the norm of Σ, will lead to a smaller norm for Σ^{-1}, this is in line with the considerable increase in background volatility that the Asian markets experienced around that time. Conversely, however, changes in the maximum eigenvalue could also be related to changes in the transmission mechanism, i.e. in α.

Before we move on to discuss changes in the transmission mechanism, we note that in some cases, the maximum eigenvalue already displays a sharp drop roughly half a year to a year before the crisis actually began. In particular, this is the case for all pairings involving Thailand, notably in the daily data; to a somewhat lesser extent this also shows up in the monthly data sets. This finding seems in line with Kaminsky and Schmukler [42] who note that the first episode of notable pressure on the Thai baht occurred in July 1996, following the collapse of the Bangkok Bank of Commerce and the injections of liquidity the Bank of Thailand to support the financial system.

The next step is to determine if the transmission mechanism changes over the period of observation. In doing this, we estimate recursively the relative impulse response $\chi = \alpha_1/\alpha_2$ for the four different data sets. Taking the results from the recursive estimation of $\chi = \alpha_1/\alpha_2$ as given, we then calculate its standard deviation based on 1000 series of the α_1/α_2 that are computed using a bootstrap.

In figures 3.19-3.32 on pages 124-137 we plot the recursive estimate of the relative impulse response α_1/α_2 together with the standard deviation for each of data sets. This enables us to examine whether the transmission mechanism changed during the Asian crisis. Using the confidence interval as the criteria for rejection, it is quite surprising how stable the estimate of α_1/α_2 is in many of the cases we examine particularly in the case of stock market index and daily interest rates (see figure 3.19-3.26 on pages 124-131). This is in stark contrast to the relatively high variation in the maximum eigenvalue (see figure 3.5-3.11 on pages 110-116). The results of this study suggest that most of the turmoil during the crisis can be ascribed to exogenous changes in volatility rather than to a generic change in the transmission mechanism. However, in many cases, there is also a distinct blip in the relative impulse response, if only for a rather short period. This phenomenon is particularly obvious in daily data where we find that in many cases the overall stability of the response is interrupted for only a very short period. These are instances of contagion. In particular, we find many such instances in the pairings involving either Indonesia or Thailand suggesting that the transmission of the crisis from or to these countries was sometimes subject to contagion.

In monthly data, the changes in the transmission mechanism appear to be more frequent compared to the changes in daily data. As can be seen, in some cases, α_1/α_2 is relatively unstable throughout the period, but does not show the type of spikes that it does in daily data (see Figure 3.26 to 3.32 on pages 131-137).

Overall our findings suggest that while contagion is not likely to have played a major role in the transmission of the crisis (i.e. stock market and daily interest data), it can clearly be detected - especially in monthly data. In this respect, our approach reproduces the stylized findings of Corsetti *et al.* [12] who examine stock market data and also find that, while interdependence was dominant, contagion was nonetheless present in a number of cases. In the case of monthly interest rate data, however, our result seems to support similar findings that have been reported in Baig and Goldfajn [1]. It is worth introducing a note of caution regarding the conclusion in this study, since we do not conduct formal inference. The existing discussion of the results is merely conjecture rather than a formal test. In order to conduct a formal test of the stability of the transmission mechanism, it would be necessary to split the whole sample into crisis and non-crisis periods and obtain independent estimates together with standard errors. In this case, the window of crisis and non-crisis could be split endogenously using the methodology that has been suggested by Caporale *et al.* [5].

3.4 Conclusion

In the aftermath of the recent Asian crisis a lot of research effort has gone into identifying in which way the crisis spread between financial centres. In particular, it is important to understand whether the transmission mechanisms between markets change during crisis periods.

In this chapter, we propose an alternative procedure that allows us to test for the presence of contagion (i.e. a crisis-specific transmission mechanism). The advantage of our method is that it does not require any -potentially implausible - identifying assumptions. Rather, it is entirely data based and can be implemented using a simple cointegrated VAR.

We argue that it is important to acknowledge the non-stationarity of the data involved and that the presence (or absence) of cointegration should in itself be read as an indication of whether there is a structural transmission mechanism between financial markets. The data we examine are for the 6 ASIAN countries (Indonesia, Singapore, Thailand, Malaysia, Philippines, Korea) over the 1990-1999 period.

Whereas there is mixed evidence of pair-wise cointegration between these markets over most of the period, we propose to analyse the stability of a potential error-correction mechanism using the maximum-eigenvalue method suggested by Hansen and Johansen [33]. This maximum eigenvalue measure can be interpreted as the speed of error-correction in a cointegrated VAR. Our empirical results show considerable instability in the period shortly before and during the Asian crisis.

To tackle the issue of whether parameter instability in the VAR is due to contagion or due to transmission we recognize that the speed of error correction will depend on two factors: first the size of shocks by which the mechanism is hit and secondly the response of the cointegrating disequilibrium to these shocks. The latter can be interpreted as the transmission mechanism and the presence of contagion would then be indicated by changes in this impulse response over time. Using this framework we show that most of the instability in the maximum eigenvalue is due to changes in the background noise, i.e. in the size of shocks by which markets were hit. Still, there are a number of important cases during which the transmission mechanism changed substantially.

We conclude that while the spread of the Asian crisis cannot ultimately be attributed to contagion, contagion was still present in a number of episodes and is likely to have sped up the spread of the crisis.

3.5 Section Three Tables and Figures

Country	STOCK PRICE (DAILY)					
	Mean	Std Dev	Minimun	Maximum	Skewness	Kurtosis
Indonesia	472	123	256.8	740.8	-0.290	-0.860
Singapore	1589	393	805.0	2222.5	-0.721	-0.660
Malaysia	792	240	262.7	1271.6	-0.102	-1.464
Thailand	830	365	207.3	1415.0	0.825	-0.649
Philippines	1985	772	1082.2	3447.6	-0.150	-1.047
Korea	736	176	280.0	1027.9	-0.276	-1.005

Table 3.1: The Summary Statistics of Stock Market Price Index

Country	INTEREST RATE (DAILY)					
	Mean	Std Dev	Minimum	Maximum	Skewness	Kurtosis
Indonesia	22.77	14.84	14	64	1.746	1.445
Singapore	3.25	1.31	0.375	7	0.685	0.207
Malaysia	7.07	1.22	5	10.3	0.619	-0.046
Thailand	11.99	4.71	5	27.5	0.622	-0.043
Philippines	9.41	2.49	4.5	14.25	0.114	-0.827
Korea	13.49	3.37	10.05	22.95	1.287	0.808

Table 3.2: The Summary Statistics of Daily Interest Rate

Country	MONEY MARKET (MONTHLY)					
	Mean	Std Dev	Minimun	Maximum	Skewness	Kurtosis
Indonesia	18.57	15.30	5.68	81.01	2.484	5.295
Singapore	3.93	1.52	1	9	0.730	0.481
Malaysia	6.10	2.16	2	9.98	-0.208	-0.712
Thailand	9.27	4.25	1.33	23.87	0.792	0.910
Philippines	14.92	4.36	7.71	28.57	1.029	0.725
Korea	12.36	3.57	4.75	25.63	0.622	1.573

Table 3.3: The Summary Statistics of Money Market

Country	DEPOSIT RATE (MONTHLY)					
	Mean	Std Dev	Minimun	Maximum	Skewness	Kurtosis
Indonesia	19.88	7.80	10.34	54.67	2.624	7.642
Singapore	3.36	0.91	1.68	5.78	0.374	-0.579
Malaysia	12.59	1.90	2	9.98	-0.073	-0.665
Thailand	12.59	1.89	1.5	16.5	-0.822	4.132
Philippines	11.96	3.90	5.2	27.07	1.026	0.650
Korea	12.92	2.23	7.28	17	-0.104	-0.290

Table 3.4: The Summary Statistics of Deposit Rate

	Stock Market Index (Daily)		Daily Interest Rate (Daily)	
	Lag Order (p)	ADF Statistics	Lag Order (p)	ADF (Statistics)
Indonesia	2	-42.6559	1	-2.1501
Singapore	1	-43.6764	2	-2.3133
Malaysia	1	-22.7915	1	-1.7194
Phillipines	1	-42.6163	1	-1.2357
Korea	1	-49.3932	1	-3.7692
Country	Money Market Rate Monthly		Deposit Rate Monthly	
	Lag Order (p)	ADF Statistics	Lag Order (p)	ADF Statistics
Indonesia	1	-1.1501	2	-2.6414
Singapore	2	-2.1138	1	-2.5964
Malaysia	2	-1.9194	2	-2.3699
Phillipines	1	-2.2337	1	-1.3848
Korea	2	-2.7392	1	-2.0726
Lag order chosen using value of SBC, AIC, and HQ criterion.				

Table 3.5: Unit Root Test Results for Stock market price, Daily Interest Rate, Monthly Money Market rate, and Monthly Deposit Rate

Country		Johansen Test Statistics			
		Eigenvalue		Trace	
		H_o: r=0	H_o: r⩽1	H_o: r=0	H_o: r⩽1
Indonesia	Thailand	7.9528	3.5442	11.4970	3.5442
	Singapore	11.2909	2.0450	13.3359	2.0450
	Malaysia	12.3398	1.7004	14.0402	1.7004
	Phillipines	14.3959*	2.6573	17.0532*	2.6573
	Korea	10.6277	1.9533	12.5809	1.9533
Thailand	Singapore	2.5693	.99711	3.5664	.99711
	Malaysia	8.3351	2.6908	11.0259	2.6908
	Phillipines	9.7865	4.0303	13.8167	4.0303
	Korea	2.9536	1.1227	4.0763	1.1227
Singapore	Malaysia	4.3982	1.4066	5.8048	1.4066
	Phillipines	2.5204	1.1450	3.6653	1.1450
	Korea	19.8477*	1.3354	21.1831*	1.3354
Malaysia	Phillipines	13.7776	1.1767	14.9544	1.1767
	Korea	9.1384	2.0672	11.2056	2.0672
Phillipines	Korea	5.7108	1.6621	7.3729	1.6621

* denotes rejection of the null hypothesis of no cointegration at 5% level of significance

Table 3.6: Cointegration Test Results for Stock Market Index

		Johansen Test Statistics			
Country		Eigenvalue		Trace	
		H_o: r=0	H_o: r⩽1	H_o: r=0	H_o: r⩽1
Indonesia	Thailand	8.5142	5.2276	13.7417	5.2276
	Singapore	7.6500	3.2644	10.9144	3.2644
	Malaysia	4.8883	3.1451	8.0334	3.1451
	Phillipines	4.9082	1.0670	5.9752	1.0670
	Korea	20.1311*	1.1967	21.3277*	1.1967
Thailand	Singapore	14.2762	.017889	14.2941	.017889
	Malaysia	15.2448*	.28185	15.5267	.28185
	Phillipines	4.2670	.83434	5.1014	.83434
	Korea	20.8431*	.44294	21.2860*	.44294
Singapore	Malaysia	18.4952*	.62574	19.1209*	.62574
	Phillipines	1.4571	.21578	1.6729	.21578
	Korea	20.4189*	.32261	20.7415*	.32261
Malaysia	Phillipines	2.8463	1.3838	4.2301	1.3838
	Korea	27.7016*	3.4238	31.1254*	3.4238
Phillipines	Korea	19.6126*	1.4706	21.0832*	1.4706

* denotes rejection of the null hypothesis of no cointegration at 5% level of significance

Table 3.7: Cointegration Test Results for Daily Interest Rate

		Johansen Test Statistics			
Country		Eigenvalue		Trace	
		H_o: r=0	H_o: r⩽1	H_o: r=0	H_o: r⩽1
Indonesia	Thailand	14.0371*	10.25*	33.36*	10.25*
	Singapore	14.0371	5.8134	19.8505*	5.8134
	Malaysia	10.0493	4.6654	14.7147	4.6654
	Phillipines	5.5120	3.2912	8.8032	3.2912
	Korea	10.3107	4.8052	15.1159	4.8052
Thailand	Singapore	19.2829*	3.2493	22.5322*	3.2493
	Malaysia	17.5711*	3.4859	21.0570	3.4859
	Phillipines	12.0692	.91297	12.9822	.91297
	Korea	24.2443*	.14213	24.3864*	.14213
Singapore	Malaysia	12.4707	8.4800	20.9507*	8.4800*
	Phillipines	17.8511*	2.5407	20.3918*	2.5407
	Korea	14.7360	1.3929	16.1290	1.3929
Malaysia	Phillipines	11.1023	2.9959	14.0982	2.9959
	Korea	28.1049*	1.6570	29.7618*	1.6570
Phillipines	Korea	7.6987	.21479	7.9135	.21479

* denotes rejection of the null hypothesis of no cointegration at 5% level of significance

Table 3.8: Cointegration Test Results for Money Market Interest Rate

		Johansen Test Statistics			
Country		Eigenvalue		Trace	
		H_o: r=0	H_o: r⩽1	H_o: r=0	H_o: r⩽1
Indonesia	Thailand	15.9007*	8.9638*	24.8645*	8.9638*
	Singapore	22.8247*	10.1890*	33.0138*	10.1890*
	Malaysia	7.1179	4.2472	11.3651	4.2472
	Phillipines	6.9121	4.0839	10.9960	4.0839
	Korea	11.7184	6.6285	18.3469*	6.6285
Thailand	Singapore	58.4697*	6.5142	64.9839*	6.5142
	Malaysia	39.0208*	6.1464	45.1672*	6.1464
	Phillipines	33.5962*	5.2185	38.8148*	5.2185
	Korea	30.5406*	5.3231	35.8637*	5.3231
Singapore	Malaysia	14.4046*	5.2167	19.6212*	5.2167
	Phillipines	14.6825*	4.3949	19.0774*	4.3949
	Korea	8.3888	6.1824	14.5712	6.1824
Malaysia	Phillipines	10.9724	4.0977	15.0701	4.0977
	Korea	10.5222	5.4455	15.9676	5.4455
Phillipines	Korea	14.0175	3.9504	17.9679*	3.9504
* denotes rejection of the null hypothesis of no cointegration at 5% level of significance					

Table 3.9: Cointegration Test Results for Monthly Deposit Interest Rate

	Johansen Trace Statistics					
STOCK MARKET INDEX						
	Indonesia	Thailand	Singapore	Malaysia	Philippines	Korea
Indonesia	.	0	0	0	4.3959 (0.03)	0
Thailand	0	.	0	0	0	19.8977 (0.02)
Singapore	0	0	.	0	0	0
Malaysia	0	0	0	.	0	7.6918 (0.17)
Philippines	0	0	0	0	.	0
Korea	0	0	0	0	0	
DAILY INTEREST RATE						
Indonesia	.	0	0	0	0	20.1311 (0.00)
Thailand	0	.	15.696 (0.01)	15.2448 (0.01)	0	20.8431 (0.00)
Singapore	0	0	.	184952 (0.00)	0	20.4189 (0.00)
Malaysia	0	0	0	.	0	27.7016 (0.00)
Philippines	0	0	0	0	.	19.6126 (0.00)
Korea	0	0	0	0	0	.
P-value in parentheses.						

Table 3.10: Summary of cointegration test results based on Trace statistic

	Johansen Max.Eigenvalue Statistics					
STOCK MARKET INDEX						
	Indonesia	Thailand	Singapore	Malaysia	Philippines	Korea
Indonesia	.	0	0	0	17.0532 (0.01)	0
Thailand	0	.	0	0	0	0
Singapore	0	0	.	0	0	21.1831 (0.01)
Malaysia	0	0	0	.	0	
Philippines	0	0	0	0	.	0
Korea	0	0	0	0	0	
DAILY INTEREST RATE						
Indonesia	.	0	0	0	0	21.3277 (0.00)
Thailand	0	.		15.2448 (0.00)	0	21.2860 (0.00)
Singapore	0	0	.	9.66 (0.02)	0	0
Malaysia	0	0	0	.	0	31.1254 (0.00)
Philippines	0	0	0	0	.	21.032 (0.00)
Korea	0	0	0	0	0	.
P-value in parentheses.						

Table 3.11: Summary of cointegration test results based on Maximum Eigenvalue

	Johansen Trace Statistics					
MONEY MARKET INTEREST						
	Indonesia	Thailand	Singapore	Malaysia	Philippines	Korea
Indonesia	.	36.36 (0.00)	19.8505 (0.00)	0	0	0
Thailand	0	.	22.5322 (0.00)	21.0570 (0.00)	0	24.3864 (0.00)
Singapore	0	0	.	20.9507 (0.01)	20.3918 (0.01)	
Malaysia	0	0	0	0		29.7618 (0.00)
Philippines	0	0	0	0	.	
Korea	0	0	0	0	0	.
MONTHLY DEPOSIT INTEREST						
Indonesia	.	24.8545 (0.02)	33.0138 (0.01)	0	0	
Thailand	0	.	64.9839 (0.00)	45.1672 (0.00)	38.8148 (0.00)	35.8637 (0.00)
Singapore	0	0	.	19.6212 (0.01)	19.0774 (0.03)	0
Malaysia	0	0	0	.	0	0
Philippines	0	0	0	0	.	17.9679 (0.00)
Korea	0	0	0	0	0	.
P-value in parentheses.						

Table 3.12: Summary of cointegration test results based on Trace statistics

Johansen Max.Eigenvalue Statistics						
MONEY MARKET INTEREST						
	Indonesia	Thailand	Singapore	Malaysia	Philippines	Korea
Indonesia	.	14.0371 (0.01)	0	0	0	
Thailand	0	.	19.2829 (0.01)	17.5711 (0.00)	0	24.2443 (0.01)
Singapore	0	0	.		17.8511 (0.01)	
Malaysia	0	0	0	0		28.1044 (0.00)
Philippines	0	0	0	0	.	
Korea	0	0	0	0	0	.
MONTHLY DEPOSIT INTEREST						
Indonesia		15.9007 (0.01)	22.8247 (0.01)	0	0	
Thailand		.	58.4697 (0.00)	39.0208 (0.00)	33.5462 (0.02)	30.5406 (0.01)
Singapore		0	.	14.4046 (0.01)	14.6825 (0.24)	0
Philippines		0	0	.	0	0
Malaysia		0	0	0	.	0
Korea		0	0	0	0	.
P-value in parentheses.						

Table 3.13: The summary of cointegration test results based on Maximum Eigenvalue statistics

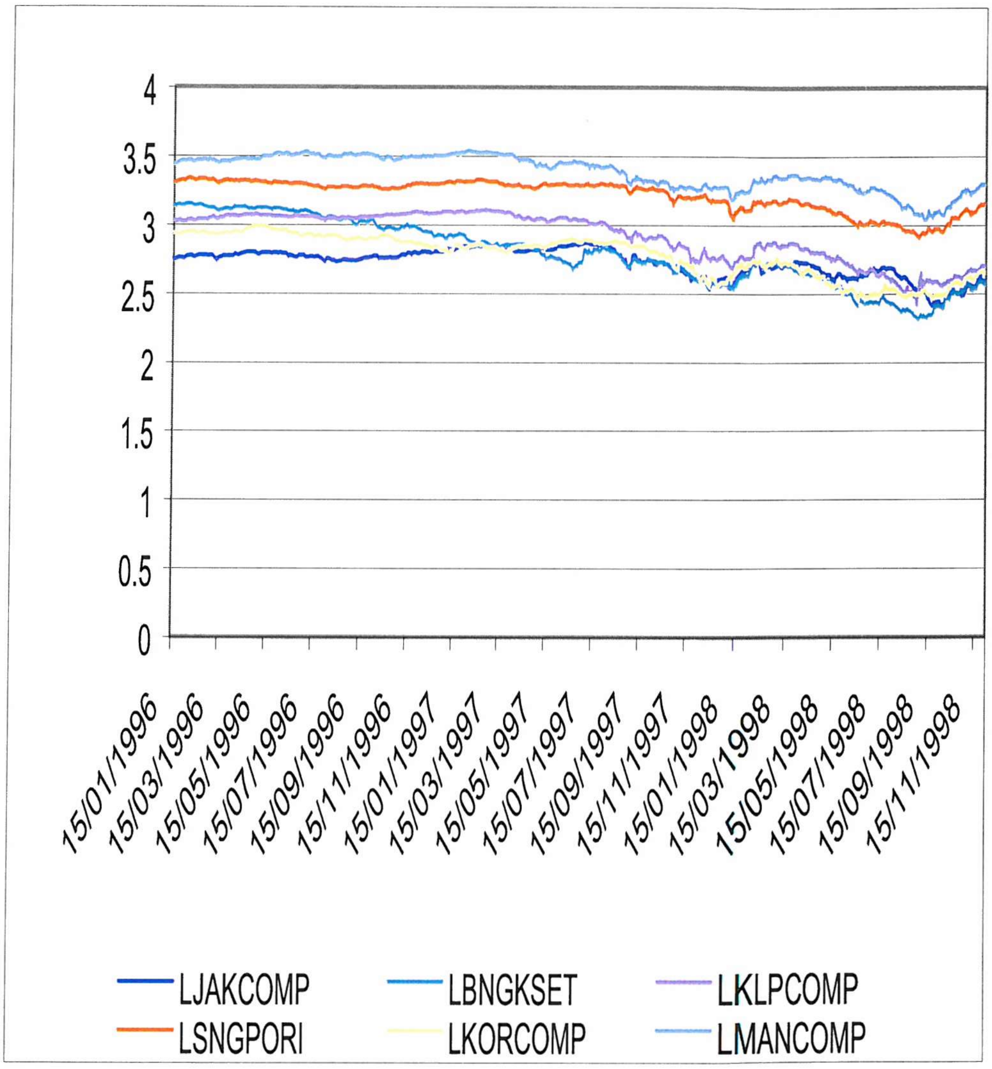


Figure 3.1: Asian Stock Market Index (in logarithmic form)

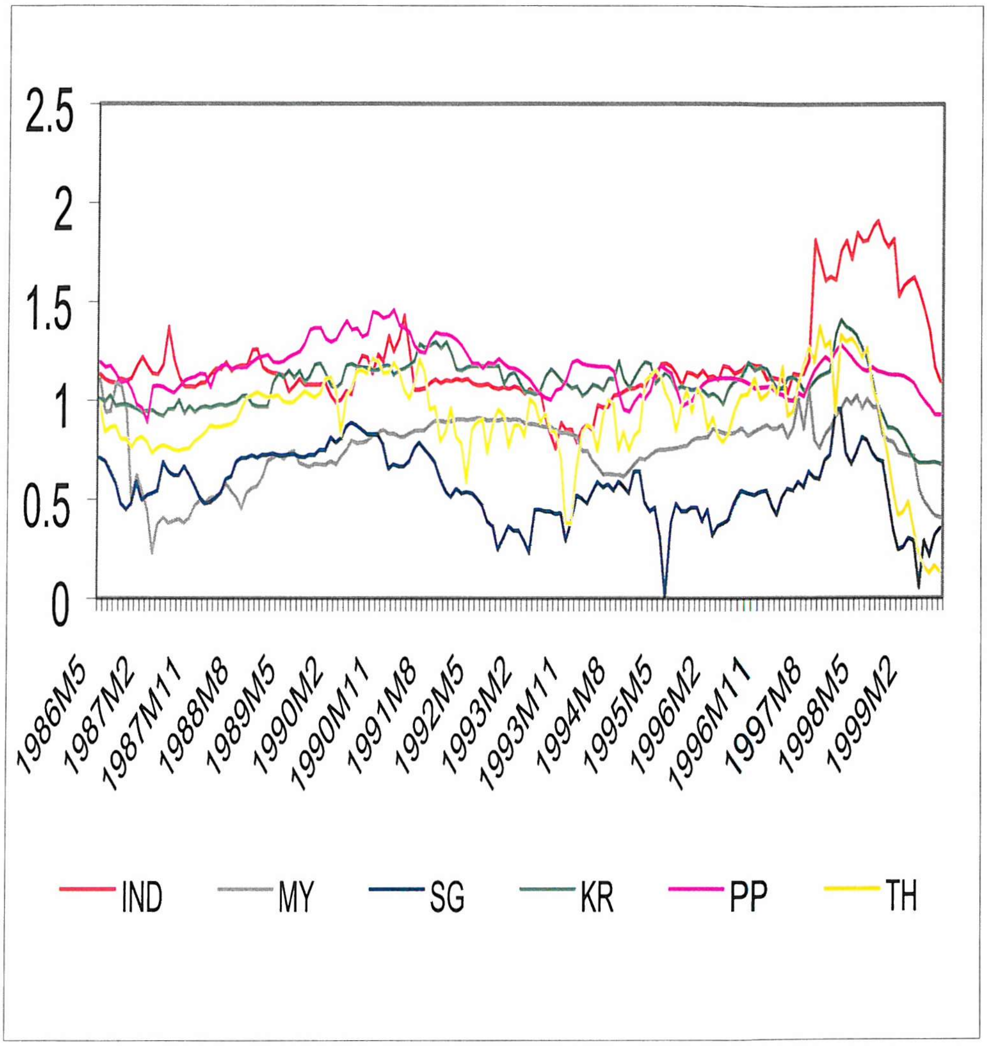


Figure 3.2: Asian Money Market Interest Rate (in logarithmic form)

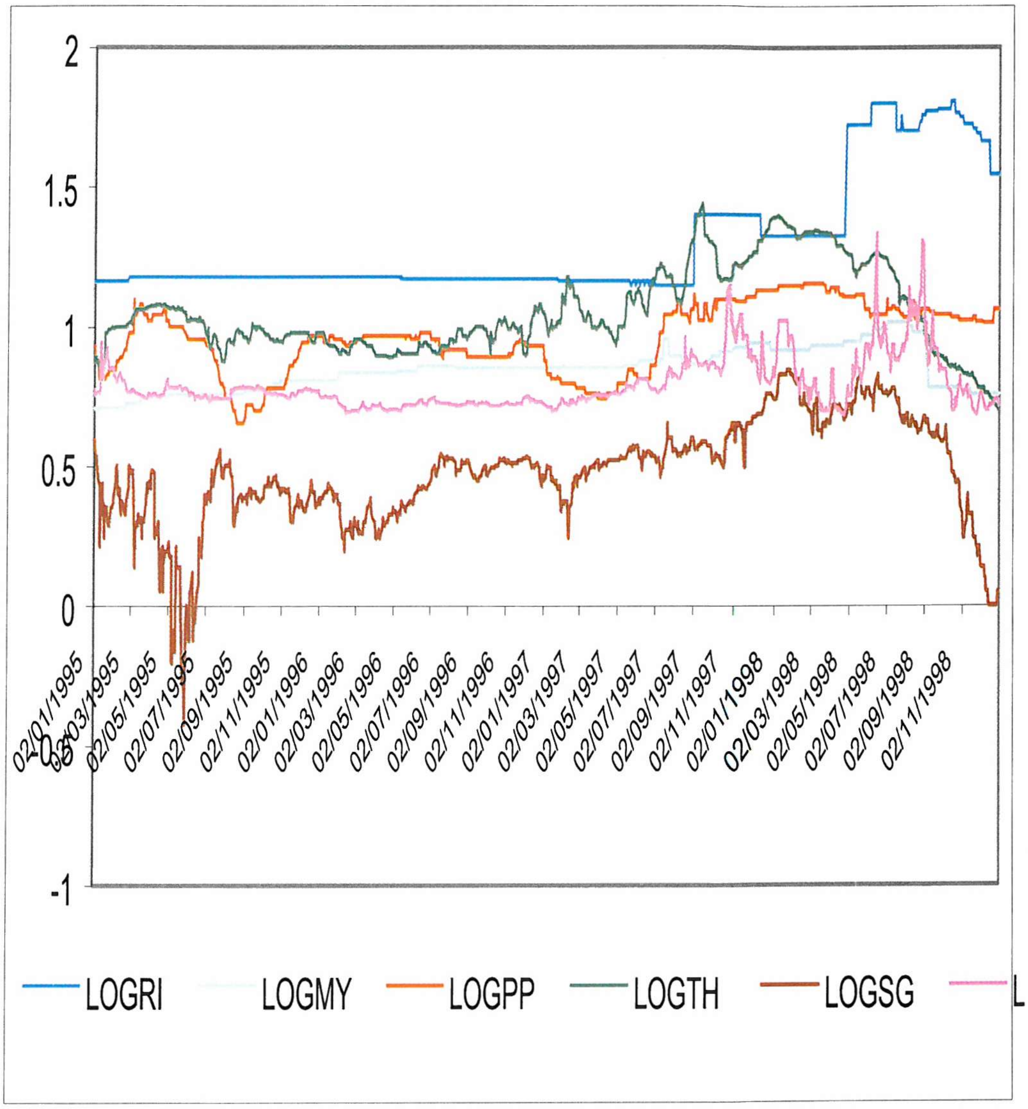


Figure 3.3: Asian Daily Nominal Interest Rate (in logarithmic form)

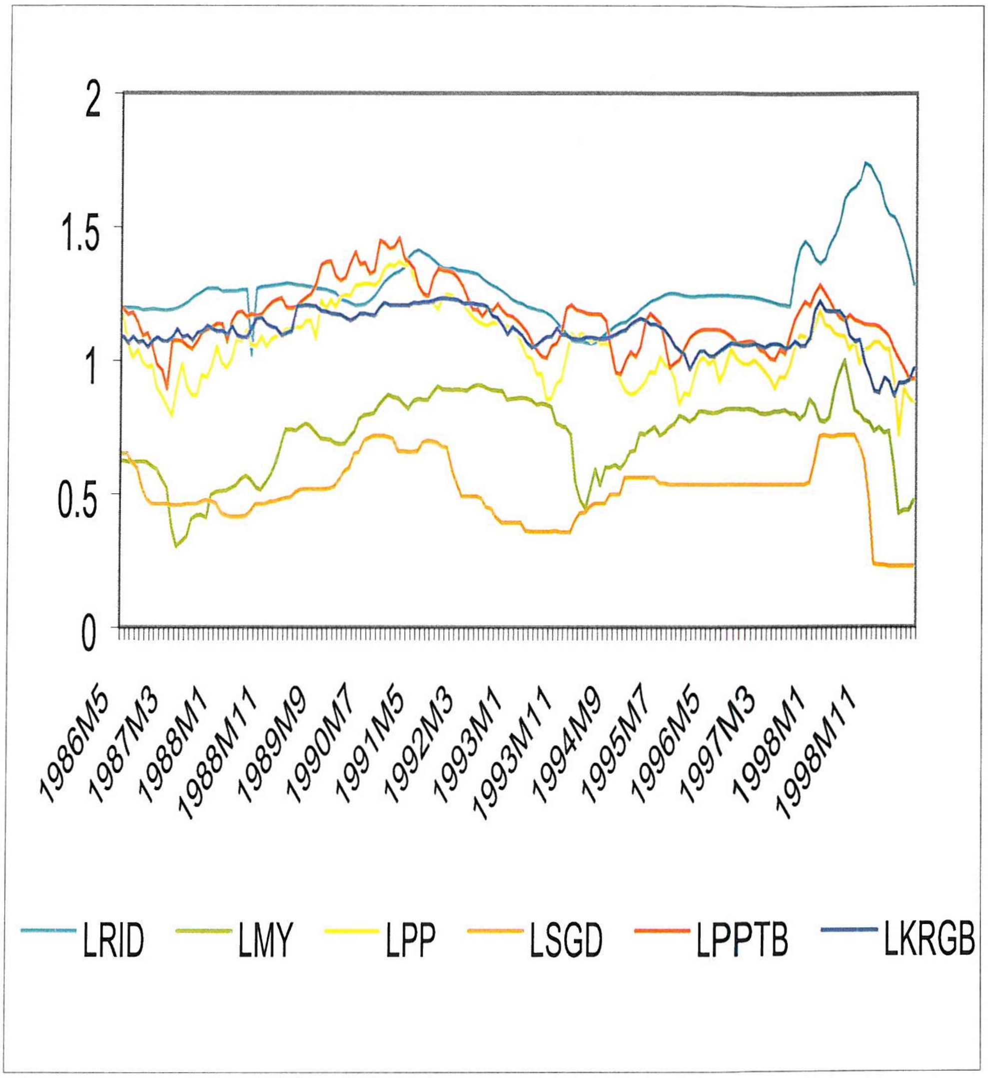


Figure 3.4: Asian Deposit Rate (in logarithmic form)

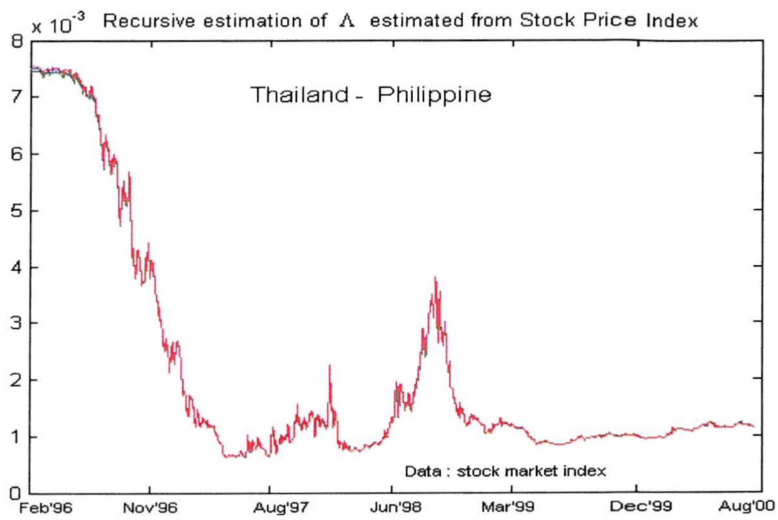
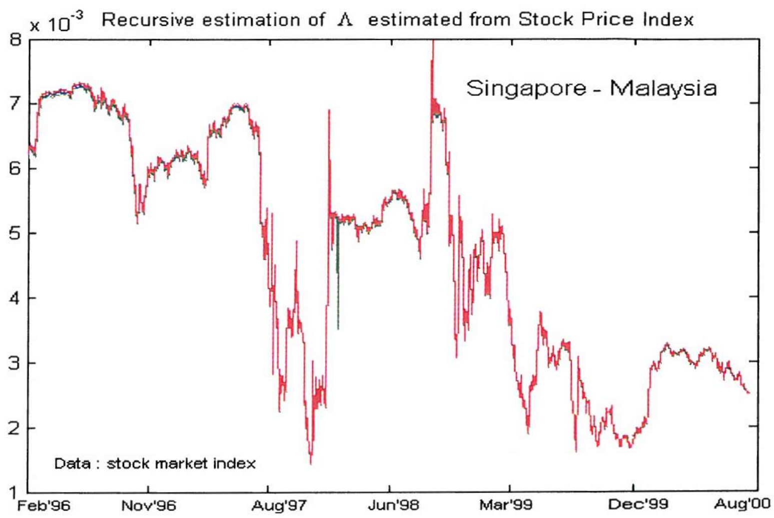


Figure 3.5: Recursive Estimate of $\mathbf{\Lambda}$ from Stock Market Index



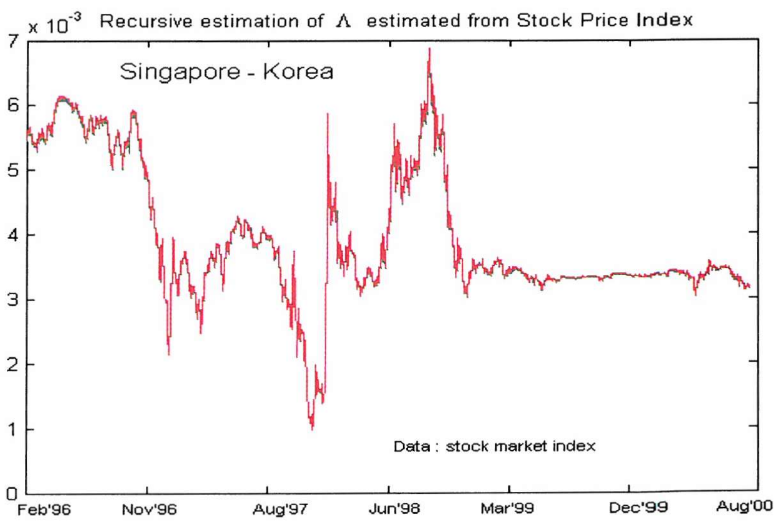
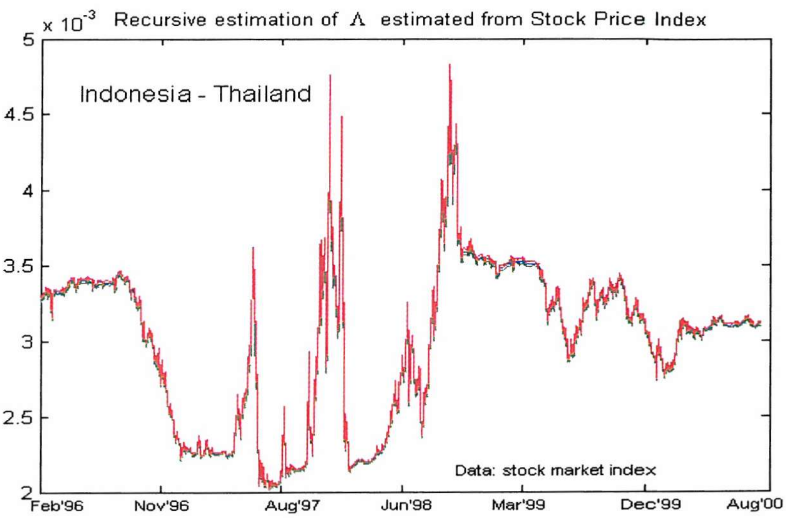


Figure 3.6: Recursive Estimate of $\mathbf{\Lambda}$ from Stock Market Index (continued)



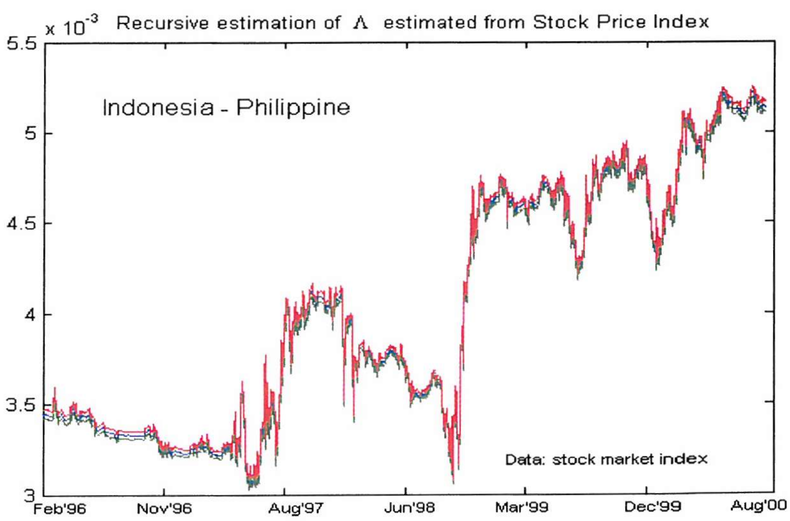
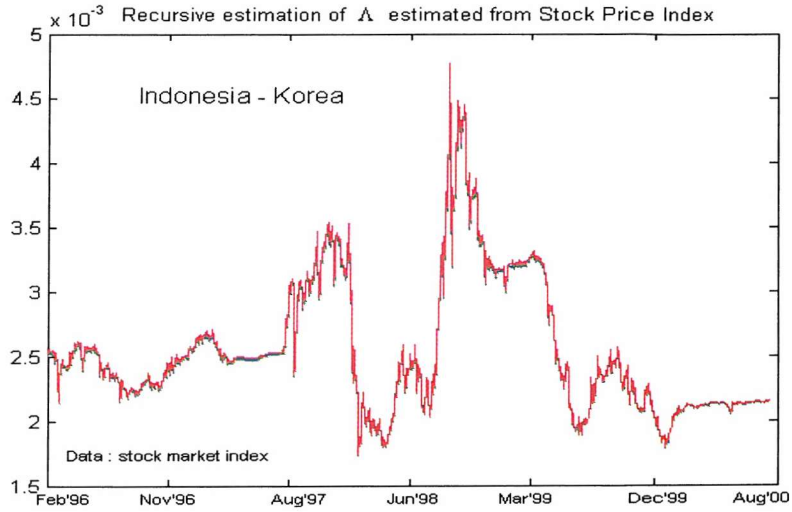


Figure 3.7: Recursive Estimate of $\mathbf{\Lambda}$ from Stock Market Index (continued)



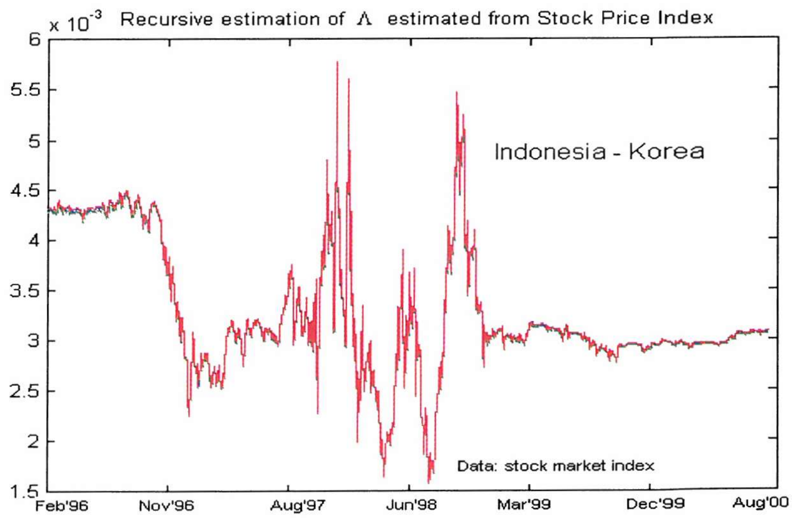


Figure 3.8: Recursive Estimate of $\mathbf{\Lambda}$ from Stock Market Index (continued)

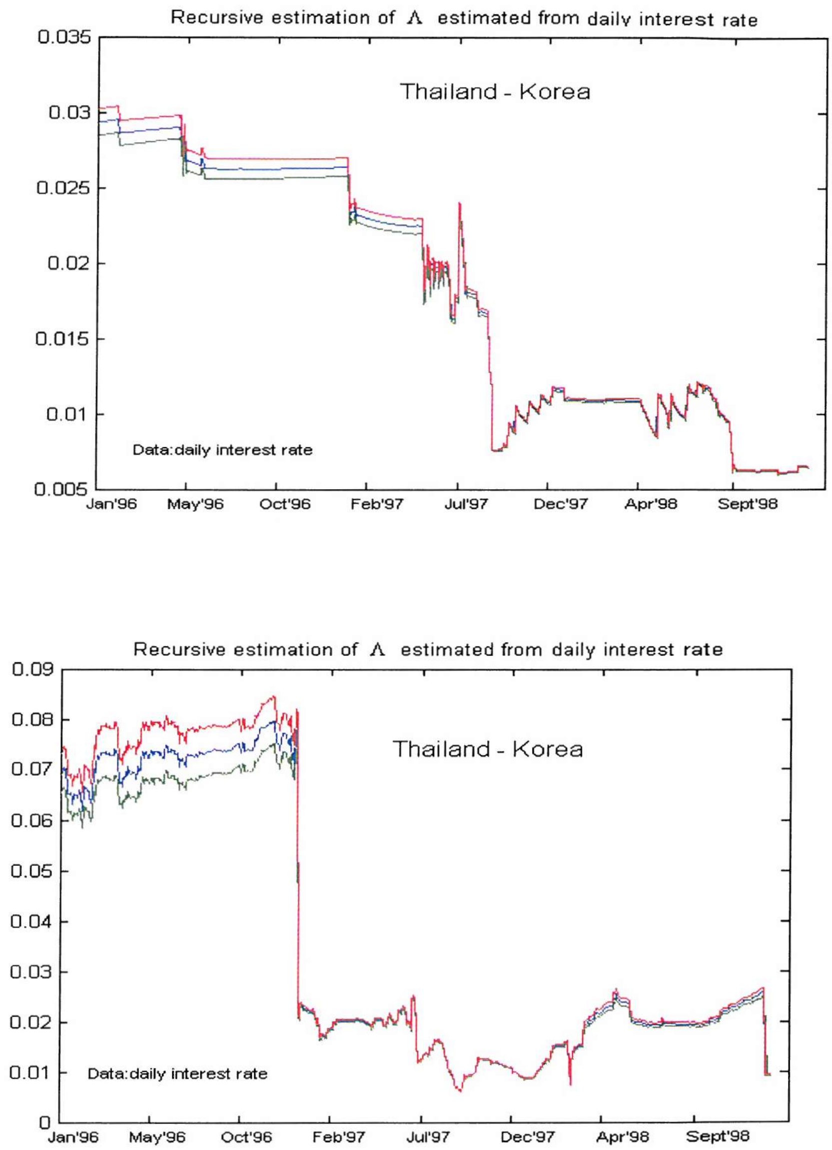
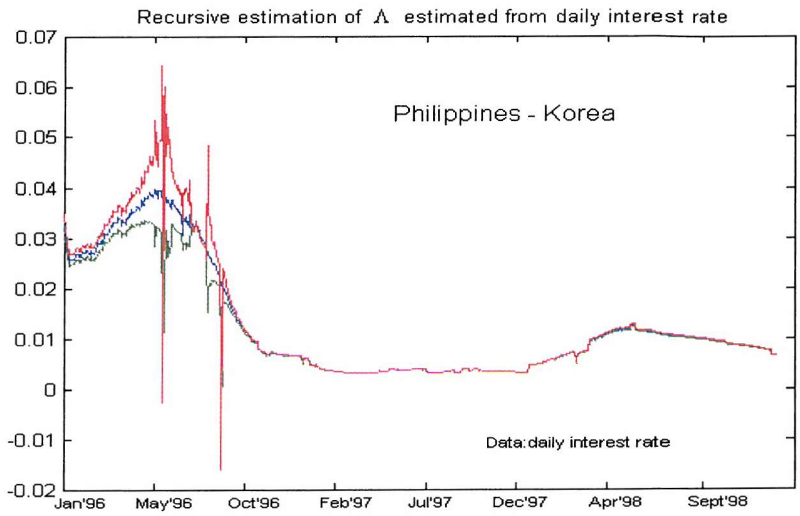


Figure 3.9: Recursive Estimate of $\mathbf{\Lambda}$ from Daily Interest Rate



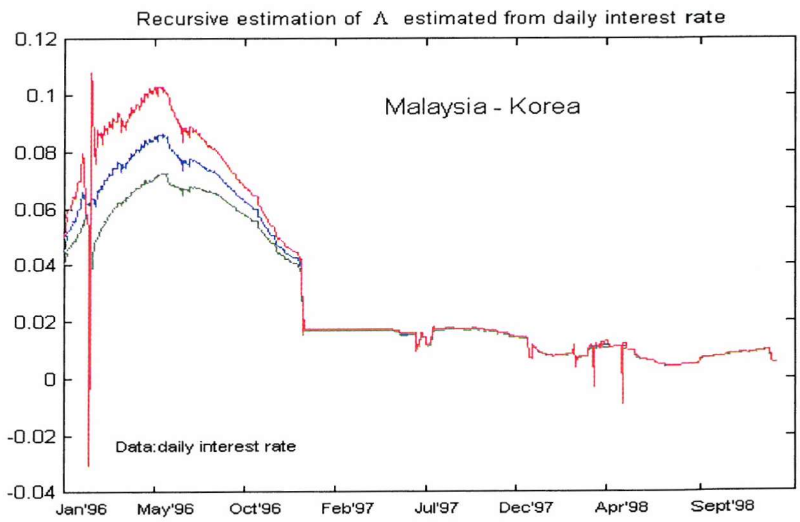


Figure 3.10: Recursive Estimate of $\mathbf{\Lambda}$ from Daily Interest Rate (continued)

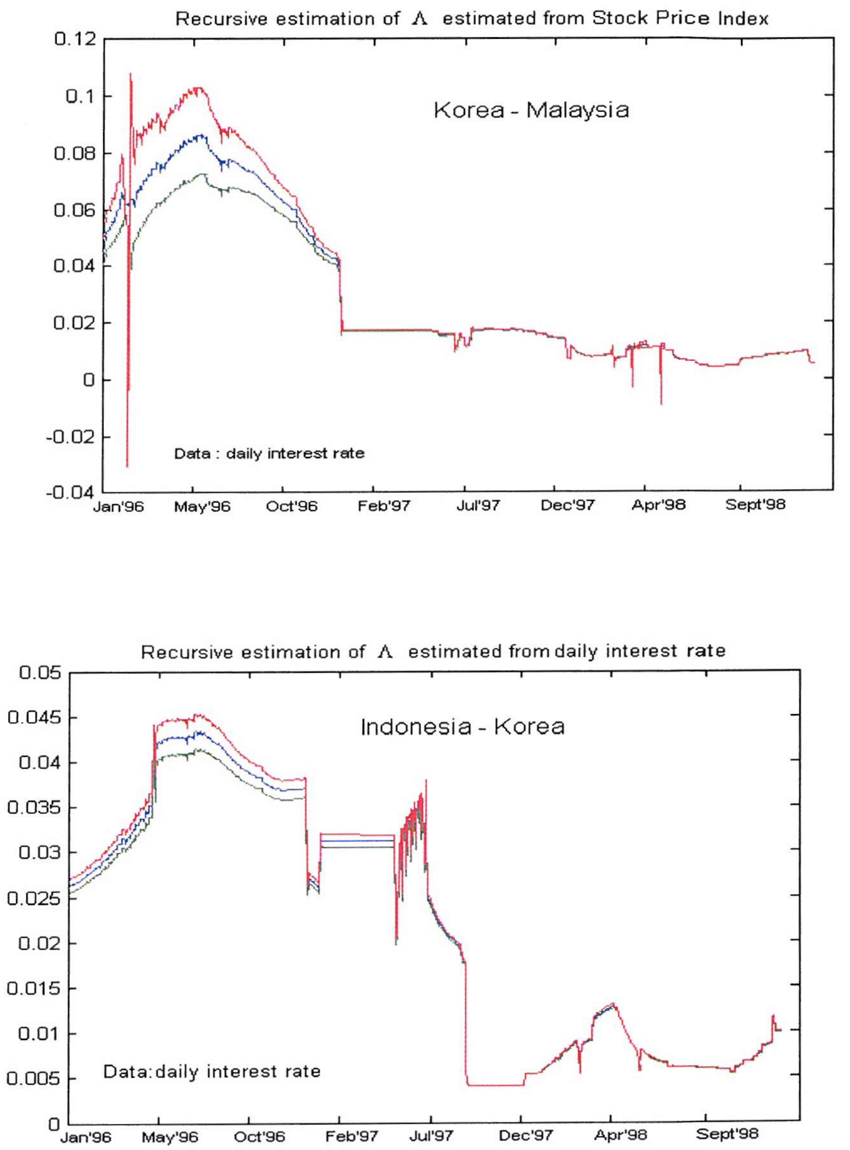


Figure 3.11: Recursive Estimate of $\mathbf{\Lambda}$ from Daily Interest Rate (continued)

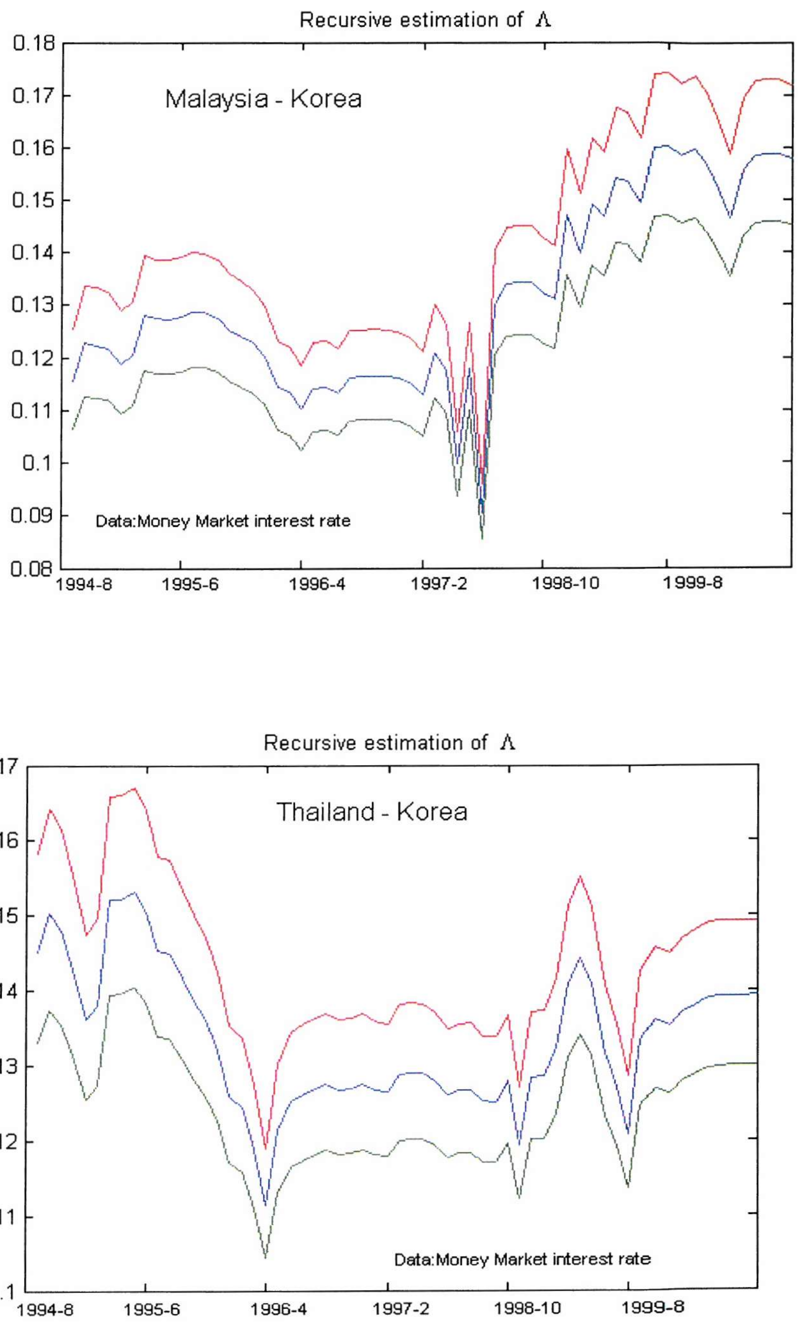
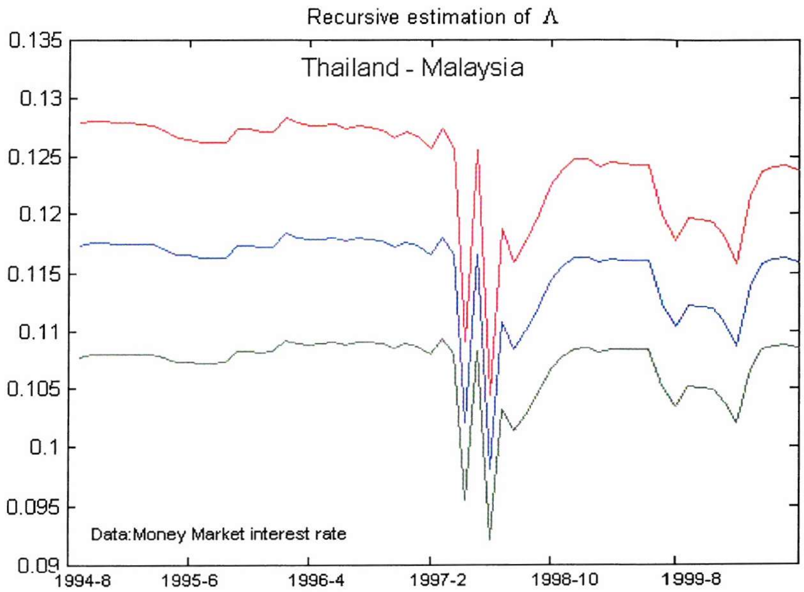


Figure 3.12: Recursive Estimate of $\boldsymbol{\Lambda}$ from Money Market Rate



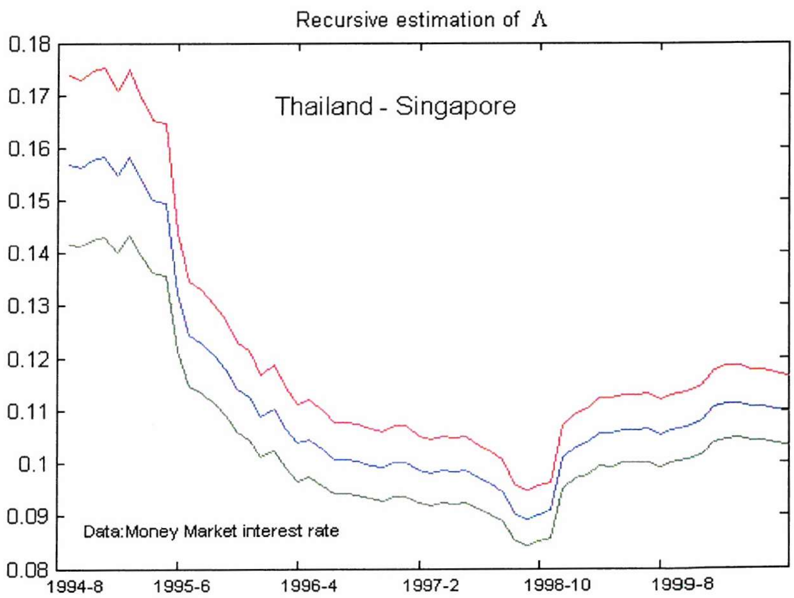
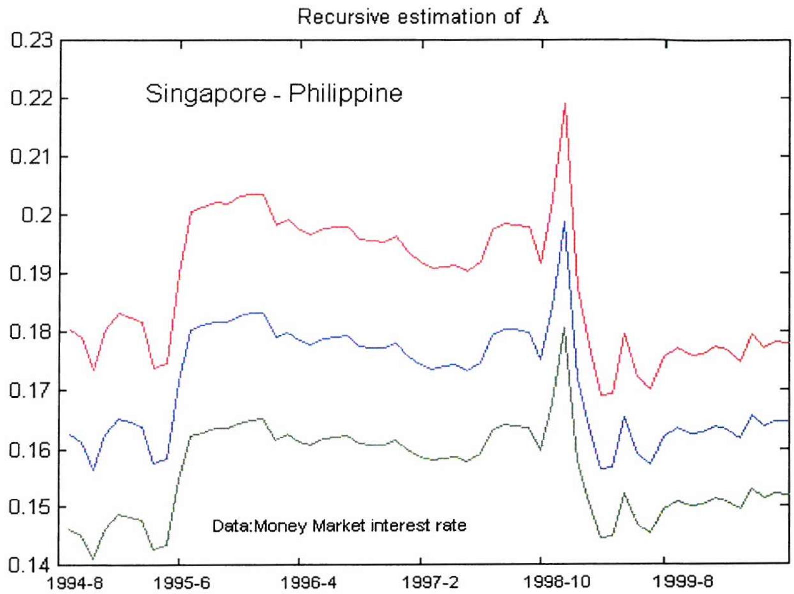


Figure 3.13: Recursive Estimate of $\mathbf{\Lambda}$ from Money Market Rate (continued)



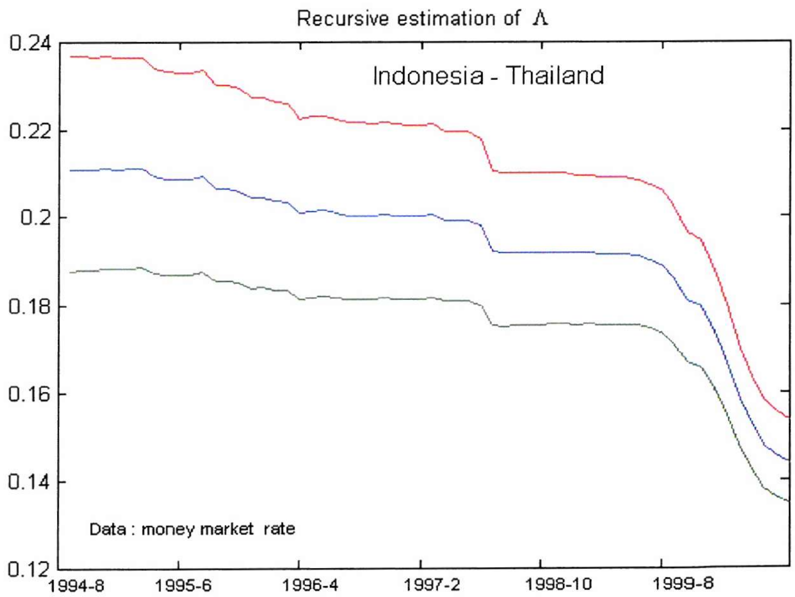
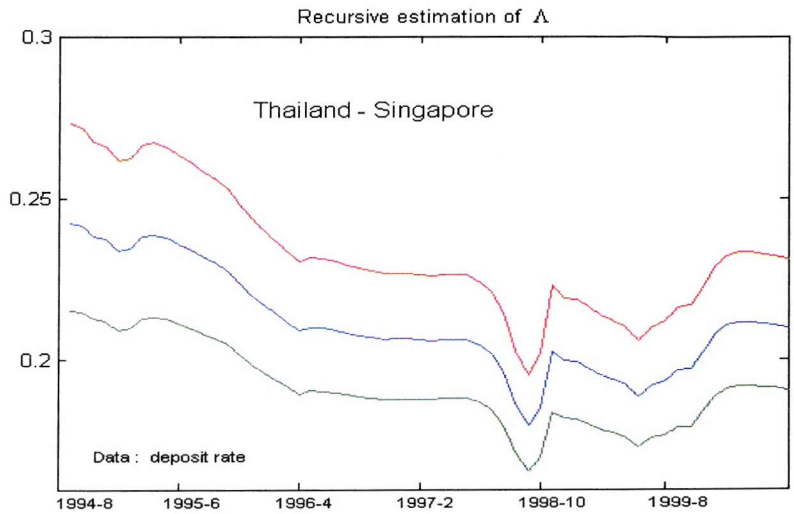


Figure 3.14: Recursive Estimate of $\mathbf{\Lambda}$ from Money Market Rate (continued)



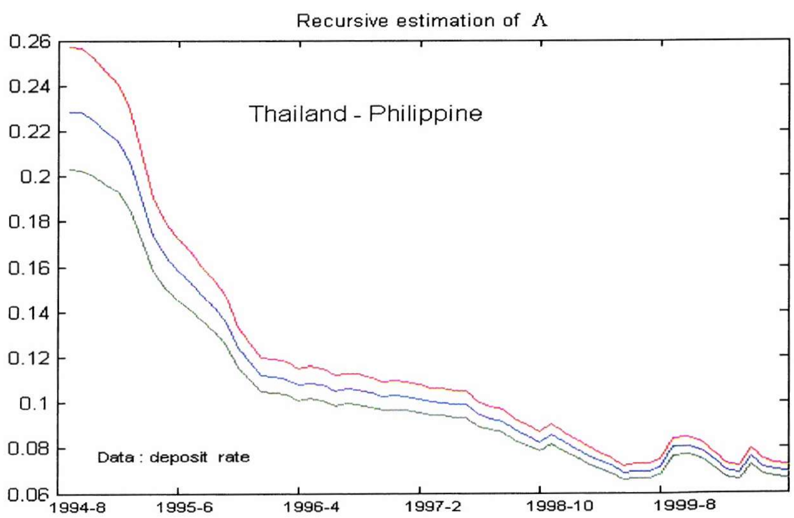
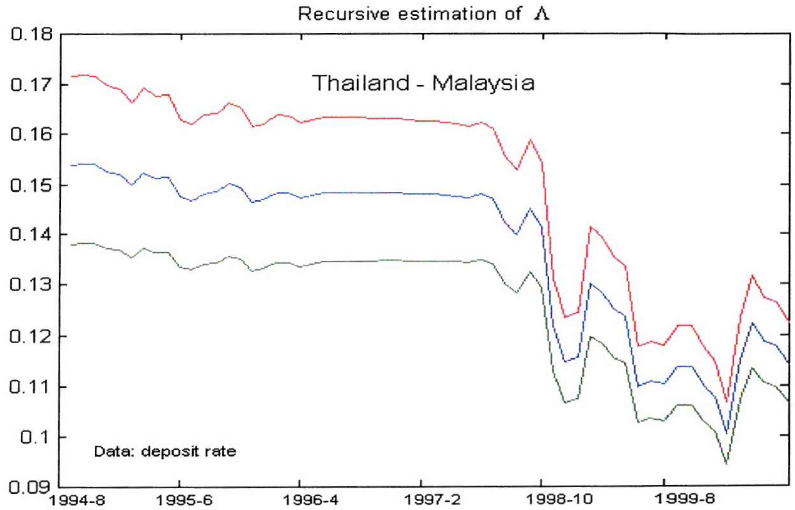


Figure 3.15: Recursive Estimate of $\mathbf{\Lambda}$ from Monthly Deposit Rate



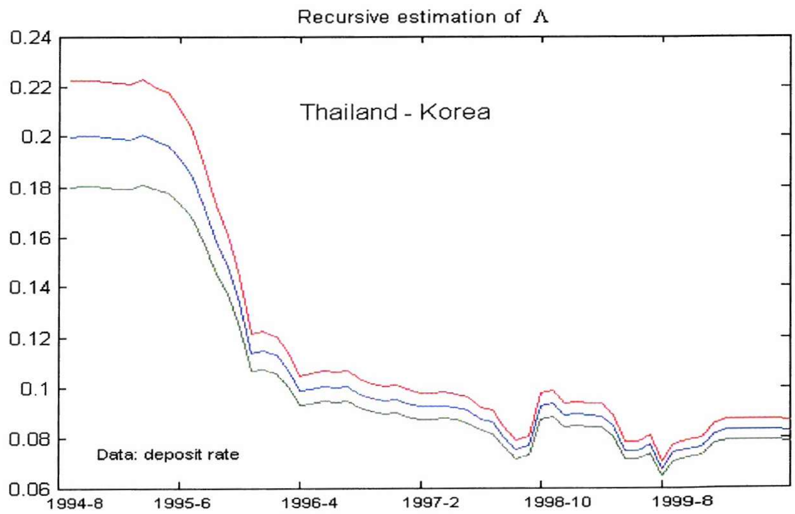
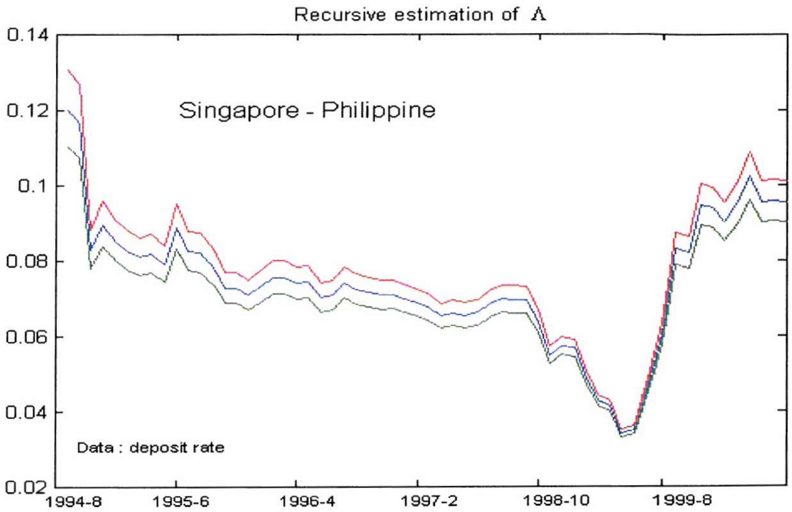


Figure 3.16: Recursive Estimate of $\mathbf{\Lambda}$ from Monthly Deposit Rate (continued)



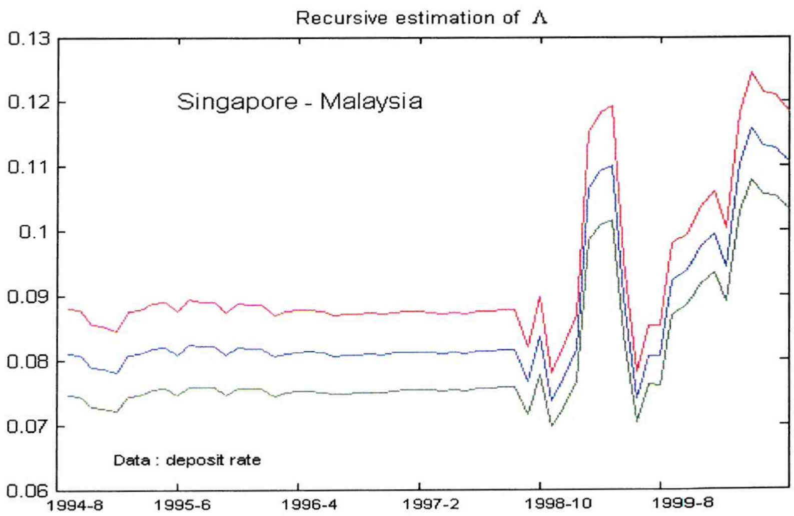
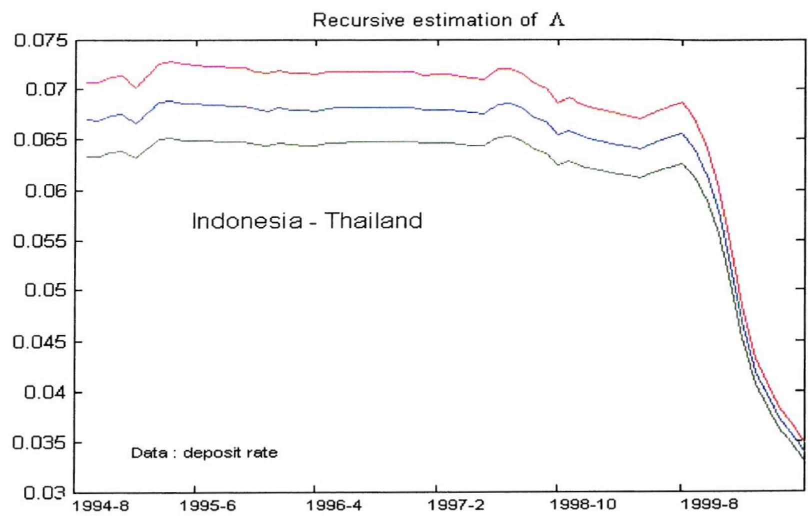


Figure 3.17: Recursive Estimate of $\mathbf{\Lambda}$ from Monthly Deposit Rate (continued)



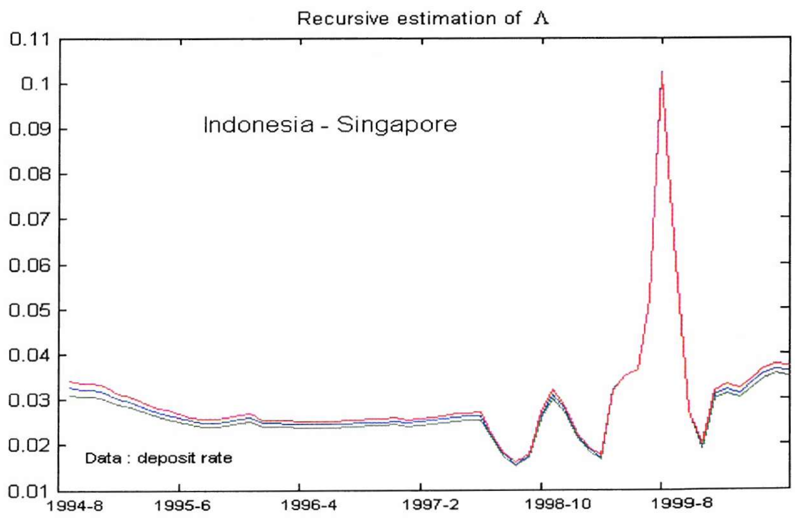
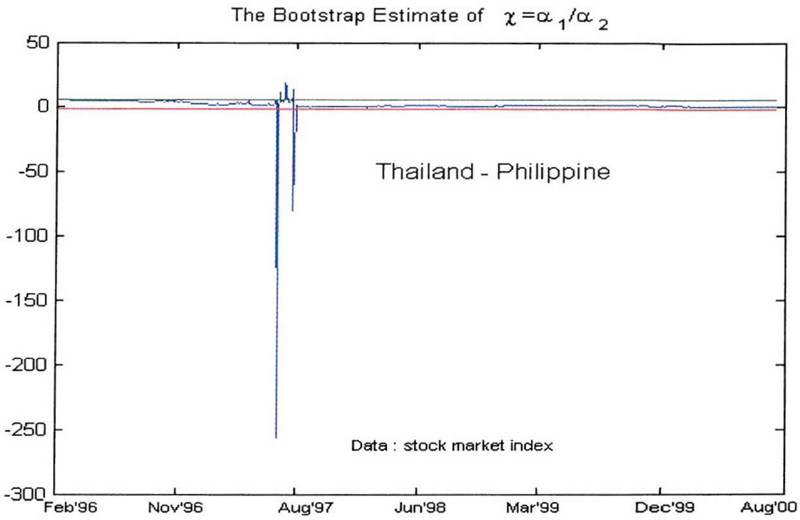


Figure 3.18: Recursive Estimate of $\mathbf{\Lambda}$ from Monthly Deposit Rate (continued)



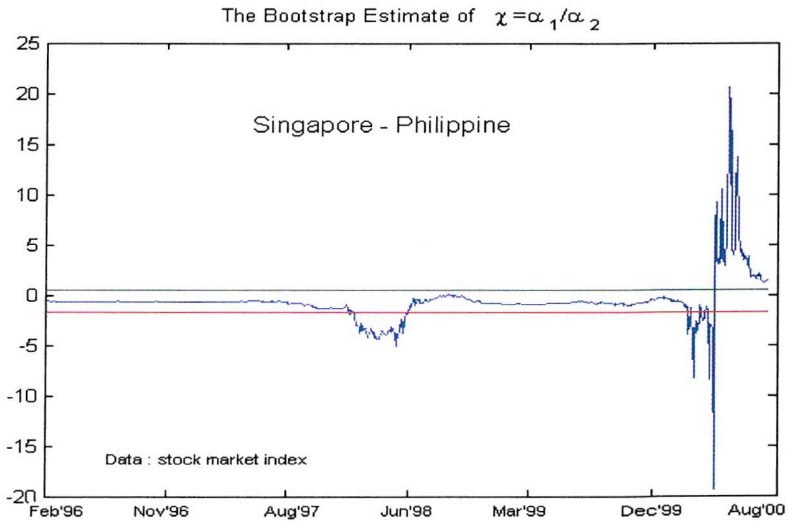
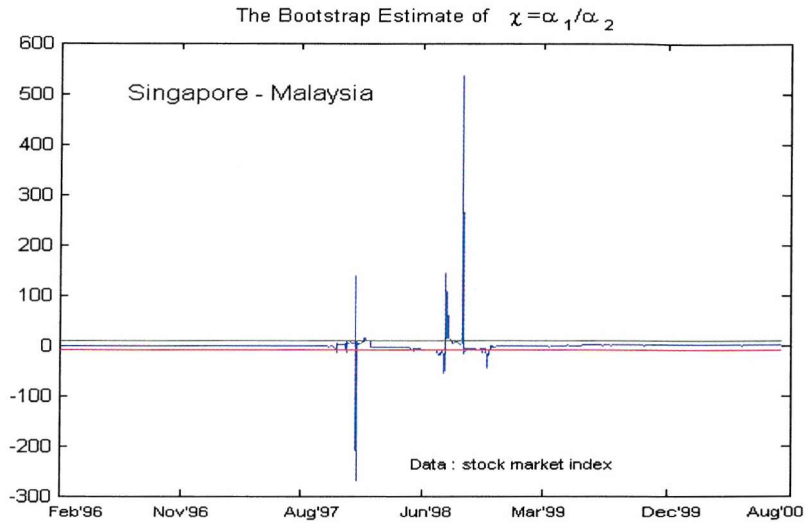


Figure 3.19: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Stock Market Index



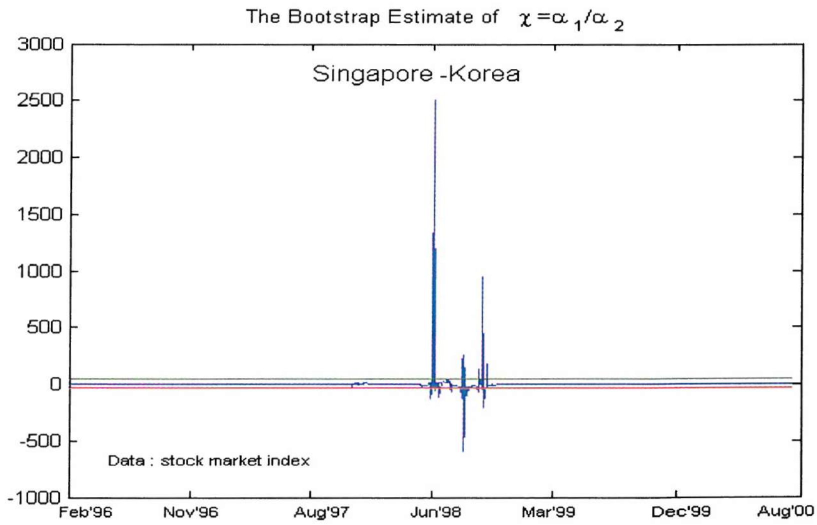


Figure 3.20: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Stock Market Index (continued)

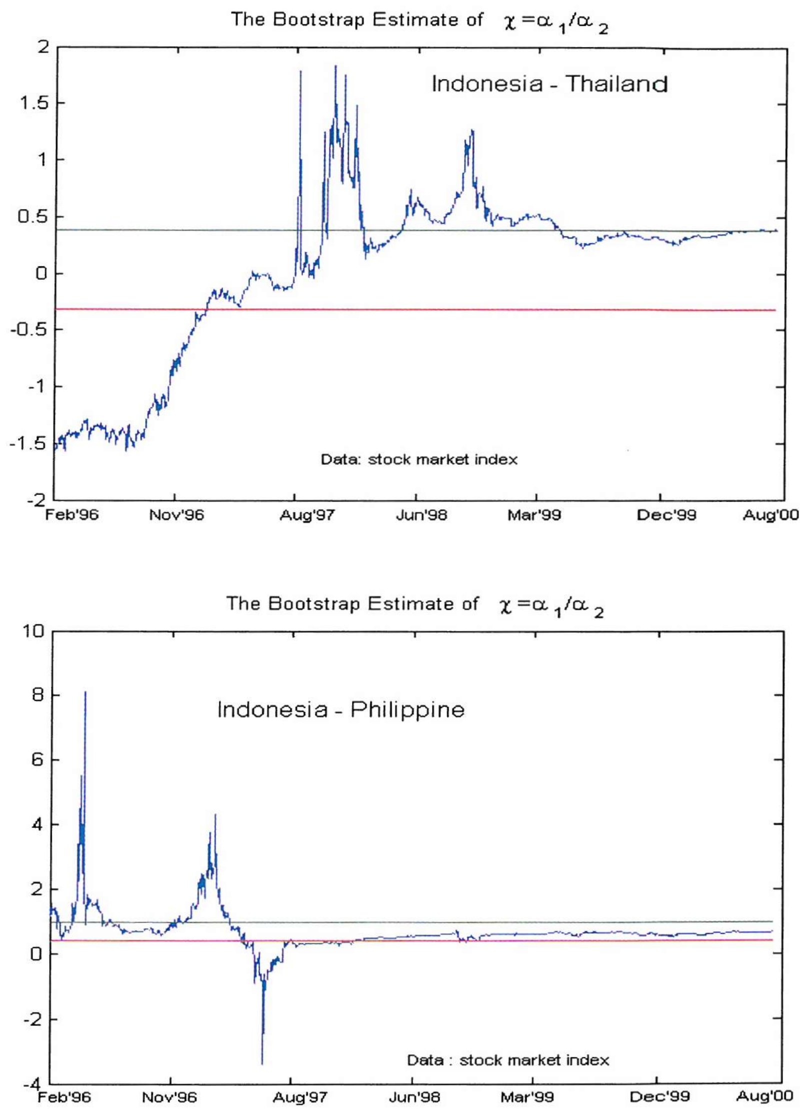
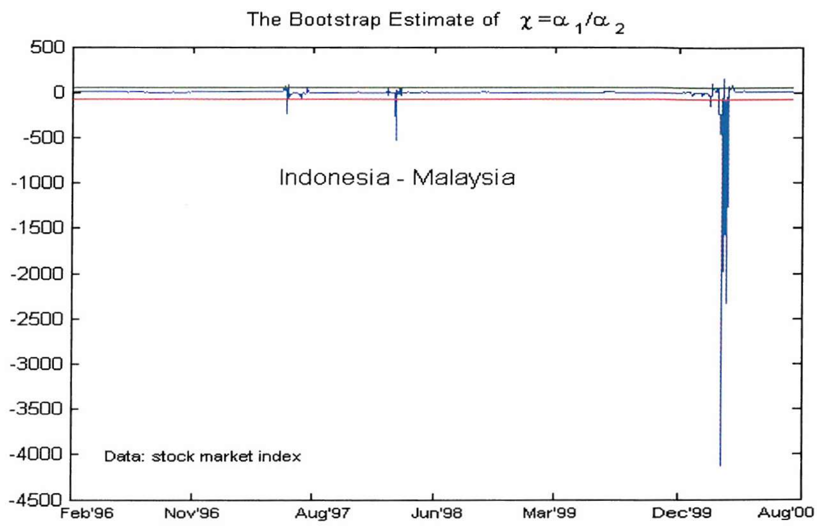


Figure 3.21: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Stock Market Index (continued)



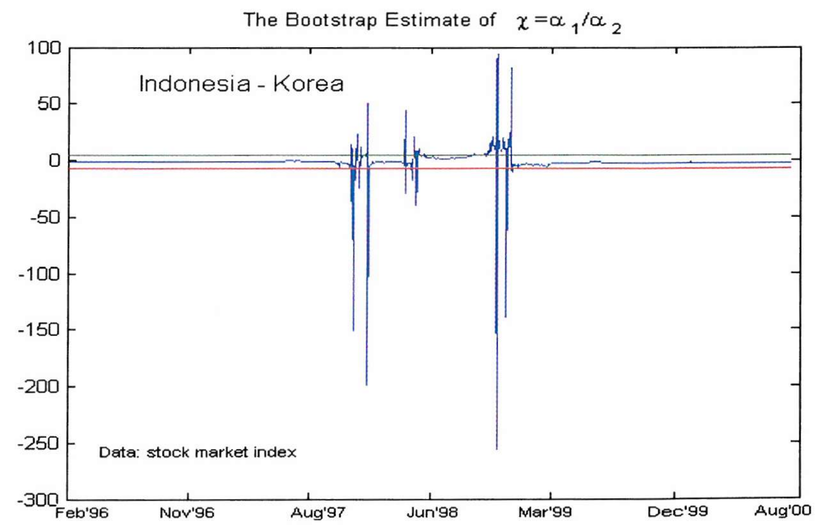


Figure 3.22: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Stock Market Index (continued)

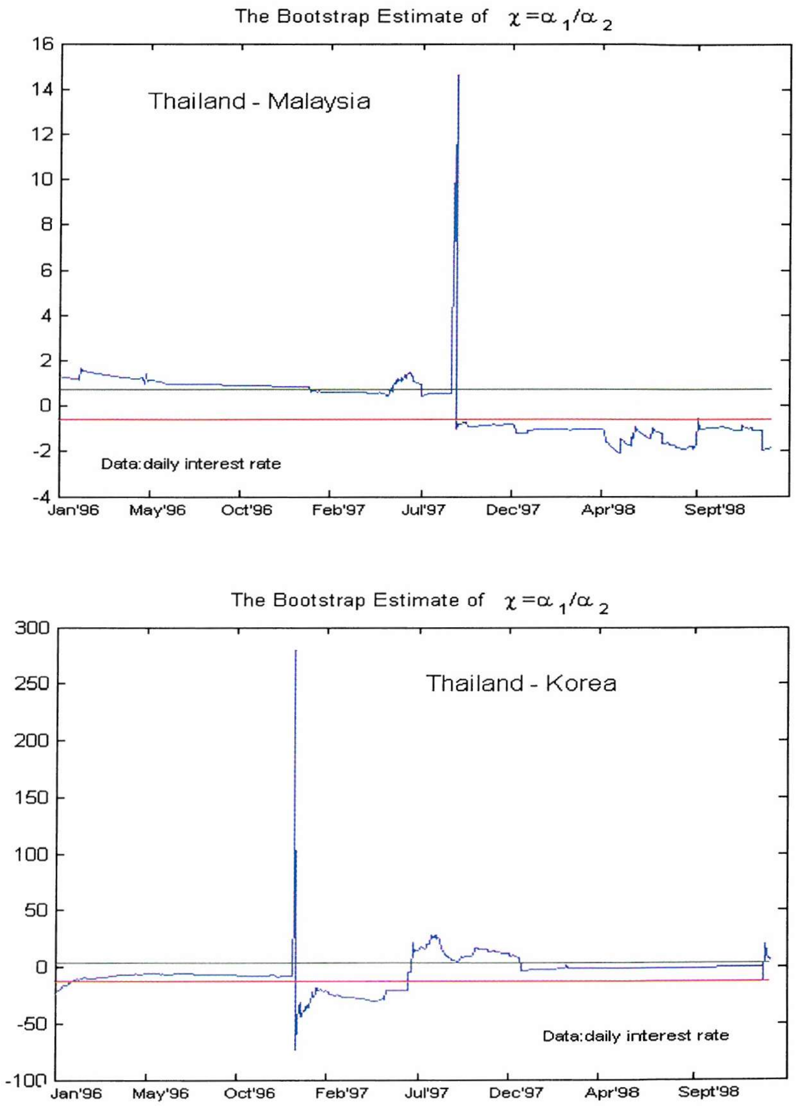


Figure 3.23: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Daily Interest Rate

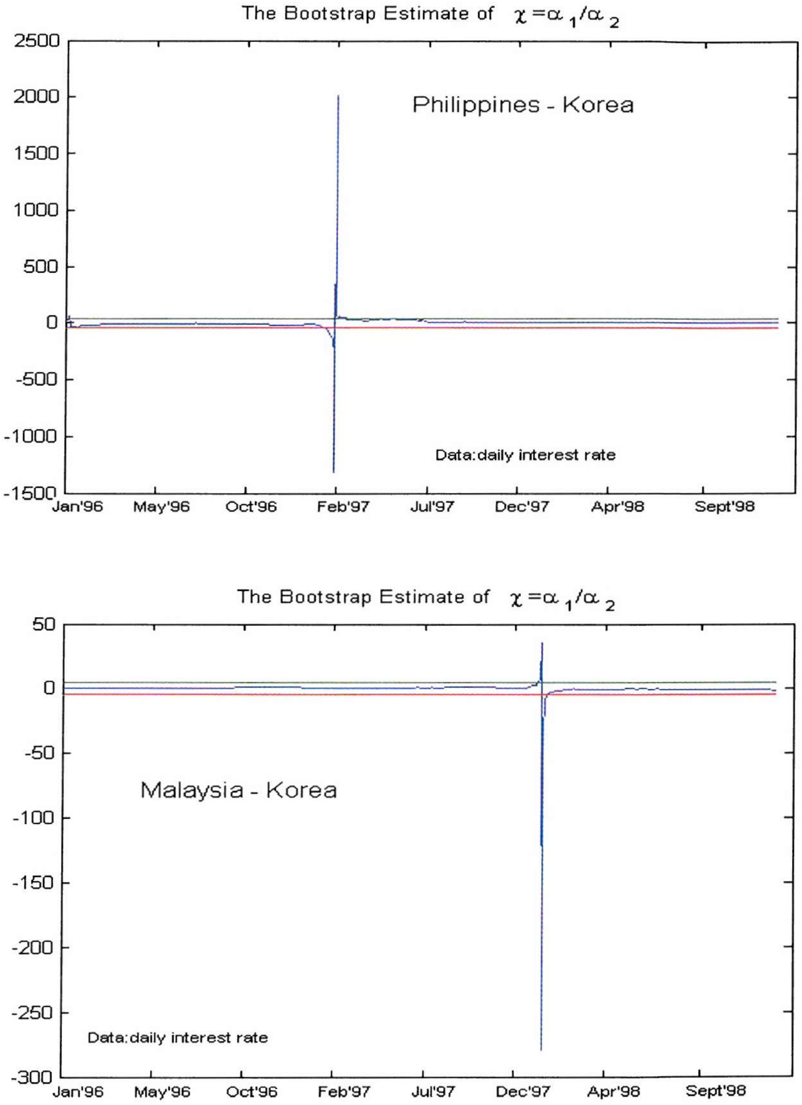
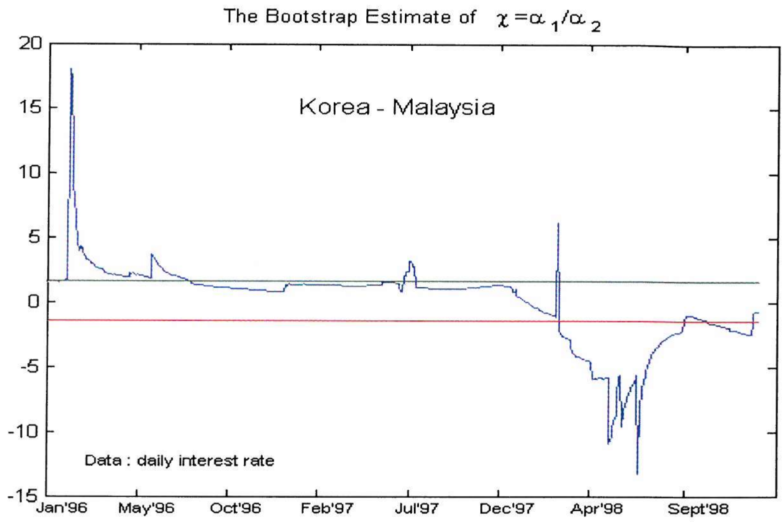


Figure 3.24: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Daily Interest Rate (continued)



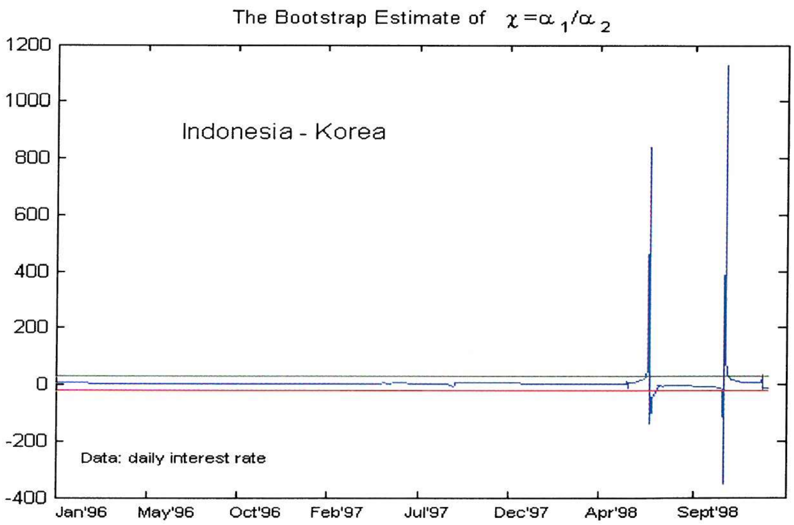


Figure 3.25: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Daily Interest Rate (continued)

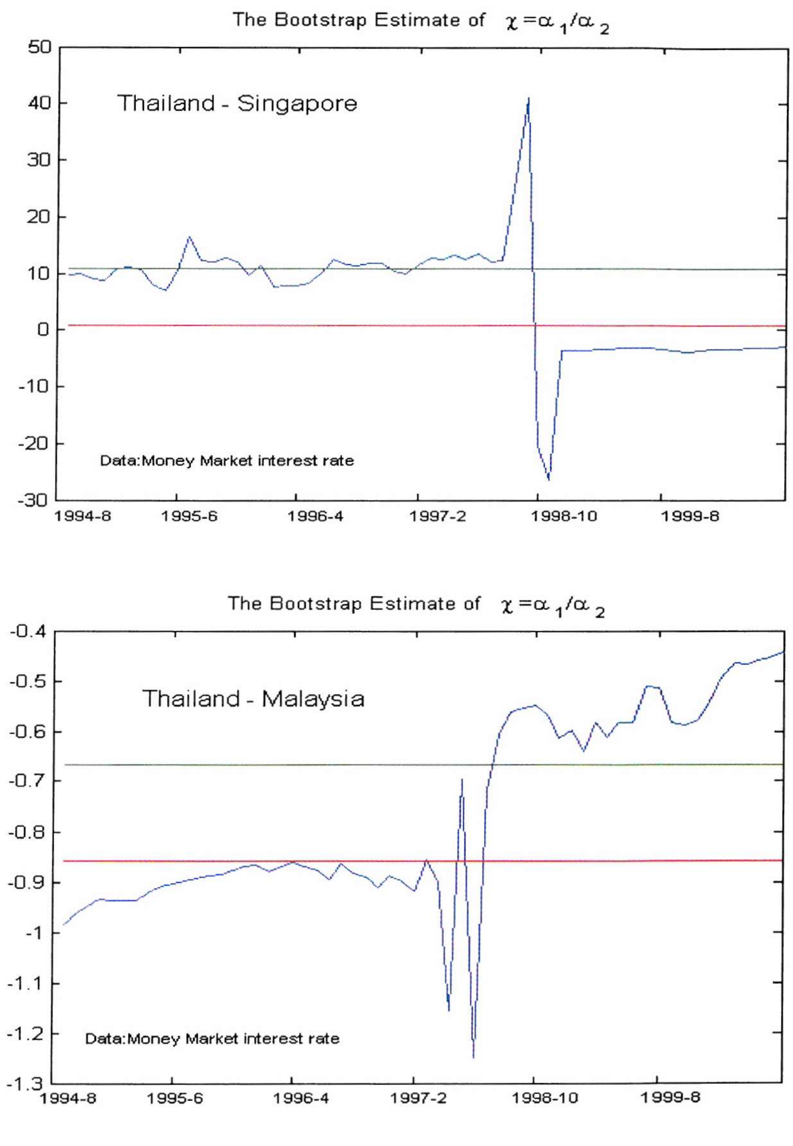


Figure 3.26: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Monthly Deposit Rate

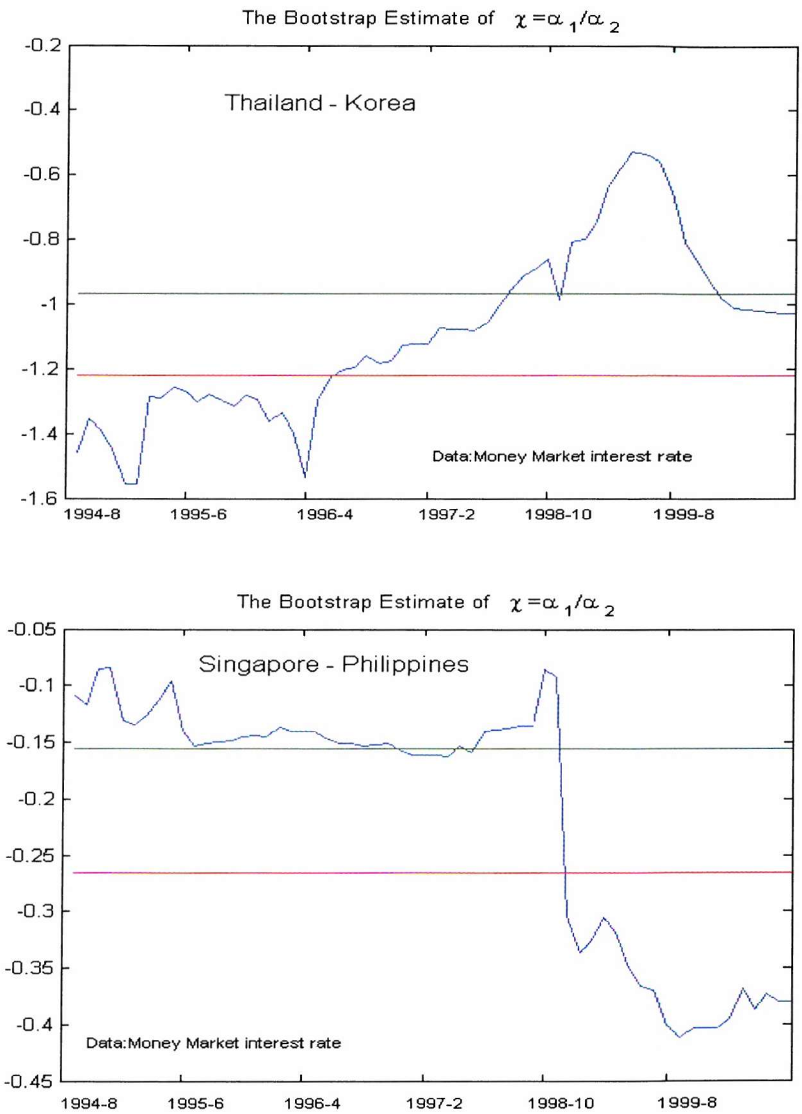
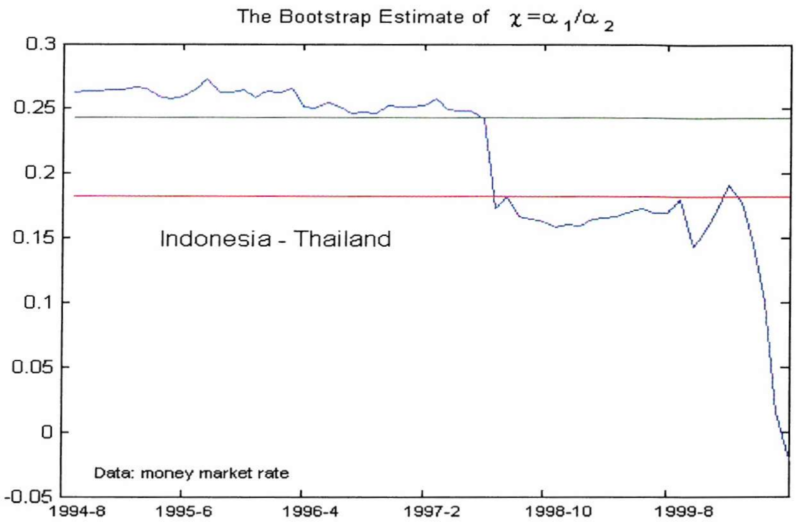


Figure 3.27: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Money Market Rate (continued)



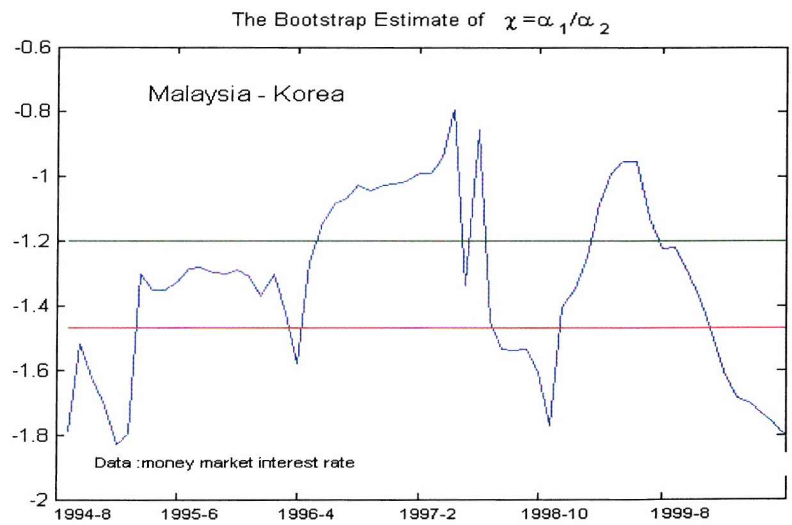
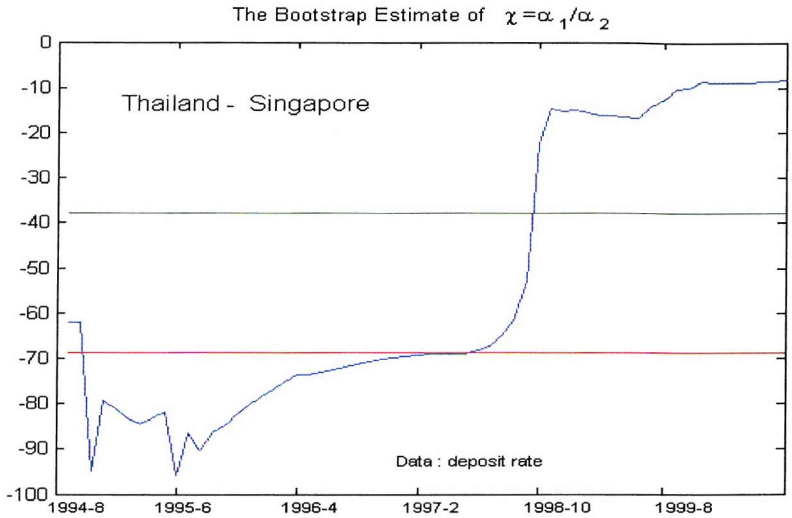


Figure 3.28: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Money Market Rate (continued)



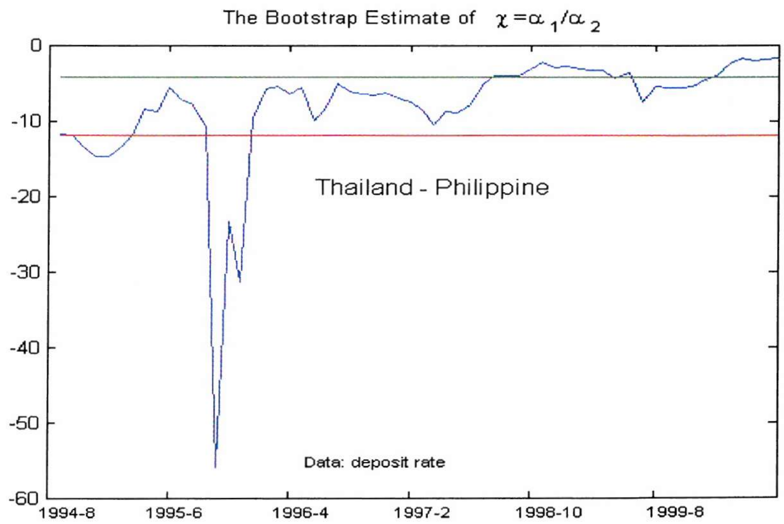
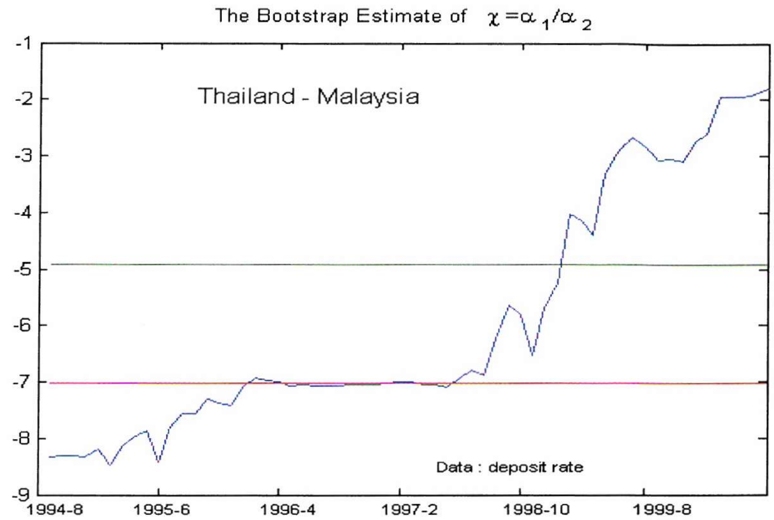


Figure 3.29: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Monthly Deposit Rate



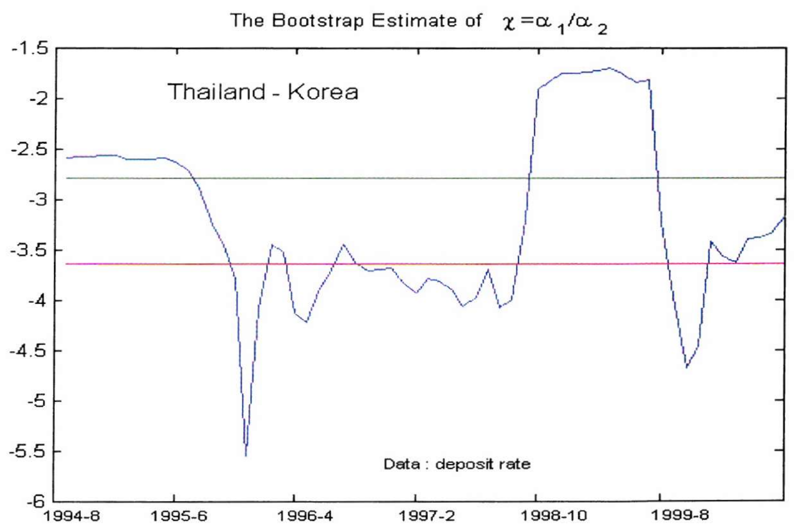


Figure 3.30: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Monthly Deposit Rate (continued)

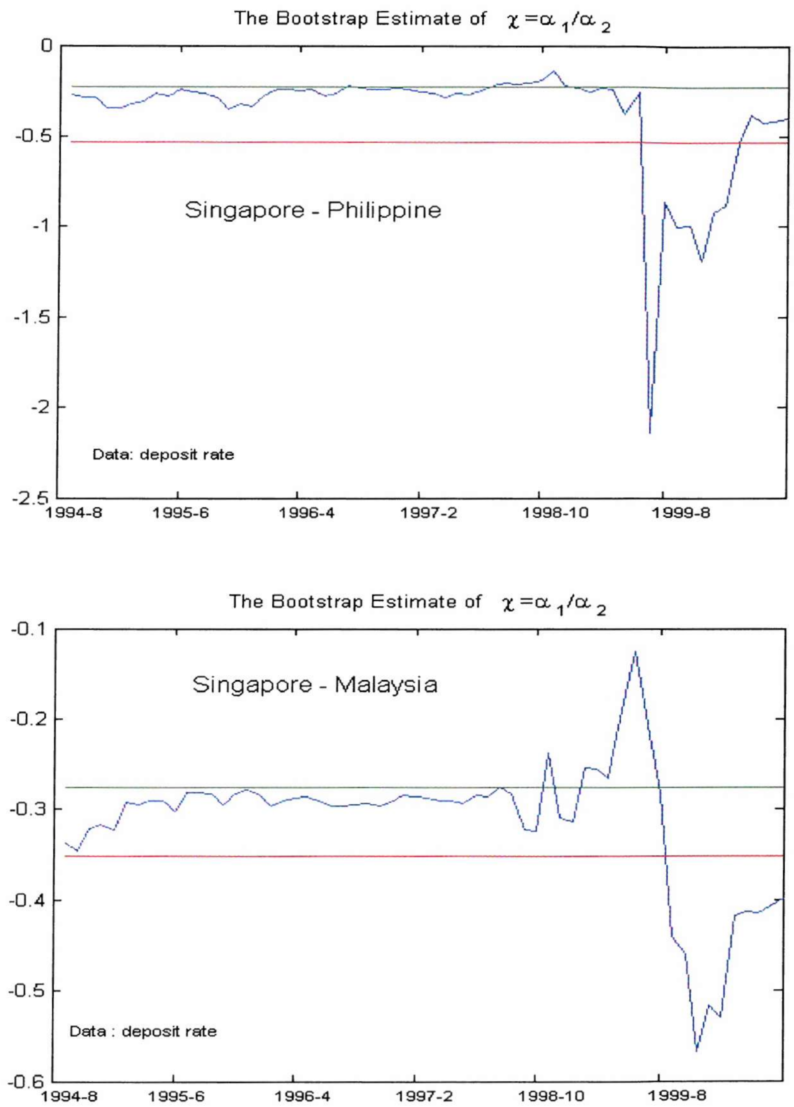
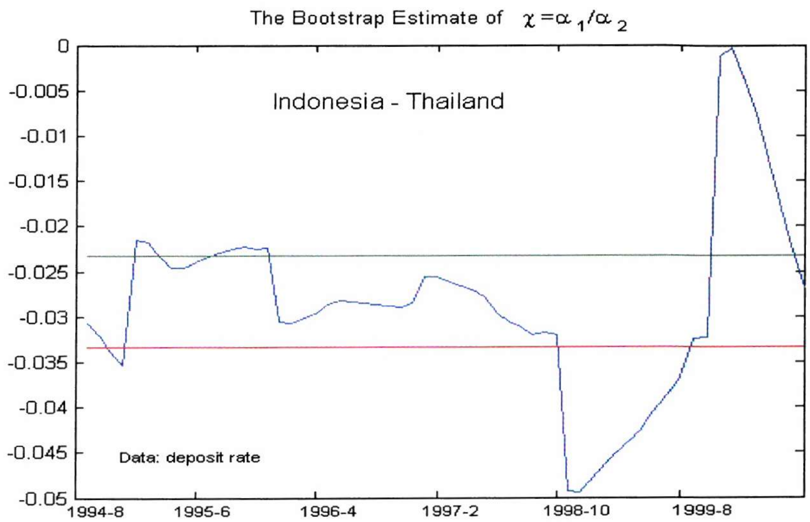


Figure 3.31: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Monthly Deposit Rate (continued)



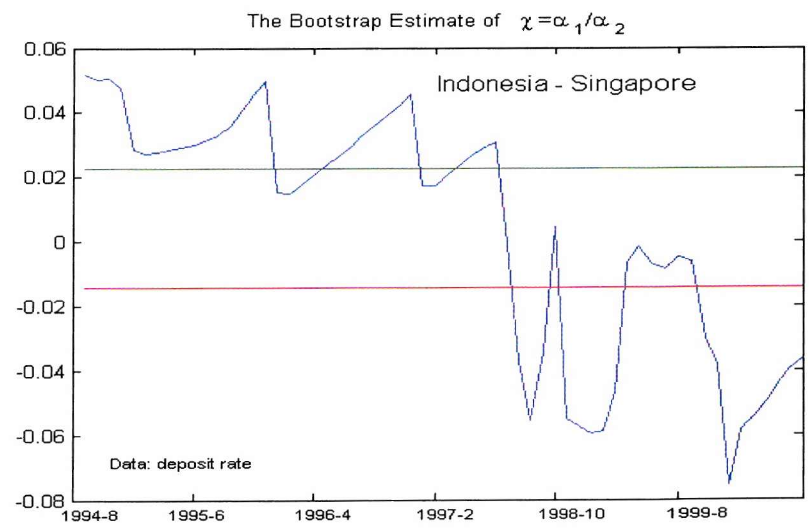


Figure 3.32: Recursive Estimate of $\chi = \alpha_1/\alpha_2$ from Monthly Deposit Rate (continued)

Chapter 4

The Asian Crisis: The Role of Trade and Financial Channels in Transmitting Economic Shocks

4.1 Introduction

The propagation of the financial crises that hit countries in recent years (the ERM crisis of 1992-93, the Mexican crisis of 1994-95, the Asian crisis of 1997 and the Russian crisis of 1998) has been the subject of intensive investigation among researchers. In particular, there is a need to understand the factors that drive the spreading of financial disturbances across countries. The question of whether trade linkages, sudden shifts in market expectations, trade spillovers, or common shocks were the primary source of the financial crises remains unclear.

In the literature there have been attempts to analyze such issues. It has been argued that trade linkages between countries and geographic proximity is the responsible factor in explaining the spread of currency crises across countries (Eichengreen, Rose and Wyploz [16], Glick and Rose [27]. Others argued that financial turmoil reflected a crisis in market confidence which is associated with the strong financial linkages between a crisis country and its major lender (Kaminsky and Reinhart [40], [38]).

In the Asian crisis case, however, it seems that the two views cannot be distinguished since the currency and banking crises as well as the stock market collapse occurred at nearly the same time. The validity of the 'competitive devaluation' view has recently been questioned, because the bilateral trade linkages among Indonesia, Malaysia, Philippines, Thailand and Korea are not very striking. However, it is important to examine the basic intuition of the theory, particularly the argument that one country's devaluation may have indirect effects on export sales from other countries that compete in the same market (Gerlach and Smets [26]).

There are two main reasons: first, the large portion of East Asian countries' exports that go to Japan and the US (see Table 4.1 which is taken from Baig and Goldfajn [1]); second, the fact that almost all empirical studies of financial market integration suggest that, as a result of financial and trade liberalization policies which started in early 1990s, the Asian domestic financial markets tended to be integrated with Japan and the US (Faruqee [20], Phylaktis [49]). The process of financial market integration was associated with increased Japanese and US financial influence in Asia. For example, in 1972 and 1980-82, 65 % and 55 % respectively, of net capital flows (public and private) among Pacific Basin Economies came from Japan. In the same periods, a total of 31 % and 41 %, respectively were from US (Yuan [62]). Chin

	Thailand	Malaysia	Phillipines	Indonesia	Korea	US	Japan
Thailand	...	4.6	1.2	2.0	1.8	19.8	15.0
Malaysia	3.7	...	1.3	1.5	3.2	18.3	12.4
Phillipines	2.4	3.0	...	0.4	1.8	37.4	16.1
Indonesia	1.7	2.4	1.4	...	7.1	16.3	24.7
Korea	2.0	3.1	1.6	2.9	...	16.6	10.6
Source : Direction of Trade Statististics Quarterly. International Monetary Fund(June,1998)							

Table 4.1: Export Share of the Asian-5 in 1997 (as a percentage of total export).

and Frankel [11] reported that Japan purchased US$ 725 million worth of foreign securities from Newly Industrialized countries in Asia on a cumulative basis in the period from 1988-1991. In examining the role of the Yen in the Asian region, Tavlas and Ozeki [59] found that in the1980s the Yen was being widely used to invoice trade and finance in Asia. The percentage of South-East Asia imports denominated in Yen increased from 2% in 1983 to 19.4 % in1990.

In terms of the specific transmission channel through which disturbances are transmitted internationally, it is very likely that the spread of international disturbances during the East Asian crisis was caused by both trade and financial channels simultaneously with Japan and US acting as the main partners. However, one of these channels might have been more important in particular countries.

This chapter aims at addressing these issues. We utilize a set of trade and financial variables to measure the relationship between the East Asian countries and their trading partners (Japan and US) as well as the relationship between the countries with their trading partners in the same region.

We analyze four variables, namely, direct (indirect) bilateral trade, real interest rates and exchange rates within a cointegrated VAR framework. The empirical analysis is conducted using the Johansen method of cointegration. Within this framework, we are going to interpret the presence of cointegration as a measure of whether there are structural linkages between the transmission channels.

To identify which specific channel transmission is relatively more important, we simply look at which of these variables responds more strongly to the disequilibrium. We argue that if financial variables play a significant role in determining the shocks, they should not be weakly exogenous in the cointegrated system. We, therefore, perform the test for the hypothesis of weak exogeneity using the methodology suggested in Johansen [37]. In practice, we test whether the speed of adjustment parameters, (α), are zero for a certain subset of equations. The rejection of the hypothesis would suggest that the variable under examination is important in channelling shocks.

Our study is closely related to a number of very recent studies which emphasize the relative importance of specific transmission channels of international disturbances (Kaminsky and Reinhart [40], Carramanza *at al.* [7], and Van Rijckeghem and Weder [54]).

In general, these studies conclude that the financial channel plays a more important role than the trade channel. However, it is important to note that most of the tests in these studies have used cross-country data and the probability approach where trade, financial and other indicators are treated as exogenous variables. The dependent variable takes two values (i.e. 0 and 1) which reflect the probability that a country will suffer a crisis given that another country (ground zero) experiences a crisis[1].

[1]Instead of a binary variable, many researchers utilise a continuous value in the dependent variable (see:Cerra,V

In order to analyse the importance of different transmission channels, the approach used in these studies is to look at the significance of the regression parameters of the trade and financial indicators (i.e. the significance of these variables in affecting the dependent variable). Thus, in principle the researcher is able to estimate the average influence of the determinants of financial crises.

One of the limitations of this approach is that the question of causality cannot be addressed satisfactorily. In particular, it ignores the fact that it is very likely in reality that an economic disturbance will spread across countries through different transmission channels simultaneously. As a result, very often the trade and financial indicators appear to be highly correlated. Treating such highly correlated variables as independent variables in the probit regression will be problematic in the estimation of their parameters. As a result, it is difficult to establish which channel is more important[2]. Thus, from a methodological point of view, the studies applying cross-section regression analysis and treating trade and financial variables as exogenous variables were unable to capture the magnitude of the joint dynamic relationship which may exist between them.

Our approach is based on time series data. We use a simple VAR framework. Indeed, the advantage of using the VAR approach is that it is very helpful in examining the relationships among a set of economic variables without worrying about the endogeneity of the variables that we are going to analyzes (Enders [18]). Furthermore, the concepts of cointegration, causality, and error correction pioneered by Engle

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and Saxena [8])

[2]In the Asian crisis case, Van Rijckeghem and Weber [54] , Kaminsky and Reinhart [41] found a high correlation between trade and financial links. As a result of this, it is difficult to distinguish their separate roles.

and Granger [19], and Granger [30] the provide an alternative solution which can be used in order to understand the causal relationship among these variables. We perform Granger-causality tests for each cointegrating system using recent methodology suggested by Toda and Yamamoto [60].

We apply our approach to six East Asian countries (Indonesia, Malaysia, Singapore, Thailand, Korea, and the Philippines) and their major trading partners (US and Japan) as well as their trading partners in the same region. The data cover the period between January 1970 and February 1998. The data are monthly.

In a number of the cases analyzed in this study, our empirical results indicate that the trade and financial variables are cointegrated. In the most of the cointegrated cases, the exchange rate, interest rate differentials, bilateral trade and indirect trade indicators, are not weakly exogenous. Our results suggest that both trade and financial variables did play a fundamental role in the propagation of the East Asian Crisis.

The results of the causality tests based on the methodology suggested by Toda and Yamamoto [60] indicate that there is a mixed evidence of causality between the trade and financial variables. While the dominance of financial variables in influencing trade variables in the Asian market is clearly appearent in case of Singapore-Japan, Phillipines-Japan and Korea-US, the direction of causality in a number of cases we study is still unclear. In the case of Malaysia, we found two-way causality with both the USA and Japan.

In causality tests between financial and trade variables among countries within the Asian region, the results of this study indicate that there is also mixed evidence on the causality between trade and financial links. We found that less than 50 percent of all possible pairs appear to have one-direction causality from trade to finance or vice versa. In the remaining cases, however, their causal direction cannot be identified.

The remainder of this chapter is organized as follows: In Section 4.2 an error-correction framework is discussed which is employed to test for the relative importance of the financial and trade linkages. We apply our approach to the various data sets from Asian emerging markets and discuss our results in Section 4.3. Finally, Section 4.4 of the chapter concludes.

4.2 Methodology

4.2.1 Measuring the Relative Importance of Transmission Channels

In identifying the transmission channel, one should ideally include all potential trade/finance variables in the VAR so that the mechanism of interrelationships between two sets of variables can be evaluated (Sims [56]). However such a specification, which may involve a VAR with many variables, needs a very long sample series. Given the rather limited sample period that we have (i.e. trade variables are available from January 1970 to February 1998), we concentrate on the dynamics of the relationship between direct/indirect trade indicators, real interest rate differentials, and the exchange rates. We analyze these variables for each pair of countries.

Suppose that $X_t = [T, F]$ with T and F being sets of variables which measure trade and financial links between the pair of countries i and j. As demonstrated in Granger [30], if a set of variables is cointegrated, then their behaviour can be validly parameterized by an error correction model. The converse is also true, in that an error correction mechanism always produces a set of variables that are cointegrated. We argue that cointegration properties can be used to explain the existence of transmission of economic shocks. Consider a cointegrated system with the same order of integration, $C(1,1)$, which can be expressed in the following form

$$\mathbf{\Delta X}_{t=} = \mathbf{\Pi X}_{t-1} + \varepsilon_t \tag{4.1}$$

Where $\mathbf{\Delta}$ is the usual difference operator. If the parameter matrix $\mathbf{\Pi}$ has reduced rank it can be written in the form $\mathbf{\Pi} = \alpha\beta'$ where α and β are $n \times p$ matrices of rank p, with $p < n$. The matrix β is the matrix of cointegrating parameters or long-run matrix, and the matrix α is the matrix of weights with which each cointegrating vector enters the n equations of the VAR. The matrix α is also known as the matrix of the speed of adjustment parameters.

In the bivariate specification, the cointegrated system between $Trade$ and $Financial$ variables can be expressed in error correction terms as

$$\begin{bmatrix} \Delta T \\ \Delta F \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} [T_{t-1} - \beta F_{t-1}] + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{4.2}$$

In this setup, we are going to interpret the vector $\alpha = \begin{bmatrix} \alpha_1 & \alpha_2 \end{bmatrix}'$ of speed of adjustment parameters as embodying the transmission mechanism between the two variables. To identify which specific transmission channel is relatively more important, we simply look at which of the two variables responds to the disequilibrium. We argue that if financial variables play a significant role in transmitting the shocks, they should not be weakly exogenous in the cointegrated system. We, therefore, perform a test for the hypothesis of weak exogeneity using the methodology suggested in Johansen [37]. In practice, we test whether the speed of adjustment parameters, (α), are zero for a certain subset of equations.

In our case, we have four variables so $X = \{x_1, x_2, x_3, x_4\}'$. All of the variables are $I(1)$ and x_1, x_2, x_3, x_4 are defined as the interest rate differentials, the exchange rate, direct trade, and indirect trade, respectively. The interest rate spread and exchange rates are the subset of variables representing the financial links, whereas direct (indirect) trade are the subset of variables that capture the trade links. In the cointegrated system, the hypothesis that the subset of variables is weakly exogenous can be formulated as a linear restriction on the column of α which can be expressed as (see Johansen [37] for a complete exposition).

$$\alpha = A\psi, \tag{4.3}$$

where A is $(p \times m)$ and known and ψ is the $(m \times r)$ parameter to be estimated.

Within this framework, if the cointegration rank is two : α and β are (4×2) (confirmed by Johansen test of cointegration), the relative roles of trade and financial variables in the transmission of the shocks can be traced by examining six null hypotheses. The first is the hypothesis that financial variables (i.e. interest rate differentials and exchange rates) do not play an important role in transmission of the shocks, which implies that the resulting cointegration vector only affects trade variables, the last two variable (i.e. x_3 and x_4). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho: \ \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{pmatrix}, \qquad \text{Where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} 0 & 0 \\ 0 & 0 \\ \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}$$

The second hypothesis is that trade variables (i.e. bilateral trade (direct) and indirect trade variables) do not play an important role in the transmission of the shocks, which implies that the resulting cointegration vector only affects financial variables, the first two variable (i.e. x_1 and x_2). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho: \ \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}, \qquad \text{Where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$$

The third hypothesis is that exchange rates and indirect trade variables do not play an important role in the transmission of the shocks, which implies that the resulting cointegration vector only affects financial variables, the second variable and fourth variable (i.e. x_2 and x_4). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho : \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{pmatrix}, \qquad \text{where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} 0 & 0 \\ \psi_{11} & \psi_{12} \\ 0 & 0 \\ \psi_{21} & \psi_{22} \end{pmatrix}$$

The fourth hypothesis is that exchange rates and direct trade variables do not play an important role in the transmission of the shocks, which implies that the resulting cointegration vector only affects financial variables, the second variable and third variable (i.e. x_2 and x_3). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho : \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{pmatrix}, \qquad \text{where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} 0 & 0 \\ \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \\ 0 & 0 \end{pmatrix}$$

The fifth hypothesis is that interest rate differentials and direct trade variables do not play an important role in the transmission of the shocks, which implies that the resulting cointegration vector only affects financial variables, the first variable and fourth variable (i.e. x_1 and x_4). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho : \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{pmatrix}, \qquad \text{where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ 0 & 0 \\ 0 & 0 \\ \psi_{21} & \psi_{22} \end{pmatrix}$$

The sixth hypothesis is that interest rate differentials and indirect trade variables do not play an important role in the transmission of the shocks, which implies that the resulting cointegration vector only affects financial variables, the first variable and third variable (i.e. x_1 and x_3). This restricts the α matrix, leaving β unrestricted, and is expressed as $Ho : \alpha_{p=2} = A\psi$:

$$\mathbf{A} = \begin{pmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 1 \\ 0 & 0 \end{pmatrix}, \qquad \text{where } \psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ \psi_{21} & \psi_{22} \end{pmatrix}, \qquad \mathbf{A}\psi = \begin{pmatrix} \psi_{11} & \psi_{12} \\ 0 & 0 \\ \psi_{21} & \psi_{22} \\ 0 & 0 \end{pmatrix}$$

The rejection of the first hypothesis and the acceptance of the second hypothesis (*Case 1*) would imply that both interest rate differentials and exchange rates are not weakly exogenous for α, and suggest that financial links play an important role in transmission of the shocks. The rejection of second hypothesis and the acceptance of the first hypothesis (*Case 2*) would imply that both bilateral trade and indirect trade are not weakly exogenous for α, and suggest that trade links play an important role in transmission of the shocks. Table 4.2 summaries all of the possible cases that can be tested in order to identify the relative importance of the transmission channels of the international shocks. Within this framework, empirical evidences for *Case* number 3, 4, 5, 6, 7 and 8 would imply that both trade and financial variables play an important role in transmission of the shocks.

Definition	Hypothesis						Implications
	1	2	3	4	5	6	
Case 1	r	a	.	.	.	.	interest rate and exchange rates are important
Case 2	a	r	.	.	.	.	direct and indirect trade are important
Case 3	.	.	r	.	a	.	interest rate and direct trade are important
Case 4	.	.	.	r	a	.	interest rate and indirect trade are important
Case 5	.	.	r	.	.	a	direct trade and interest rate are important
Case 6	.	.	.	r	a	.	indirect trade and interest rate are important
Case 7	.	.	.	a	r	.	exchange rate and direct trade are important
Case 8	.	.	a	.	.	r	exchange rate and indirect trade are important
r,a denotes rejection and acceptance of the null hypothesis of weak exogeneity							

Table 4.2: Summary Hypothesis and its implication

4.2.2 Cointegration and Granger Causality

The information about the direction of causality among the set of variables in the system is important for detection of which variables are dominant in influencing other variables over the period under consideration. In this context, the properties of the cointegration relationships between variables provide an excellent way to test the causal relationships which may exist among a set of economic indicators. According to Granger [29] [30], the evidence of cointegration between two variables (or more) implies there is Granger causality in at least one direction. The financial variable is a Granger cause of $Trade$ ($F \rightarrow T$), if present T can be predicted with better accuracy by using past value of F than by not doing so, other information being identical. Since the evidence of cointegration between trade and financial variables itself is not informative about the exact direction of causality, the issue of interest is which of the variables acts as a leading variable. This study analyses this issue by examining the causal relationships among the series.

In the literature, there are a number of approaches that can be used to test the direction of causality in the cointegrated VARs. In recent methodological discussion on this issue, Caporale and Pittis [6] argued that testing for causality based on an

ECM framework is preferable rather than a VAR formulation since the limiting distribution of the ECM framework is likely to be standard. However, adopting the ECM procedure to investigate the causal direction is potentially subject to pre-testing bias due to rank deficiency. In practice, the popular test for cointegration rank is Johansen [36] in which this test is extremely sensitive to nuisance parameter (see: Toda and Yamamoto [60]) and suffers from finite-sample biases. In a level VAR formulation, on the other hand, Sims *et. al* [57] show that Granger F tests are asymptotically valid. However, the system should be integrated, which means that the procedure requires pre-testing of cointegration ranks. Moreover, the procedure does not apply for the case where the variables are I(0), I(1) and I(2).

One of the alternative solutions to circumvent this problem, as discussed in Caporale and Pittis [6] and Masih and Masih [46], is to conduct causality tests in the context of a VAR in levels using methodology developed by Toda and Yamamoto [60]. This approach has desirable properties since it results in a standard Wald test and does not require pre-testing for cointegration properties in the system. In addition, the approach applies no matter whether the process variable under examination is stationary I(1), I(2), has a linear trend, or whether it is cointegrated. However, in using this approach, it is necessary to establish the optimal number of lag length in the VAR and the maximum order of cointegration of the variables under consideration. In this study we investigate the causal direction in the series by employing the Toda-Yamamoto [60] methodology. The procedure of the test can be summarized as follows :

Toda and Yamamoto [60] proposed estimation of a level VAR of the form

$$X_t = \gamma_0 + \gamma_1 + \gamma_1 t + ... + \gamma_q t^q + \pi_1 X_{t-1} + ...\pi_k X_{t-k} + ... + \pi_p X_{t-p} + \xi_t$$

by OLS, where $t = 1, ...T$, and $p \geqslant (k + d)$ consisting of X_t 's that are $I(d)$ which may be $CI(d, b)$

The θ's are coefficient matrices but hypothesis testing of restrictions will preclude the term $\theta_{K+1,}..., \theta_p$ which are assumed to be zero. In matrix notation, this can be written as

$$X' = \Psi\Lambda' + PY' + \Pi Z' + E',$$

where,

$\mathbf{\Psi} = [\gamma_0, ...\gamma_q]$, $\mathbf{\Lambda} = [\tau_1, ..., \tau_T]$ with $\tau_t = (1, t, ..., t^q)$,

$\mathbf{P} = [\pi_1, ...\pi_k]$, $Y_t = [y_{1,...}y_T]$ with $y_t = [X'_{t-1}, ..., X_{t-k}]'$,

$\mathbf{\Pi} = [\pi_{k+1}, ...\pi_p]$

$\mathbf{Z} = [z_1, ..., z_T]$ with $z_t = [X'_{t-k-1}, ..., X_{t-p}]'$

and $\mathbf{E} = [\varepsilon_1, ..., \varepsilon_T]$.

Toda and Yamamoto [60] then show that the hypothesis H_0: $f(\pi)$ (where $\pi = vec(\mathbf{P})$ is a parameter vector) may be tested by a Wald test statistic which is asymptotically chi-square, χ^2, with m degree of freedom, subject to $p \geqslant (k+d)$. The statistic is given by

$$\omega = f(\widehat{\pi})\left[f(\widehat{\pi})\{T^{-1}\widehat{\Sigma}_E \otimes (X\widehat{Q}X)F(\widehat{\pi})'\right]^{-1} f(\widehat{\pi})$$

where,

$\widehat{\Sigma}_E = T^{-1}\hat{E}'\hat{E}$, $\widehat{Q} = \widehat{Q}_\tau - \widehat{Q}_\tau Z(Z'\widehat{Q}_\tau Z)^{-1}Z'\widehat{Q}_\tau$ and $Q_\tau = \mathbf{I}_T - \widehat{\Lambda}(\widehat{\Lambda}'\widehat{\Lambda})^{-1}\widehat{\Lambda}'$

where $\mathbf{I}_t$ is $T \times T$ identity matrix.

As mentioned earlier, in conducting the causality test under this framework, the researcher requires two pieces of information, namely, the maximum order of cointegration of the variable under consideration and the optimal lag length in the VAR model.

Assume that the maximum order of cointegration of the variable under consideration is $d(max)$ and the optimal lag length in our VAR model is, k, (i.e confirmed by Schwartz Information Criteria). Following Toda and Yamamoto [60], the first step in implementing this procedure is to estimate the VAR with k lags since the $p-k$, at the inference stage, are assumed zero and ignored. The second step is to re-estimate the VAR with variables appearing in levels with a total of $p = k +\ d(max)$ lags. In our case, namely, a VAR with four variables (i.e. 2 finance variables and 2 trade variables), and assuming that $k = 2$ and $d(max) = 1$, the Granger non-causality test in this study can be specified as :

$$\begin{bmatrix} X_{1,t} \\ X_{2,t} \\ X_{3,t} \\ X_{4,t} \end{bmatrix} = \begin{bmatrix} \gamma_{01} \\ \gamma_{02} \\ \gamma_{03} \\ \gamma_{04} \end{bmatrix} + \begin{bmatrix} \pi^1_{11} & \pi^1_{21} & \pi^1_{31} & \pi^1_{41} \\ \pi^1_{21} & \pi^1_{22} & \pi^1_{23} & \pi^1_{24} \\ \pi^1_{31} & \pi^1_{32} & \pi^1_{33} & \pi^1_{34} \\ \pi^1_{41} & \pi^1_{42} & \pi^1_{43} & \pi^1_{44} \end{bmatrix} \begin{bmatrix} X_{1,t-1} \\ X_{2,t-1} \\ X_{3,t-1} \\ X_{4,t-1} \end{bmatrix} +$$

$$\begin{bmatrix} \pi^2_{11} & \pi^2_{12} & \pi^2_{13} & \pi^2_{14} \\ \pi^2_{21} & \pi^2_{22} & \pi^2_{23} & \pi^2_{24} \\ \pi^2_{31} & \pi^2_{32} & \pi^2_{33} & \pi^2_{34} \\ \pi^2_{41} & \pi^2_{42} & \pi^2_{43} & \pi^2_{44} \end{bmatrix} \begin{bmatrix} X_{1,t-2} \\ X_{2,t-2} \\ X_{3,t-2} \\ X_{4,t-2} \end{bmatrix} + \begin{bmatrix} \pi^3_{11} & \pi^3_{12} & \pi^3_{13} & \pi^3_{14} \\ \pi^3_{21} & \pi^3_{22} & \pi^3_{23} & \pi^3_{24} \\ \pi^3_{31} & \pi^3_{32} & \pi^3_{33} & \pi^3_{34} \\ \pi^3_{41} & \pi^3_{42} & \pi^3_{43} & \pi^3_{44} \end{bmatrix} \begin{bmatrix} X_{1,t-3} \\ X_{2,t-3} \\ X_{3,t-3} \\ X_{4,t-3} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ e_{4t} \end{bmatrix}$$

Where $\mathbf{X}_t$ is an 4 vector of jointly determined (endogenous) variables, γ_0 is a vector of constant parameters, $p = 2 + 1 = 3$, is the number of lags, and $\mathbf{e}_t$ is an vector of unobserved of white noise disturbances. Suppose that $\mathbf{X}_t$ is divided into two block variables (i.e. finance (X_{1t}, X_{2t}) and trade (X_{3t}, X_{4t})).

Under this technique, the direction of causality of the trade and financial variables can be traced by examining two null hypotheses: the first is the hypothesis that the subset of the financial variables does not Granger-cause the trade variable $(F \nrightarrow T)$ or

$$Ho : \pi^1_{13} = \pi^2_{13} = \pi^1_{14} = \pi^2_{14} = \pi^1_{23} = \pi^2_{23} = \pi^1_{24} = \pi^2_{24} = 0$$

The second hypothesis is that the subset of the trade variables do not Granger-cause the subset of financial variables $(T \nrightarrow F)$ or

$$Ho : \pi^1_{31} = \pi^2_{31} = \pi^1_{32} = \pi^2_{32} = \pi^1_{41} = \pi^2_{41} = \pi^1_{42} = \pi^2_{42} = 0$$

	First Hypothesis	Second Hypothesis	Direction of causality
Case 1	A	R	$F \rightarrow T$
Case 2	R	A	$T \rightarrow F$
Case 3	A	A	unknown
Case 4	R	R	$F \leftrightarrows T$
A= Acceptance R=Rejection			

Table 4.3: Summary of Hypothesis for Causal Directions

The acceptance of the first hypothesis and the rejection of the second hypothesis suggests that financial links are Granger-caused by the trade link($T \rightarrow F$). The rejection of the first hypothesis and the acceptance of the second hypothesis suggests that trade variables are Granger-caused by the financial variables ($F \rightarrow T$). The rejection of both the first hypothesis and the second hypothesis would be suggestive that both trade and financial variables show Granger-causality in two directions ($F \rightleftarrows T$). Therefore, this test involves examination of the statistical significance of the parameters of trade variables (X_{1t}, X_{2t}) and those of trade variables ($X_{3t,}X_4$) . Table 4.3 summaries all of the possible cases that can be tested in order to detect the causal relationship of the series.

4.3 Empirical Results

4.3.1 The data and their properties

Our data consist of three sets of variables, namely, bilateral trade data, bilateral exchange rates, and interest rate differentials for six countries in East Asia (Indonesia, Malaysia, Korea, The Philippines, Singapore and Thailand) and their trading partners (i.e. all of countries in the same region, plus the US and Japan). Since the availability and starting dates on bilateral data on trade are different from country to country, the span of sample in our estimations is based on the availability of data in each pair of country observations. For example, in the case of observations between Singapore and Korea, the paper uses monthly data that span the period 1976 M6 to 1998 M2, while in the case of observations between Malaysia and Korea, the export data span the period 1976 M1 to1998 M2.

The direct/indirect trade indicator is calculated from bilateral export/import data in order to capture the relationship between two countries from the trade side. Following an approach similar to Eichengreen, Rose and Wyplosz [16], Van Ricjkhegem and Weder [54] and De Gregorio and Valdes [31], we measure trade variables in two ways, i.e. direct trade and trade competition in third markets (indirect trade).

The direct trade variable between country i and country j is calculated as the ratio of total trade (exports and imports) relative to the total of country i exports. An indicator of trade competition in third markets (indirect trade) is calculated based on the relative importance of the trade balance in country ij in total export to the main destination country[3]. The source of monthly bilateral exports (and imports) data is the IMF Direction of Trade (IMFdots). The IMFdots report monthly export (import) for 208 countries and their trading partners and regional group worldwide.

Monthly interest rates and monthly average exchange rates are all from International Financial Statistic (IFS) CD ROM. The IFS provides the exchange rate data in local currency with respect to US dollar. We apply the appropriate US dollar/local currency exchange rate to convert a local currency with respect to the local currency

[3]In De Gregorio and Valdes [31], direct trade links are measured by the ratio of bilateral trade between country i and k to total trade of country i. Trade competition in third markets is calculated based on the relative importance in total exports of six sectors (agriculture, food, fuel, ores, high-tech manufacturing, and low-tech manufacturing).

of their trading partner.

Figures 4.1-4.3 on pages 171-173 plot the bilateral country exports for 6 countries within the East Asian region for which the data have been available since 1970. It is clear from the figures that despite the fact that their bilateral exports tend to increase, Singapore appears to be the main destination country for exports within the East Asian region, whereas the main destination for exports from Singapore within the Asian region is Malaysia. The plots of bilateral trade and exchange rates are presented in Figures 4.4-4.6. with exchange rates expressed in terms of US dollars, bilateral trade data in millions of US dollars. Casual inspection of the figures suggests a negative correlation between trade and the exchange rate indicating that a depreciation of the exchange rate was associated with a rise in bilateral trade.

The relationship of (real) interest rates across countries is of central importance to our understanding of open economy macroeconomics. In a number of empirical studies attempting to measure the degree of openness between domestic and foreign markets, many researchers use real interest rates as the main indicator of financial links between countries (Phylaktis [49], Faruqee [20], among others). Following their approach, we used the real interest rate differential as a measure of the financial links between two countries. Real interest rates are computed by subtracting the realized monthly inflation rate over the subsequent period from corresponding nominal rates. Inflation rates are calculated as the first differences of the natural logarithms of consumer price indices (CPI), obtained from the International Financial Statistics (IFS) CD ROM. The exchange rate has also to be considered, as the theoretical literature (Gerlach and Smets [26]) indicates it will affect a country's exports.

In order to implement the ideas described in the previous sections, we begin our study by performing a unit root test on trade and financial variables i.e. the monthly bilateral export (EX), Direct/Indirect trade indicators (DT/IDT), real interest rate differentials (IRD)and exchange rates (ER) over the period of investigation. For simplicity, we used a Dickey Fuller test.

It can be seen from Tables 4.8-4.13 that, in the majority of cases, the variables in question are non-stationary. For example, the unit root test results on bilateral exports, deposit rates, direct and indirect trade indicators indicate that in 23 out of 30 cases, 26 out of 30, and 24 of 30, respectively, the hypothesis that the variables contain a unit root cannot be rejected at the 5 percent level. We also performed a heteroskedasticity and normality test of the series used in this study. The results suggest that in a number of cases, the series appear to be subject to heteroskedasticity and non-normality.

As explained in the previous section, the presence of cointegration is necessary to detect the transmission of the shocks. The next step is to proceed with the cointegration tests. Johansen's cointegration test is a test for cointegrating relations in the context of Vector Autoregressive (VAR) error correction model. This test assumes that the disturbances in the error correction model are $i.i.d$ Gaussian. In the context of our study, however, the Johansen test for cointegration has several advantages since it is robust under various situations where the assumptions are violated. Cheung and Lai [10] examine the performance of this test where the innovation is non-normal, including non-symmetric and leptokurtic. They conclude that Johansen tests are reasonably robust to excess kurtosis. Lee and Tse [58] examine the consequences of the presence of GARCH effects on the performance of the Johansen test for cointegration. They find that the test tends to overreject the null hypothesis of no cointegration, but the problem is generally not very serious. In a recent study, Rahbeek *et al.* [51] examine the effect of ARCH innovations on the trace test for the cointegrating rank in VAR model. They find that the Johansen test is valid for ARCH process and in general for martingale differences. Therefore, the test is well suited for our study. Given the presence of unit roots, heteroskedasticity and non-normality, we employ standard test procedures (i.e. using maximum eigenvalue and the trace statistics suggested in the Johansen test of cointegration). We use this test for detecting the presence of cointegration in both bivariate and multivariate VAR The lag length is chosen by applying the Schwartz Information criteria (SIC) on undifferenced VAR. In these tests, it is necessary that each variable should be non-stationary and integrated of the same order. The lag length in this study is between 1 and 5.

Tables 4.14-4.16 present the results of bivariate cointegration tests between exports and exchange rates, direct trade indicators and interest rate differentials, indirect trade and interest rate differentials for each of the pair East Asian countries, respectively. As can be seen from the results in the Tables, 50-70 % of the test statistics for zero cointegrating vectors ($H_0 : r = 0$), against the alternative of one or more cointegrating vectors imply rejection of the null. On the other hand, the hypothesis of at most one cointegrating vector ($H_0 : r \leq 1$) is rejected in almost every case. The relationship between the indirect trade indicator and interest rate differentials appears to be more cointegrated compared to the other two links (i.e. direct trade vs exchange rates and direct trade vs interest rate differentials). In the multivariate test for the presence of cointegration, we find that exchange rates, interest rate differentials, direct trade, and the indirect measure of competition in third markets are cointegrated with the number of cointegrating vector being between 1 and 2 (see: Table 4.17-4.20, the fifth row).

4.3.2 Detecting the Transmission Channel

Our main concern is to determine the channel through which international shocks are propagated internationally. As stated earlier, the transmission mechanism of a shock is only present when the trade and financial variables are cointegrated. Given that the presence of cointegration has already been established, in order to detect whether trade or financial variable are important transmission channels, we then test the exogeneity of the variables using the methodology described in Section 4.2.1 We first test the cointegrating rank in each pair of the East Asian countries with Japan and the USA. We also test for cointegration for all possible pairs of countries within the East Asian region. Further investigation tested all the possible pairs of countries with their trading partners in the East Asian region.

Given the cointegrating rank, we first restrict to zero the α matrix that corresponds to the financial variables. Since in our VAR we have only four variables, the maximum number of cointegrating vectors is three. In this setup, the first two equations in the VAR (i.e. interest rate differentials and exchange rates) capture the financial links, so the rejection of the first hypothesis and the acceptance of the second hypothesis would imply that both interest rate differentials and exchange rates are not weakly exogenous for α, and suggest that financial links play an important role in the transmission of shocks.

The results of the tests for weak exogeneity for the financial variables for all possible pairs of Asian countries with the Japan are presented in Tables 4.17-4.18. The results are quite encouraging. As we can see from the Tables 4.17-4.18, the number of cointegrating vectors is two for the pairs of Japan-Indonesia, Japan-Singapore, and Japan-Thailand. For the pair of Japan-Korea, Japan-Malaysia, and Japan-Philippine, the number of cointegrating vectors is one.

The results show that the *Case 3,4,5,6,7* and *8* occur in all pairs of the countries except the pair Indonesia and Japan, and Japan and Singapore, where the *Case* number *1* clearly occurs. These results suggest that both financial and trade variables are important.

The results of the test for weak exogeneity for the financial variables for all possible pairs of Asian countries with the USA are presented in Tables 4.19-4.20. The number of cointegrating vectors is one except for Indonesia and Singapore, where the number of cointegrating vectors is two. Again, in this case, there is mixed evidence with the *Case 3,4,5,6,7*,and 8 occurring in all of the pairs between Asian the countries and the USA, except the pair Singapore-USA, where the *Case 2*, namely, the first

	Hypothesis					
USA vs Asian-6	1	2	3	4	5	6
Indonesia	r	r	r	r	r	r
Malaysia	r	r	a	a	r	r
Korea	r	r	r	r	r	r
Singapore	r	a	r	r	r	r
Thailand	r	r	a	a	r	r
Philippines	r	r	r	r	r	r
	Hypothesis					
Japan vs Asian-6	1	2	3	4	5	6
Indonesia	r	a	r	r	r	r
Malaysia	r	r	r	r	r	r
Korea	r	r	r	r	r	a
Singapore	r	a	r	r	r	r
Thailand	r	r	r	r	r	r
Philippines	r	r	r	r	r	r
r,a denotes rejection and acceptance of the null hypothesis of weak exogeneity						

Table 4.4: The summaries of the test of weak exogeneity (full sample) in Tables 4.17-4.20

hypotheses of weak exogeneity are clearly rejected and the second hypothesis are accepted at the 1 percent level. Again, these results suggest that both financial and trade variables are important. The summary of the test for weak exogeneity for all possible pairs of Asian countries with Japan and the Asian countries with the USA is presented in Table 4.4.

Overall the results suggest that the hypothesis that both financial and trade links are important transmission channels of the shocks between Indonesia, Thailand, Malaysia, Korea and the Philippines and their trading partners (Japan and the USA) is strongly supported by the data. In the case of Singapore, the role of financial variables appears to be stronger than the trade variables.

In the previous analysis, we used a full sample that included observations for the period before the financial crisis and the period of financial crisis. However, it is also interesting to see what happens to the results of the weak exogeneity tests when the sample is split into two groups (i.e. pre-crisis sample and crisis sample). As the data is available monthly, the splitting of the full sample resulted in a limited number of observations in the sample. Given this, we experimented by examining the condition of weak exogeneity for the pre-crisis and the crisis samples separately. In this experiment, we also impose the same cointegrating vectors in the crisis period as in the non-crisis periods(i.e. without testing for cointegration separately in the crisis period).

Tables 4.5 presents the summaries of the results of the hypotheses of the weak exogeneity based on non-crisis and crisis sample for all possible pairs of the Asian countries with the USA and Japan. The results show that evidence for *Case 1* appears to be more frequent in the crisis non-period compared to the crisis period. As we can see from Table 4.20-4.28 on page 190-198, the rejection of the first and the acceptance of the second hypothesis (i.e. *Case 1*) occurs in the pairs Indonesia-Japan, Singapore and Japan, Thailand and Japan, Indonesia and the USA, and Singapore and the USA, while in the crisis sample, *Case 1* occurs only in the pairs between the Singapore and Japan, and Indonesia and the USA. During the financial crisis the case number 3,4,5,6,7,and 8 occur in most of the pairs between Asian countries and their trading partners (Japan and the USA). These results suggest that both financial and trade variable are important channels in the propagation of the shocks between East Asian countries and Japan and the USA during the financial crisis.

	Pre-Crisis Sample						Crisis Sample					
	Hypothesis						Hypothesis					
USA vs Asian-6	1	2	3	4	5	6	1	2	3	4	5	6
Indonesia	r	a	r	r	r	r	r	a	r	r	a	r
Malaysia	r	r	a	r	r	r	a	r	r	r	r	r
Korea	r	r	r	r	r	r	r	r	r	r	r	r
Singapore	r	a	r	r	r	r	r	a	r	r	a	r
Thailand	r	r	r	r	r	r	r	a	a	a	a	a
Philippines	r	r	r	r	r	r	r	a	r	r	r	r
	Hypothesis						Hypothesis					
Japan vs Asian-6	1	2	3	4	5	6	1	2	3	4	5	6
Indonesia	r	a	r	a	r	r	r	a	r	r	r	r
Malaysia	r	r	r	r	r	r	r	r	r	r	r	r
Korea	r	r	a	a	r	a	r	r	a	a	r	a
Singapore	r	a	r	r	r	r	r	a	a	r	r	r
Thailand	r	a	r	r	r	r	r	r	r	r	a	a
Philippines	r	r	r	a	r	r	r	r	r	r	r	r
r, a denotes rejection and acceptance of the null hypothesis of weak exogeneity												

Table 4.5: The summaries of the test result of weak exogeneity in Tables 4.21-28

A further investigation is to test the importance of the financial or direct/indirect trade variables as propagating mechanisms of the shocks among countries in the Asian region. In doing this, we repeat the weak exogeneity tests for the exchange rate, interest differential, direct and indirect trade variables in our empirical model. The summary results are presented in Table 4.6.

The results show that the relative importance of transmission channels of the international shocks among countries within the East Asian region varies from country to country. However, in general, these results suggest that both financial and trade variable are important. In the test of weak exogeneity of Singapore and its trading partners in Asian region, for example, the results show that the first and the second hypotheses are strongly rejected except for the pairs of Singapore and the Philippines, and Singapore and Korea, where they are accepted. In the relationship

Asian	vs Asian	Hypothesis 1	2	3	4	5	6
Indonesia	Singapore	...	...	...	...	...	...
	Thailand	r	a	r	r	r	r
	Malaysia	r	r	r	r	r	r
	Philippines	a	r	r	r	r	r
	Korea	r	r	r	r	r	r
Singapore	Indonesia	r	r	r	a	a	r
	Thailand	r	r	r	r	r	r
	Malaysia	r	r	r	r	a	r
	Philippines	r	a	r	r	r	r
	Korea	r	a	r	r	r	r
Thailand	Singapore	r	r	r	r	r	r
	Indonesia	r	r	r	r	r	r
	Malaysia	r	a	r	r	r	r
	Philippines	r	a	r	r	r	r
	Korea	r	r	r	r	r	r
Malaysia	Singapore	r	r	r	r	r	r
	Thailand	r	a	r	r	r	r
	Indonesia	r	a	r	r	r	r
	Philippines	r	r	r	r	r	r
	Korea	r	r	r	r	r	r
Philippines	Singapore	r	a	r	r	r	r
	Thailand	r	a	r	r	r	r
	Malaysia	a	r	r	r	a	r
	Indonesia	a	r	r	r	r	r
	Korea	r	r	r	r	r	r
Korea	Singapore	r	a	r	r	r	r
	Thailand	r	a	r	r	r	r
	Malaysia	r	a	r	r	r	r
	Philippines	r	r	r	r	r	r
	Indonesia	r	a	r	r	r	r

r,a denotes rejection and acceptance of the null hypothesis of weak exogeniety

Table 4.6: The summary of test results of weak exogeneity among Asian countries

between Korea and its Asian trading partners, the role of financial links appears to be relatively more important than the trade of links. This is indicated by the result of the weak exogeneity tests on the financial and trade variables, where the first hypothesis is rejected and the second hypothesis is accepted in all possible pairs of the observations. In the case of Thailand, the weak exogeneity tests on the financial variables are rejected only for the pairs Thailand and Malaysia, and Thailand and the Philippines. This finding seems consistent with what has been found in Kaminsky and Reinhart [39] that Malaysia is closely linked with Thailand. In general, the results in this study show that both financial and trade variables are not weakly exogenous, suggesting that both trade and financial channels are important.

4.3.3 Direction of the causality

In this section, we perform a test of the direction of causality using the methodology discussed earlier in Section 4.2.2. The objective is to detect which set of variables used in this study is dominant in influencing the other. The VAR was estimated in levels with d[max]=1, as evidence indicated that the maximum order of integration was equivalent to one. The selection of lag-length, k,is determined via Schwarz Information Criteria (SIC). A $(k+1)$ order VAR was estimated with restrictions performed on lagged terms up to the (k-th lag). We first test the restriction $\pi^1_{13} = \pi^2_{13} = \pi^1_{14} = \pi^2_{14} = \pi^1_{23} = \pi^2_{23} = \pi^1_{24} = \pi^2_{24} = 0$. Secondly, we test for reverse causality from trade variables to financial variables (*i.e.* $\pi^1_{31} = \pi^2_{31} = \pi^1_{32} = \pi^2_{32} = \pi^1_{41} = \pi^2_{41} = \pi^1_{42} = \pi^2_{42} = 0$).

As stated in Table 4.3, the acceptance of the first hypothesis and the rejection of the second hypothesis suggests that financial links are Granger-caused by the trade link($T \rightarrow F$). The rejection of the first hypothesis and the acceptance of the second hypothesis suggests that trade variables are Granger-caused by the financial variables ($F \rightarrow T$). The rejection of both the first hypothesis and the second hypothesis would be suggestive that both trade and financial variables show Granger-causality in two directions ($F \rightleftarrows T$). The acceptance of both the first hypothesis and the second hypothesis would suggest that the direction of causality is unknown.

Table 4.29 provides the results of the Granger causality test for all possible pairs between Asian countries (Indonesia, Singapore, Thailand, Malaysia, Philippines, Korea), US and Japan. The first and the second hypothesis test results are presented in the fourth and fifth columns. The last column presents the implication of the results of the first and the second hypotheses.

As can be seen in Table 4.29, the results are quite revealing. The dominance of financial variables in influencing trade variables in the Asian market is clearly apparent in case of Singapore-Japan, Phillipines-Japan and Korea-US. Only two pairs analysed in this study (i.e. the pair between Japan and Malaysia and the USA and Malaysia) is found to have two-way causality between trade and financial links. In the rest of the pairs, however, the direction of causality remains unclear. In the same context, our evidence seems to complement the findings of Van Rijckeghem and Weder [54], Kaminsky and Reinhart [39] who arrived at a similar conclusion using cross sectional data.

In order to perform the causality tests between financial and trade variables among countries within the Asian region, we repeat the Granger-causaality test suggested by Toda and Yamamoto [60]. The results are presented in Table 4.30. As can be seen from the Table 4.30, there is also mixed evidence of causality between trade and financial links. As much as 50 percent of all possible pairs we analysed appear to have one-direction of causality from trade to finance or vice versa. However, it is also interesting to note that in 40 percent of cases the causal relationship can not be identified. The difficulty in detecting this direction of causality would seem to stem from the limited amount of bilateral trade volume among countries within Asian country region. Other possible factors may arise from the fact that the institutional structure in Asian emerging market is still limited in terms of market size and liquidity.

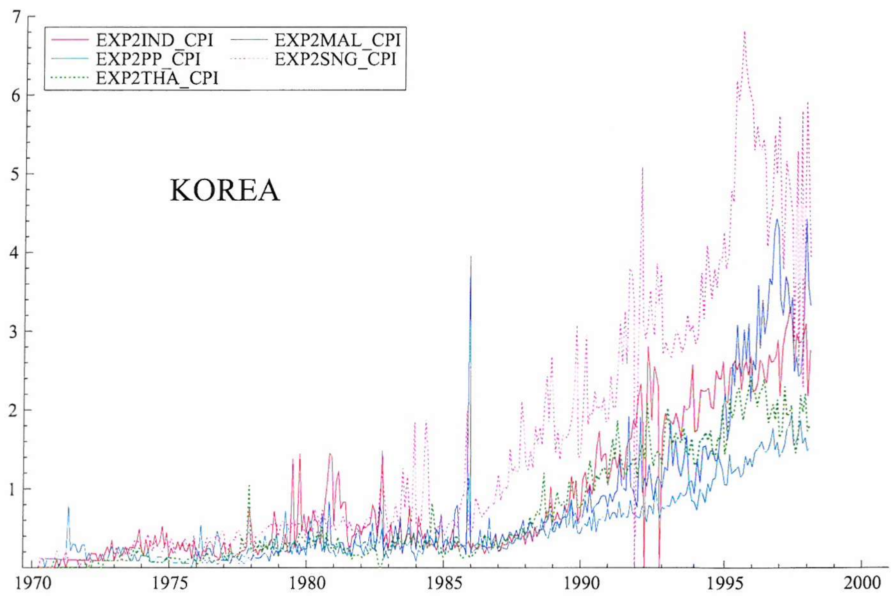
4.4 Conclusion

This study provides additional empirical evidence on the issue of identifying the source of propagation of international shocks. We examine exchange rate, direct/indirect trade and real interest rate differentials as a measure of the relationship between 6 East Asian countries (Thailand, Indonesia, Malaysia, Korea, Malaysia, Singapore, and the Philippines) and their main trading partners (Japan and the USA) and the relationship between 6 East Asian countries with their partners in the same region within a framework of a Vector Error Correction model. Using data that cover the period between January 1970 and February 1998, the empirical results of the paper show that for the majority of East Asian countries analyzed in this study, trade and financial variables are cointegrated. Conditional on the presence of cointegration, in each of the pairs of countries analyzed in the study, the relative response to disequilibrium between the two sets of variables (i.e. trade and finance) is tested. In most cointegrated cases, the exchange rate, real interest rate differentials, bilateral trade and indirect trade indicators, are not weakly exogenous. Our results suggest that both trade and financial channels did play a fundamental role in the propagation of the East Asian Crisis. We also examined the weak exogeneity of these variables for the non-crisis and crisis periods separately. The results suggest that financial variables appear to be relatively important compared to the trade variables in a number of cases.

The direction of causality is tested based on the methodology suggested by Toda and Yamamoto [60]. Our empirical results indicate that there is mixed evidence of which variables appear to be dominant in influencing other variables. While the direction of causality cannot be identifed in a number of cases ,the dominance of financial variables in influencing trade variables in the Asian market is clearly apparent in case of Singapore-Japan, Phillipines-Japan and Korea-US.

In the test of causality between financial and trade variables among countries within the Asian region, the results of this study indicate that there is little evidence of two-way causality between trade and financial variables. The results also indicate that considerable amounts of all possible pairs we analysed appear to have unknown direction of causality, either trade to finance or vice versa. Overall, our evidence seems to complement the findings of Van Rijckeghem and Weder [54], Kaminsky and

Reinhart [39] who used cross sectional data and arrived at the conclusion that the financial channel plays a more important role than the trade channel. Our findings also seem to be consistent with both classes of theories based on trade and/or finance such as product competition, portfolio recomposition or liquidity shock.



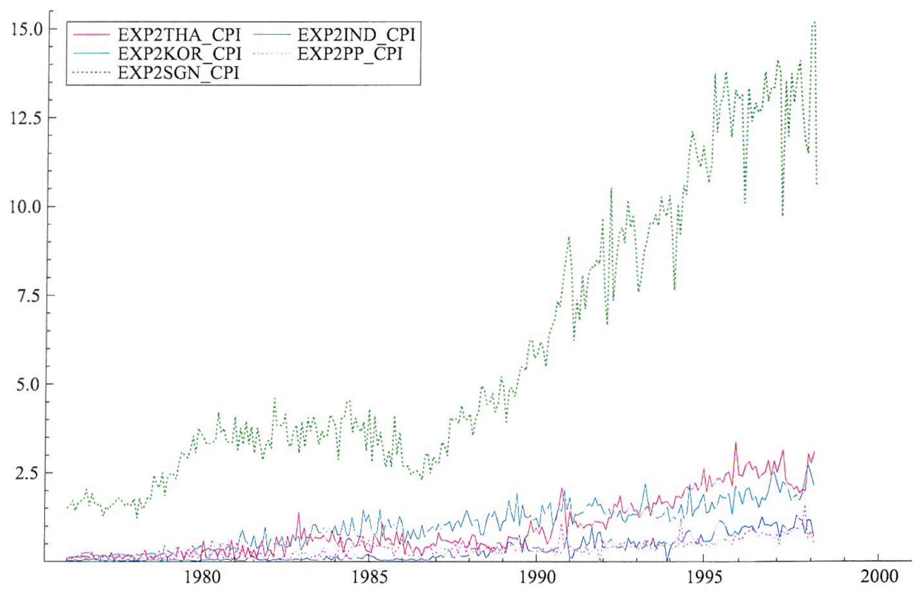
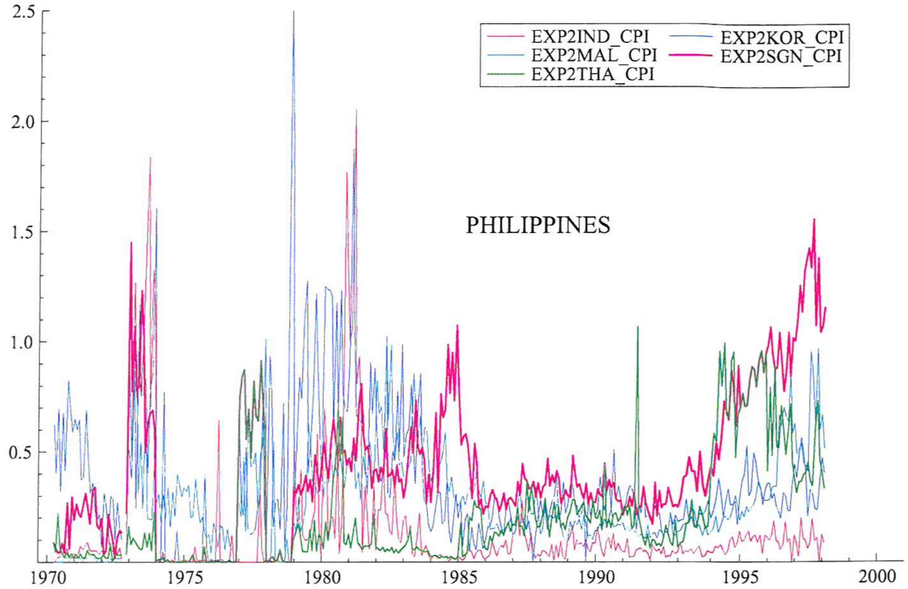


Figure 4.1: The Bilateral Pattern of East Asian Countries' Exports



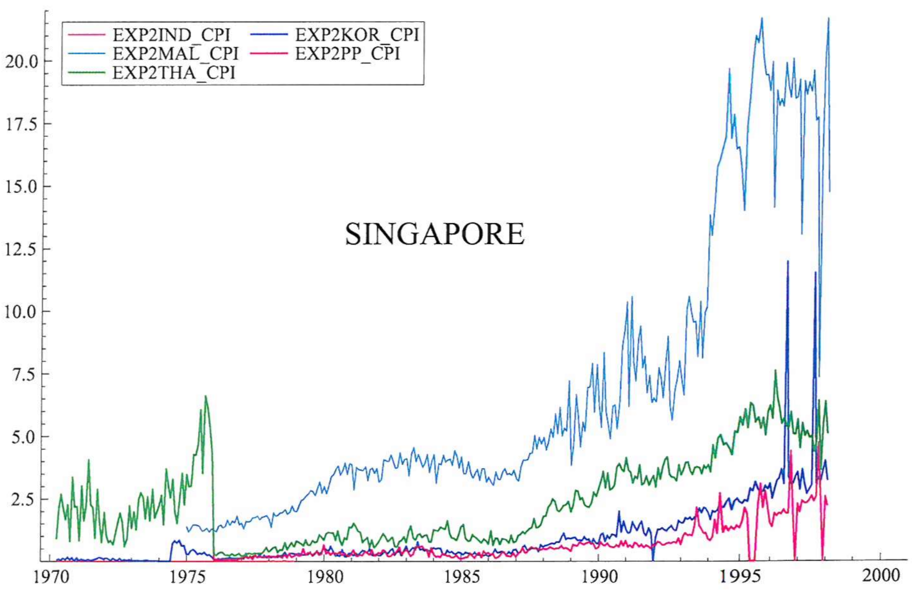


Figure 4.2: The Bilateral Pattern of East Asian Countries' Exports (continued)

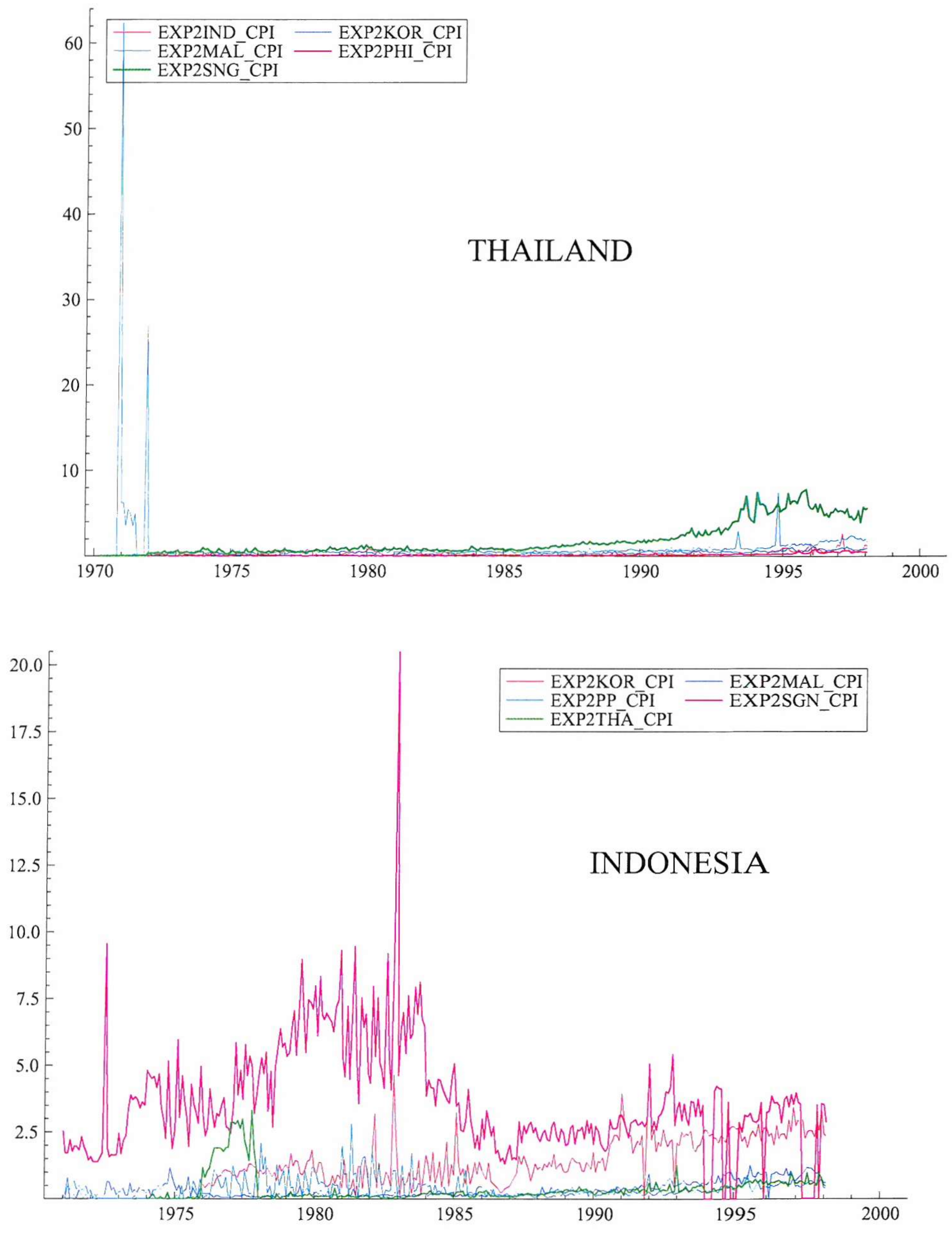
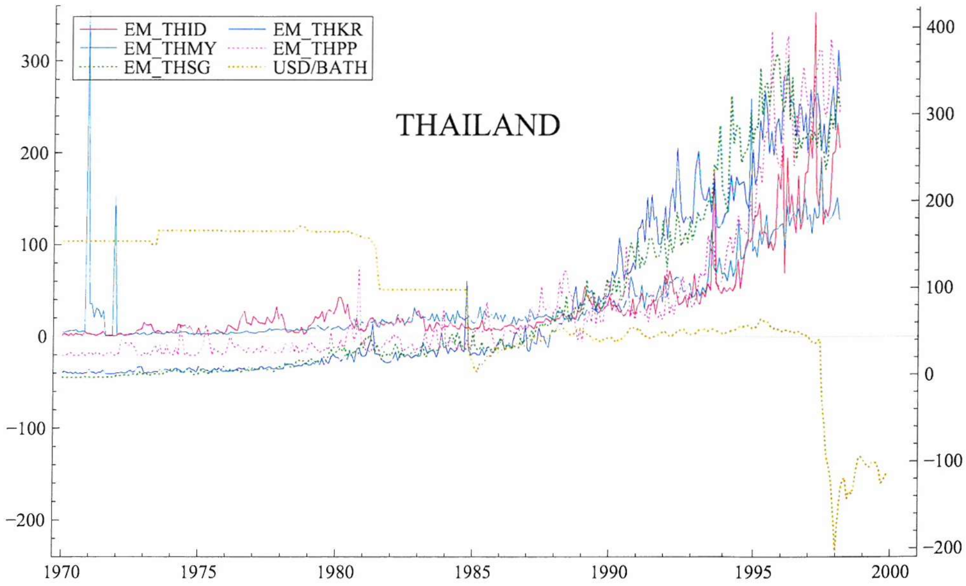


Figure 4.3: The Bilateral Pattern of East Asian Countries' Exports (continued)



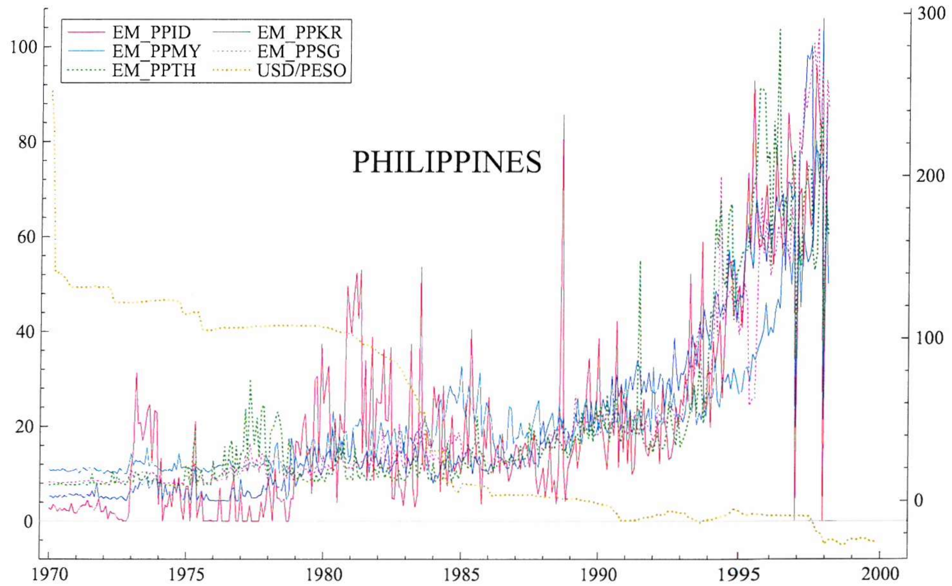
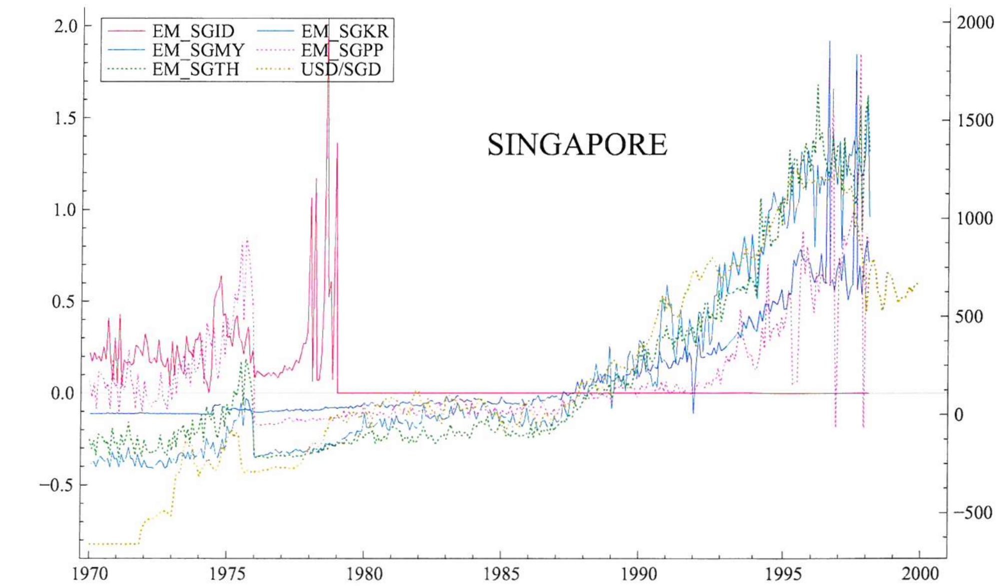


Figure 4.4: The Plot between Trade indicators and Exchange Rates



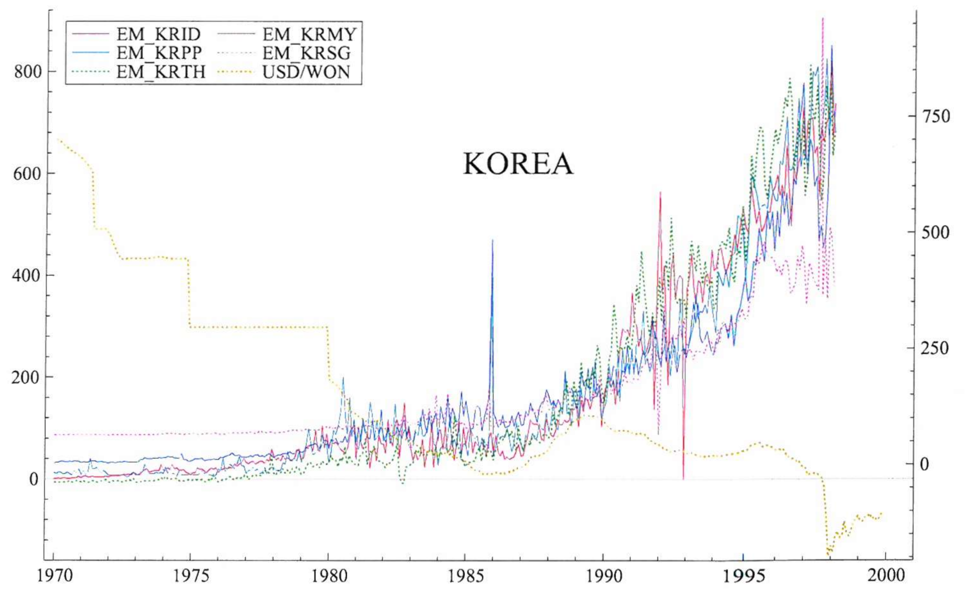
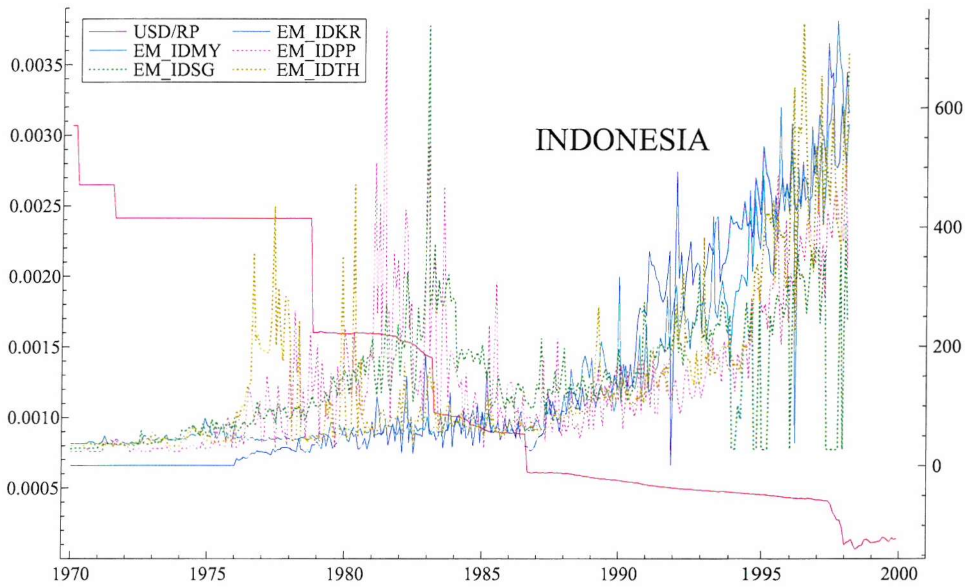


Figure 4.5: The Plot between Trade indicators and Exchange Rates (continued)



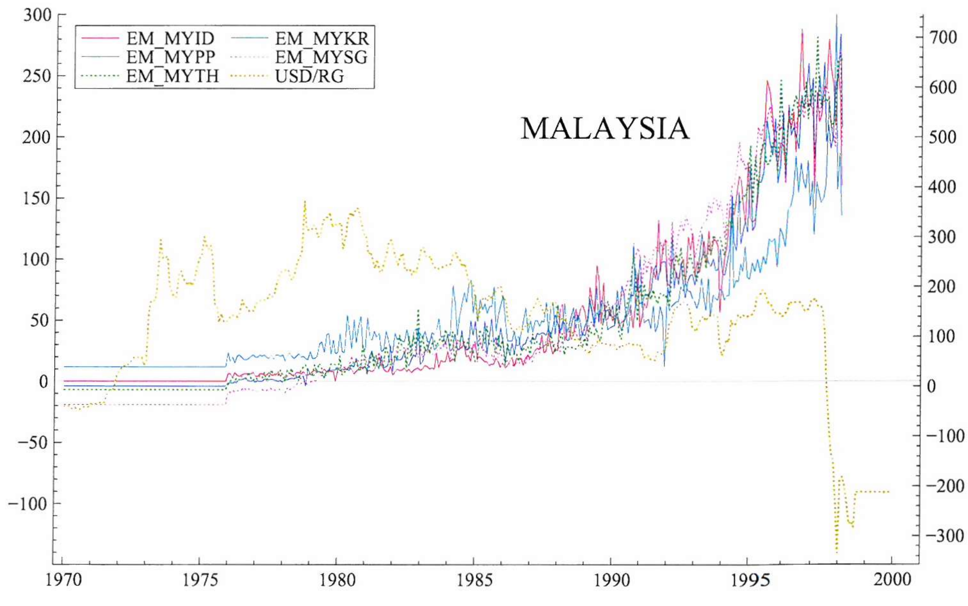


Figure 4.6: The Plot between Trade indicators and Exchange Rates (continued)

		Descriptive Statistics						
Country	Country partner	Acronym	Sample Periods	nobs	mean	std	min	max
Indonesia	Singapore	EX2SGN	1971M1-1998M2	326	155.6	116.7	0	743.0
	Thailand	EXP2THA	1974M1-1998M2	290	20.8	23.4	0	115.0
	Malaysia	EXP2MAL	1971M1-1998M2	326.	22.6	31.9	0	132
	Philippines	EXP2PP	1971M1-1998M2	326	17.9	19.1	0	90.0
	Korea	EXP2KOR	1976M1-1997M2	254	93.2	87.9	0	375.0
Singapore	Indonesia	EX2IND	...	...	...	...	...	...
	Thailand	EXP2THA	1974 M1 -1998 M2	290	20.8	23.4		115.0
	Malaysia	EX2MAL	1971 M1-1998M2	326	. 22.6	31.9	0	132.0
	Philippines	EXP2PP	1971 M1-1998M2	326	17.9	19.2	0	90.0
	Korea	EX2KOR	1976M1- 1997M2	254	93.2	87.8	0	375.0
Malaysia	Indonesia	EX2IND	1977M2-1998M2	253	2			
	Thailand	EXP2THA	1974M1-1998M2	290	20.8	23.4	0	115.0
	Singapore	EX2SGN	1971M1- 1998M2	326	155.6	116.7	0	743.0
	Philippines	EX2PP	1971M1-1998M2	326	17.91	19.1	0	90.0
	Korea	EX2KOR	1976M1-1997M2	254	93.16	87.9	0	375.0
Phillipines	Indonesia	EX2IND	1970M1-1972M2	34	0.25	0.15	0	0.80
	Thailand	EXP2THA	1975M2-1998M2	34	0.20	0.16	0	1.00
	Singapore	EX2SGN	1972M2-1998M2	.	0	...	...	...
	Malaysia	EXP2MAL	1975M2-1998M2	.	0	...	...	...
	Korea	EX2KOR	1977M2-1998M2	.	0	...	...	...
Thailand	Indonesia	EX2IND	1970M2-1998M2	338	19.1	29.1	0	283.0
	Philippines	EXP2PP	1970M2-1998M2	338	9.89	15.6	0	81.0
	Singapore	EX2SGN	1970M2-1998M2	338	146.8	199.6	0	801.0
	Malaysia	EXP2MAL	1970M2-1998M2	338	55.8	96.3	0	1260.0
	Korea	EXP2KOR	1977M2-1998M2	338	21.85	26.5	0	117.0
Korea	Indonesia	EX2IND	1971M2-1998M2	338	69.2	95.0	0	361.0
	Thailand	EXP2THA	1971M2-1998M2	338	54.7	72.5	0	251.0
	Singapore	EX2SGN	1970M1-1998M2	338	125.6	125.6	0	687.0
	Malaysia	EXP2MAL	1976M2-1998M2	266	80.2	111.1	0	503.0
	Philippines	EXP2PP	1970M1-1998M2	325	37.5	50.2	0	213.0

Table 4.7: The Descriptive Statistics of Bilateral Export

		Export to country's partner (Monthly)				
Country	Country partner (p)	Acronym	Sample Periods	Num. Obs	Lag Order (p)	ADF Statistics
Indonesia	Singapore	EX2SGN	1972M2-1998M2	313	1	-6.7243*
	Thailand	EXP2THA	1975M2-1998M2	277	2	-2.3896
	Malaysia	EXP2MAL	1972M2-1998M2	313	11	-2.1621
	Philippines	EXP2PP	1975M2-1998M2	313	3	-2.6728
	Korea	EXP2KOR	1977M2-1998M2	253	3	-2.9053
Singapore	Indonesia	EX2IND	1971M2-1978M12	95	6	-0.52622
	Thailand	EXP2THA	1971M2-1998M2	325	2	-1.9080
	Malaysia	EX2MAL	1976M2-1998M2	265.	.12	-1.1564
	Philippines	EXP2PP	1975M2-1998M2	325	2	-9.8443
	Korea	EX2KOR	1971M2-1998M2	325	11	1.6287
Malaysia	Indonesia	EX2IND	1977M2-1998M2	253	2	-3.1462
	Thailand	EXP2THA	1975M2-1998M2	253	1	-2.1343
	Singapore	EX2SGN	1977M2-1998M2	253	7	-.67928
	Philippines	EXP2MAL	1977M2-1998M2	253	3	-3.5058*
	Korea	EX2KOR	1977M2-1998M2	253	3	-6.3550*
Phillipines	Indonesia	EX2IND	1972M2-1998M2	.	0	-6.7243*
	Thailand	EXP2THA	1975M2-1998M2	.	0	-4.2740*
	Singapore	EX2SGN	1972M2-1998M2	.	0	-5.4791
	Malaysia	EXP2MAL	1975M2-1998M2	.	0	-9.8443
	Korea	EX2KOR	1977M2-1998M2	.	0	-7.7489*
Thailand	Indonesia	EX2IND	1972M2-1998M2	313	0	-7.1434*
	Philippines	EXP2PP	1975M2-1998M2	253	0	-3.0550
	Singapore	EX2SGN	1972M2-1998M2	313	0	-2.9244
	Malaysia	EXP2MAL	1975M2-1998M2	313	0	-2.1213
	Korea	EXP2KOR	1977M2-1998M2	253	0	-4.7627*
Korea	Indonesia	EX2IND	1971M2-1998M2	325	6	.18519
	Thailand	EXP2THA	1971M2-1998M2	325	5	-1.0181
	Singapore	EX2SGN	1972M2-1998M2	325	5	-1.5681
	Malaysia	EXP2MAL	1977M2-1998M2	253	4	-.73528
	Philippines	EXP2PP	1977M2-1998M2	325	5	0.68111
Lag order chosen using value of SBC, AIC, and HQ criterion.						

Table 4.8: The Unit Root Test Results of Export to country's partner

		Real Interest Rate (deposit) differential (Mothly)				
Country	Country partner (p)	Acronym	Sample Periods	Num. Obs	Lag Order (p)	ADF Statistics
Indonesia	Singapore	REAL_IS	1978(2)to1998(20)	254	1	-1.865
	Thailand	REAL_IT	1978(2)to1998(20)	254	1	-2.310
	Malaysia	REAL_IM	1977(2)to1998(2)	266	2	-2.008
	Philippines	REAL_IP	1982(11)to1998(2)	197	6	-2.909*
	Korea	REAL_IK	1975(5)to1998(2)	287	1	-1.813
Singapore	Indonesia	REAL_SI	1978(2)to1998(2)	254	11	-1.255
	Thailand	REAL_ST	1978(2)to1998(2)	254	2	-3.180*
	Malaysia	REAL_SM	1978(2)to1998(2)	254	3	-2.472
	Philippines	REAL_SP	1982(12)to1998(2)	196	2	-3.123*
	Korea	REAL_SK	1978(2)to1998(2)	254	1	-2.881*
Malaysia	Indonesia	REAL_MI	1977(2)to1998(2)	266	1	-2.008
	Thailand	REAL_MT	1978(2)to1998(2)	254	4	-4.015**
	Singapore	REAL_MS	1978(2)to1998(2)	254	9	-2.520
	Philippines	REAL_MP	1982(11)to1998(2)	197	2	-2.908*
	Korea	REAL_MK	1977(2)to1998(2)	266	11	-1.869
Philippines	Indonesia	REAL_PI	1982(11)to1998(2)	197	6	-2.909*
	Thailand	REAL_PT	1982(11)to1998(2)	197	4	-3.155*
	Singapore	REAL_PS	1982(11)to1998(2)	197	4	-2.990*
	Malaysia	REAL_PM	1982(11)to1998(2)	197	2	-2.908*
	Korea	REAL_PK	1982(11)to1998(2)	197	1	-2.389
Thailand	Indonesia	REAL_TI	1978(2)to1998(20)	313	2	-2.310
	Philippines	REAL_TP	1982(11)to1998(2)	197	3	-3.155*
	Singapore	REAL_TS	1978(2)to1998(2)	254	2	-3.180*
	Malaysia	REAL_TM	1978(2)to1998(2)	254	5	-3.329*
	Korea	REAL_TK	1978(2)to1998(20)	254	2	-2.390
Korea	Indonesia	REAL_KI	1975(5)to1998(2)	287	3	-1.797
	Thailand	REAL_KT	1978(2)to1998(2)	254	3	-2.236
	Singapore	REAL_KS	1978(2)to1998(2)	254	2	-2.881*
	Malaysia	REAL_KM	1977(2)to1998(2)	266	3	-2.006
	Philippines	REAL_KP	1982(11)to1998(2)	197	3	-2.389
Lag order chosen using value of SBC, AIC, and HQ criterion.						

Table 4.9: The Unit Root Test Results of Interest Rate (deposit rate)

		Real Interest Rate Differential (Money Market)				
Country	Country partner (p)	Acronym	Sample Period	Num. Obs	Lag Order (p)	ADF Statistics
Indonesia	Singapore	REALM_IS	1987(6)to1998(2	142	2	-0.7890
	Thailand	REALM_IT	1987(6)to1998(2)	142	3	-0.6967
	Malaysia	REALM_IM	1987(6)to1998(2)	142	2	-1.112
	Philippines	REALM_IP	...	...	...	...
	Korea	REALM_IK	1987(6)to1998(2)	142	4	-0.8824
Singapore	Indonesia	REALM_SI	1987(6)to1998(2)	142	3	-0.7097
	Thailand	REALM_ST	1978(2)to1998(2)	254	3	-3.679**
	Malaysia	REALM_SM	1978(2)to1998(2)	254	3	-2.886*
	Philippines	REALM_SP	...	...	...	...
	Korea	SG_KRmm	1978(2)to1998(2)	254	3	-3.501**
Malaysia	Indonesia	REALM_MI	1987(6)to1998(2)	142	4	-0.04069
	Thailand	REALM_MT	1974(9)to1998(2)	295	7	-3.003*
	Singapore	REALM_MS	1978(2)to1998(2)	254	6	-2.259
	Philippines	REALM_MP				
	Korea	REALM_MK	1978(2)to1998(2)	254	3	-1.900
Phillipines	Indonesia	REALM_PI	...	...	...	...
	Thailand	REALM_PT	...	...	...	...
	Singapore	REALM_PS	...	...	...	...
	Malaysia	REALM_PM	...	...	...	...
	Korea	REALM_PK	...	...	...	...
Thailand	Indonesia	REALM_TI	1978(2)to1998(2)	254	2	-1.969
	Philippines	REALM_TP	...	...	...	...
	Singapore	REALM_TS	1978(2)to1998(2)	254	3	-3.679**
	Malaysia	REALM_TM	1974(9)to1998(2)	295	2	-2.819
	Korea	REALM_TK	1977(10)to1998(2)	258	1	-3.185*
Korea	Indonesia	REALM_KI	1987(8)to1998(2)	140	1	-2.364
	Thailand	REALM_KK	1981(2)to1998(2)	218	3	-0.03301
	Singapore	REALM_KS	1978(2)to1998(2)	254	2	-3.501**
	Malaysia	REALM_KM	1979(2)to1998(2)	242	3	-2.189
	Philippines	REALM_KP	...	...	...	...

Lag order chosen using value of SBC, AIC, and HQ criterion.

Table 4.10: The Unit Root Test Results of Real Interest Rate Differentials (Money Market)

Variable	Country	Unit Root Test				
		Acronym	Sample period	Num. Obs	Lag Order (p)	ADF Statistics
Exchange Rate(MONTHLY)	Indonesia	USD_RP	1971M2-1999M12	347	9	-2.4446
	Singapore	USD_SGD	1971M2-1999M12	347	8	-2.3839
	Malaysia	USD_RG	1971M2-1999M12	347	12	-1.7045
	Phillipines	USD_PESO	1971M2-1999M12	347	8	-2.7122
	Thailand	USD_BATH	1971M2-1999M12	347	2	-2.4903
	Korea	USD_WON	1971M2-1999M12	347	1	-2.8002
Deposit(Monthly)	Indonesia	REAL_I	1975 (5) to 1998 (2)	287	2	-1.964
	Singapore	REAL_S	1978 (2) to 1998 (2)	187	5	-1.373
	Malaysia	REAL_M	1977 (2) to 1998 (2)	266	6	-2.306
	Phillipines	REAL_P	1982 (11) to 1998 (2)	197	1	-2.452
	Thailand	REAL_T	1978 (2) to 1998 (2)	254	4	-2.455
	Korea	REAL_K	1975 (2) to 1998 (2)	290	2	-1.879
Money Market(MONTHLY)	Indonesia	REALM_I	1987 (6) to 1998 (2)	142	4	0.6406
	Singapore	REALM_S	1978 (2) to 1998 (2)	254	3	-2.195
	Philippines	REALM_P	...	...	...	...
	Thailand	REALM_T	1975 (2) to 1998 (2)	290	2	-2.613
	Korea	REALM_K	1977 (9) to 1998 (2)	259	1	-2.537
	Lag order chosen using value of SBC, AIC, and HQ criterion.					

Table 4.11: The Unit Root Test Results of Exchange Rates, Deposit Rates, and Money Market Rates

		DIRECT TRADE INDICATORS [Monthly]		
Country	Country partner (p)	Acronym	Sample Periods	ADF Statistics
Indonesia	Singapore	DT_IDSG	1972M2-1998M2	-2.601
	Thailand	DT_IDTH	1975M2-1998M2	-4.024**
	Malaysia	DT_IDMY	1972M2-1998M2	-0.2700
	Philippines	DT_IDPP	1975M2-1998M2	-2.219
	Korea	DT_IDKR	1977M2-1998M2	-0.1246
Singapore	Indonesia	DT_SGID	1971M2-1978M12	-2.903*
	Thailand	DT_SGTH	1971M2-1998M2	-0.4301
	Malaysia	DT_SGMY	1976M2-1998M2	-2.909*
	Philippines	DT_SGPP	1975M2-1998M2	-0.6751
	Korea	DT_SGKR	1971M2-1998M2	0.1251
Malaysia	Indonesia	DT_MYID	1977M2-1998M2	-0.9493
	Thailand	DT_MYTH	1975M2-1998M2	-1.578
	Singapore	DT_MYSG	1977M2-1998M2	-2.424
	Philippines	DT_MYPP	1977M2-1998M2	-2.099
	Korea	DT_MYKR	1977M2-1998M2	-1.655
Phillipines	Indonesia	DT_PPID	1972M2-1998M2	-3.213*
	Thailand	DT_PPTH	1975M2-1998M2	-2.515
	Singapore	DT_PPSG	1972M2-1998M2	-2.583
	Malaysia	DT_PPMY	1975M2-1998M2	-2.517
	Korea	DT_PPKR	1977M2-1998M2	-3.122*
Thailand	Indonesia	DT_THID	1972M2-1998M2	-3.215*
	Philippines	DT_THPP	1975M2-1998M2	-2.431
	Singapore	DT_THSG	1972M2-1998M2	-2.730
	Malaysia	DT_THMY	1975M2-1998M2	-2.357
	Korea	DT_THKR	1977M2-1998M2	-1.995
Korea	Indonesia	DT_KRID	1971M2-1998M2	-0.6449
	Thailand	DT_KRTH	1971M2-1998M2	-0.5431
	Singapore	DT_KRSG	1972M2-1998M2	-0.3053
	Malaysia	DT_KRMY	1977M2-1998M2	-1.004
	Philippines	DT_KRPP	1977M2-1998M2	-1.542
* denotes that the series is stationary. Lag order chosen using value of SBC, AIC, and HQ criterion.				

Table 4.12: The Unit Root Test Results of Direct Trade Indicators

		TRADE COMPETITION IN THE THIRD MARKET (INDIRECT TRADE INDICATORS)		
Country	Country partner	Acronym	Sample Periods	ADF Statistics
Indonesia	Singapore	IDT_IDSG	1971M2-1998M2	-3.176*
	Thailand	IDT_IDTH	1975M2-1998M2	-3.619**
	Malaysia	IDT_IDMY	1972M2-1998M2	-4.214**
	Philippines	IDT_IDPP	1975M2-1998M2	-2.957*
	Korea	IDT_IDKR	1977M2-1998M2	-1.302
Singapore	Indonesia	IDT_SGID	1971M2-1978M12	-5.898**
	Thailand	IDT_SGTH	1971M2-1998M2	-3.916**
	Malaysia	IDT_SGMY	1976M2-1998M2	-4.305**
	Philippines	IDT_SGPP	1975M2-1998M2	-3.745**
	Korea	IDT_SGKR	1971M2-1998M2	-4.317**
Malaysia	Indonesia	IDT_MYID	1977M2-1998M2	-1.093
	Thailand	IDT_MYTH	1975M2-1998M2	-1.559
	Singapore	IDT_MYSG	1977M2-1998M2	-1.987
	Philippines	IDT_MYPP	1977M2-1998M2	-1.962
	Korea	IDT_MYKR	1977M2-1998M2	-1.041
Phillipines	Indonesia	IDT_PPID	1972M2-1998M2	-4.860**
	Thailand	IDT_PPTH	1975M2-1998M2	-4.136**
	Singapore	IDT_PPSG	1972M2-1998M2	-5.47**
	Malaysia	IDT_PPMY	1975M2-1998M2	-6.803**
	Korea	IDT_PPKR	1977M2-1998M2	-6.721**
Thailand	Indonesia	IDT_THID	1972M2-1998M2	-4.988**
	Philippines	IDT_THPP	1975M2-1998M2	-4.999**
	Singapore	IDT_THSG	1972M2-1998M2	-3.649**
	Malaysia	IDT_THMY	1975M2-1998M2	-16.63**
	Korea	IDT_THKR	1977M2-1998M2	-4.708**
Korea	Indonesia	IDT_KRID	1971M2-1998M2	-6.183**
	Thailand	IDT_KRTH	1971M2-1998M2	-5.460**
	Singapore	IDT_KRSG	1972M2-1998M2	-3.779**
	Malaysia	IDT_KRMY	1977M2-1998M2	-8.823**
	Philippines	IDT_KRPP	1977M2-1998M2	-14.76**
* denotes that the series is stationary. Lag order chosen using value of SBC, AIC, and HQ criterion				

Table 4.13: The Unit Root Test Results of Indirect Trade Indicators

				JOHANSEN TEST STATISTICS [EXPORT VS EXCHANGE RATE]			
		Variable's acronym		Eigenvalue‡		Trace	
Country	Partner	EXPORT	EXCH. RATE	H_o: r=0	H_o: r⩽1	H_o: r=0	H_o: r⩽1
Indonesia	Singapore	EX2SGN	RP_USD	67.9740**	10.7856*	78.7595**	10.7856
	Thailand	EXP2THA	RP_USD	13.5664	4.7866	18.3530	4.7866
	Malaysia	EXP2MAL	RP_USD	15.3586	8.6493	24.0079*	8.6493
	Philippines	EXP2PP	RP_USD	13.4073	4.5038	17.9111	4.5038
	Korea	EXP2KOR	RP_USD	21.2603*	10.6438*	31.9042*	10.6438
Singapore	Indonesia	EX2IND	SG_USD	...	...	...	...
	Thailand	EXP2TH	SG_USD	17.3850*	3.0008	20.3858*	3.0008
	Malaysia	EX2MAL	SG_USD	10.0518	1.9991	12.0509	1.9991
	Philippines	EXP2PP	SG_USD	25.9759*	3.0973	29.0732*	3.0973
	Korea	EX2KOR	SG_USD	24.7560*	2.8145	27.5705*	2.8145
Malaysia	Singapore	EX2SGN	RG_USD	16.7918*	5.9393	22.7311*	5.9393
	Thailand	EXP2THA	RG_USD	12.6217	3.2669	15.8886	3.2669
	Indonesia	EX2IND	RG_USD	9.9328	2.1137	12.0465	2.1137
	Philippines	EXP2PP	RG_USD	16.5147*	2.4045	18.9192	2.4045
	Korea	EX2KOR	RG_USD	7.9979	2.5953	10.5933	2.5953
Philippines	Indonesia	EX2IND	PES_USD	7.7255	5.1809	12.9064	5.1809
	Thailand	EXP2THA	PES_USD	5.9457	3.3437	9.2894	3.3437
	Singapore	EX2SGN	PES_USD	14.2257	3.1307	17.3565	3.1307
	Malaysia	EXP2MAL	PES_USD	...	...	...	...
	Korea	EX2KOR	PES_USD	12.2247	4.2356	16.4603	4.2356
Thailand	Indonesia	EX2IND	BATH_USD	23.6403*	1.8617	25.5021*	1.8617
	Philippines	EXP2PP	BATH_USD	16.4327*	2.7732	19.2059	2.7732
	Singapore	EX2SGN	BATH_USD	8.1882	5.4718	13.6600	5.4718
	Malaysia	EXP2MAL	BATH_USD	32.8785*	1.3028	34.1813*	1.3028
	Korea	EX2KOR	BATH_USD	19.6678*	3.3247	22.9926	3.3247
Korea	Indonesia	EX2IND	WON_USD	13.0643	1.8754	14.9397	1.8754
	Thailand	EX2TH	WON_USD	16.4287*	1.7959	18.2246	1.7959
	Singapore	EX2SGN	WON_USD	8.8913	1.9569	10.8482	1.9569
	Malaysia	EXP2MAL	WON_USD	12.8040	1.3572	14.1611	1.3572
	Philippines	EXP2PP	WON_USD	19.6170*	1.5385	21.1555*	1.5385

* denotes rejection of the null hypothesis of no cointegration at 5% level of significance

Table 4.14: Johansen Test Results Between Bilateral Export and Exchage Rate

				JOHANSEN TEST STATISTICS [DIRECT TRADE VS INT RATE DIFFERENTIAL]			
		Variable's acronym		Eigenvalue‡		Trace	
Country	Partner	INT. RATE DEF	TRADE	H_o: r=0	H_o: r$\leqslant$1	H_o: r=0	H_o: r$\leqslant$1
Indonesia	Singapore	REAL_IS	DT_IDSG	...	...	...	...
	Thailand	REAL_IT	DT_IDTH	59.3043	6.7234	66.0243	6.7234
	Malaysia	REAL_IM	DT_IDMY	14.7834	3.2426	18.03	3.2489
	Philippines	REAL_IP	DT_IDPP	37.03	8.58	45.62	8.58
	Korea	REAL_IK	DT_IDKR	18.3100*	3.0725	21.3825*	3.0725
Singapore	Singapore	REAL_SS	DT_SGID	...	...	...	...
	Thailand	REAL_ST	DT_SGTH	18.4769*	5.0483	23.5252*	5.0483
	Malaysia	REAL_SM	DT_SGMY	59.6531*	6.4679	66.1209*	6.4679
	Philippines	REAL_SP	DT_SGPP	4738.2*	32.9218	4771.2	32.9218
	Korea	REAL_SK	DT_SGKR	18.6143*	6.6995	25.3138*	6.6995
Malaysia	Singapore	REAL_MS	DT_MYSG	15.4336*	7.1248	22.5585*	7.1248
	Thailand	REAL_MT	DT_MYTH	...	...	...	...
	Indonesia	REAL_MI	DT_MYID	20.8075*	3.4232	24.2307*	3.4232
	Philippines	REAL_MP	DT_MYPP	4721.7*	17.0234	4738.7	17.0234
	Korea	REAL_MK	DT_MYKR	27.5291*	5.1032	32.6323	5.1032
Philippines	Indonesia	REAL_PI	DT_PPID	...	...	...	...
	Thailand	REAL_PT	DT_PPTH	4742.1*	9.6346	4751.8	9.6346
	Singapore	REAL_PS	DT_PPSG	4723.8*	13.6507	4737.4	13.6507
	Malaysia	REAL_PM	DT_PPMY	4721.7*	27.4761	4749.1	27.4761
	Korea	REAL_PK	DT_PPKR	4681.9*	15.2241	4697.1	15.2241
Thailand	Indonesia	REAL_TI	DT_THID	24.0648*	5.6863	29.7511*	5.6863
	Philippines	REAL_TP	DT_THPP	...	...	...	...
	Singapore	REAL_TS	DT_THSG	35.7560*	11.9340	47.6900*	11.9340
	Malaysia	REAL_TM	DT_THMY	24.1752*	16.3389	40.5141*	16.3389
	Korea	REAL_TK	DT_THKR	39.2819*	4.5786	43.8604*	4.5786
Korea	Indonesia	REAL_KI	DT_KRID	...	...	...	...
	Thailand	REAL_KT	DT_KRTH	7.9927	4.5468	12.5396	4.5468
	Singapore	REAL_KS	DT_KRSG	15.2411*	6.6956	21.9367*	6.6956
	Malaysia	REAL_KM	DT_KRMY	38.7232*	5.2407	43.9639*	5.2407
	Philippines	REAL_KP	DT_KRPP	10.09	9.1422	20.13	9.7422

* denotes rejection of the null hypothesis of no cointegration at 5% level of significance

Table 4.15: Johansen Test Results Between Direct Trade and Interest Rate Differential

				JOHANSEN TEST STATISTICS [INDIRECT TRADE VS INT. RATE DIFFERENTIAL]			
		Variable's acronym		Eigenvalue‡		Trace	
Country	Partner	INT RATE DIF	TRADE	H_0: r=0	H_0: r⩽1	H_0: r=0	H_0: r⩽1
Indonesia	Singapore	REAL_IS	IDT_IDSG	...	...	...	...
	Thailand	REAL_IT	IDT_IDTH	29.7818*	5.4909	35.2727*	5.4909
	Malaysia	REAL_IM	IDT_IDMY	34.3890*	3.6012	37.9901*	3.6012
	Philippines	REAL_IP	IDT_IDPP	4578.6*	50.0027	4628.6*	50.0027
	Korea	REAL_IK	ID_IDKR	50.6070*	3.2268	53.8337	3.2268
Singapore	Singapore	REAL_SS	IDT_SGID	...	...	...	...
	Thailand	REAL_ST	IDT_SGTH	22.5753*	6.4213	28.9965*	6.4213
	Malaysia	REAL_SM	IDT_SGMY	48.6681*	6.4158	55.0839*	6.4158
	Philippines	REAL_SP	IDT_SGPP	4732.2*	37.1344	4769.4*	37.1344
	Korea	REAL_SK	IDT_SGKR	16.9164*	6.7483	23.6647*	6.7483
Malaysia	Singapore	REAL_MS	IDT_MYSG	27.3966*	6.7153	34.1119*	6.7153
	Thailand	REAL_MT	IDT_MYTH	24.6458*	16.1365	40.7823*	16.1365
	Indonesuia	REAL_MI	IDT_MYID	28.2777*	3.4219	31.6996	3.4219
	Philippines	REAL_MP	IDT_MYPP	4724.5*	17.9317	4742.4*	17.9317
	Korea	REAL_MK	IDT_MYKR	21.0802*	5.2003	26.2805*	5.2003
Philippines	Indonesia	REAL_PI	IDT_PPID	4578.6*	50.0027	4628.6*	50.0027
	Thailand	REAL_PT	IDT_PPTH	4742.5*	15.4842	4757.9*	15.4842
	Singapore	REAL_PS	IDT_PPSG	4719.7*	11.5986	4731.3*	11.5986
	Malaysia	REAL_PM	IDT_PPMY	4721.6*	21.5788	4743.2*	21.5788
	Korea	REAL_PK	IDT_PPKR	...	...	...	...
Thailand	Indonesia	REAL_TI	IDT_THID	28.3947*	5.7768	34.1715*	5.7768
	Philippines	REAL_TP	IDT_THPP	4752.2*	17.4490	4769.6	17.4490
	Singapore	REAL_TS	IDT_THSG	22.3111*	7.1098	29.4209*	7.1098
	Malaysia	REAL_TM	IDT_THMY	29.1728*	16.9257	46.0985*	16.9257
	Korea	REAL_TK	IDT_THKR	...	...	...	...
Korea	Indonesia	REAL_KI	IDT_KRID	41.3726*	3.2912	44.6637	3.2912
	Thailand	REAL_KT	IDT_KRTH	12.4180*	4.7202	17.1382*	4.7202
	Singapore	REAL_KS	IDT_KRSG	15.3177*	6.7730	22.0907*	6.7730
	Malaysia	REAL_KM	IDT_KRMY	49.2467*	5.2421	54.4888*	5.2421
	Philippines	REAL_KP	IDT_KRPP	...	...	...	...

** denotes rejection of the null hypothesis of no cointegration at 5% level of significance*

Table 4.16: Johansen Test Results Between Indirect Trade and Real Interest Rate Differential

JAPAN vs ASIAN-6 (full sample)			
	INDONESIA vs JAPAN	MALAYSIA vs JAPAN	KOREA vs JAPAN
(x_1, x_2)FINANCE	{REAL_IJ, [Rp/Yen]}	{REAL_MJ, [Ringgit/Yen]}	{REAL_KJ, [Won/Yen]}
(x_3, x_4)TRADE	{DT_IDJP, IDT_IDJP}	{DT_MYJP, IDT_MYJP}	{DT_KRJP, IDT_KRJP}
Rank (r)	2	1	1
H_0	$H_o : \alpha_{r=2}=A\psi$	$H_o : \alpha_{r=1}=A\psi$	$H_o : \alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =21.135[0.00]**	$A=\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =29.765[0.00]**	$A=\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =11.063[0.01]*
Hypothesis 2	$A=\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =[0.0428]*9.8646	$A=\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$ LR-test $\chi^2(3)$ = 19.142[0.00]**	$A=\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =22.24[0.00]**
Hypothesis 3	$A=\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =[0.0074]**13.969	$A=\begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =29.055[0.00]**	$A=\begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =13.77[0.00]**
Hypothesis 4	$A=\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =[0.0024]**16.504	$A=\begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$ LR-test $\chi^2(3)$ =9.9827[0.01]*	$A=\begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =15.01[0.00]**
Hypothesis 5	$A=\begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =12.117[0.01]*	$A=\begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =30.156[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =9.576[0.02]*
Hypothesis 6	$A=\begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =16.362[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}$ LR-test $\chi^2(3)$ =16.322[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =7.378[0.06]
Num of Obs	137	248	285
Sample	1986 (10) to 1998 (2)	1977 (7) to 1998 (2)	1974 (6) to 1998 (2)
Num of Lag	5	2	5
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.17: The Result of Weak Exogeniety of Trade and Financial Variables: Japan vs Asian-6 (full sample)

JAPAN vs ASIAN-6 (full sample)			
	SINGAPORE vs JAPAN	THAILAND vs JAPAN	PHILIPPINES vs JAPAN
(x_1, x_2)FINANCE	{REAL_SJ, [$SG/Yen]}	{REAL_TJ, [Baht/Yen]}	{REAL_PJ, $[\frac{\text{Peso}}{\text{Yen}}]$}
(x_3, x_4)TRADE	{DT_SGJP, IDT_SGJP}	{DT_THJP, IDT_THJP}	{DT_PPJP, IDT_PPJP}
Rank (r)	2	1	1
H_0	$H_o{:}\alpha_{r=2}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =45.35[0.00]**	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =49.119[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =46.630[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =5.446[0.24]	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =11.682[0.01]*	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =44.27[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =34.953[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =37.065[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =44.503[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =35.332[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =38.019[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =15.459[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =112.78[0.00**	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =18.065[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =51.07[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =112.54[0.00]**	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =23.107[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =43.79[0.00]**
Num of Obs	250	252	191
Sample	1977 (5) to 1998 (2)	1977 (3) to 1998 (2)	1982 (4) to 1998 (2)
Num of Lag	1	2	1
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.18: The Result of Weak Exogeniety of Trade and Financial Variables : Japan vs Asian-6 (full sample)

USA vs ASIAN-6 (full sample)			
	INDONESIA vs USA	MALAYSIA vs USA	KOREA vs USA
(x_1, x_2)FINANCE	{REAL_IU, [Rp/$US]}	{REAL_MU, [Ringgit/$US]}	{REAL_KU, [Won/$US]}
(x_3, x_4)TRADE	{DT_IDUS, IDT_IDUS}	{DT_MYUS, IDT_MYUS}	{DT_KRUS, IDT_KRUS}
Rank (r)	2	1	1
H_0	$H_o: \alpha_{r=2} = A\psi$	$H_o : \alpha_{r=1} = A\psi$	$H_o : \alpha_{r=1} = A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =29.174[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =[0.0000]**29.765	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =11.063[0.01]*
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =29.174[0.00]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =19.142[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =27.819[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =20.931[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =[0.4072]2.9004	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =21.687[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =16.128[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =1.398[0.70]	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =20.575[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =27.277[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =24.951[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =18.777[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =20.996[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =31.363[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =19.851[0.00]**
Num of Obs	213	219	211
Sample	1980(6) to 1998(2)	1980(1) to 1998(2)	1980 (8) to 1998 (2)
Num of Lag	5	2	5
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.19: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian-6 (full sample)

USA vs ASIAN-6 (full sample)			
	SINGAPORE vs USA	THAILAND vs USA	PHILIPPINES vs USA
(x_1, x_2)FINANCE	{REAL_SU, [$SG/$US]}	{REAL_TU, [Ringgit/$US]}	{REAL_PU, [Peso/$US]}
(x_3, x_4)TRADE	{DT_SGUS, IDT_SGUS}	{DT_THUS, IDT_THUS}	{DT_PPUS, IDT_PPUS}
Rank (r)	$2H_o{:}\alpha_{r=2}=A\psi$	1	1
H_0		$H_o{:}\alpha_{r=1}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =111.20[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =31.092[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =33.937[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =1.0193[0.90]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ = 20.506[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =17.383[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ = 85.466[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =6.7818[0.07]	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =34.649[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =95.929[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =6.7341[0.08]	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =34.559[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =39.285[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =12.543[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =41.616[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =49.529[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =12.913[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =41.729[0.00]**
Num of Obs	208	219	195
Sample	1980 (11) to 1998 (2)	1980(1) to 1998(2)	1981 (12) to 1998 (2)
Num of Lag	1	2	2
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.20: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian6 (full sample)

JAPAN vs ASIAN-6 (pre-crisis sample)			
	INDONESIA vs JAPAN	MALAYSIA vs JAPAN	KOREA vs JAPAN
(x_1, x_2)FINANCE	{REAL_IJ, [Rp/Yen]}	{REAL_MJ, [Ringgit/Yen]}	{REAL_KJ, [Won/Yen]}
(x_3, x_4)TRADE	{DT_IDJP, IDT_IDJP}	{DT_MYJP, IDT_MYJP}	{DT_KRJP, IDT_KRJP}
Rank (r)	2	1	1
H_0	$H_o : \alpha_{r=2} = A\psi$	$H_o : \alpha_{r=1} = A\psi$	$H_o : \alpha_{r=1} = A\psi$
Hypothesis 1	$A=\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =18.696[0.00]**	$A=\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =44.213[0.00]**	$A=\begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =15.750[0.003]**
Hypothesis 2	$A=\begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =6.3042[0.17]	$A=\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =29.519[0.00]**	$A=\begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =10.264[0.0165]*
Hypothesis 3	$A=\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =14.763[0.00]**	$A=\begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =43.983[0.00]**	$A=\begin{bmatrix} 0 \\ 1 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =3.7830[0.28]
Hypothesis 4	$A=\begin{bmatrix} 0 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =9.963[0.04]*	$A=\begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =15.501[0.00]**	$A=\begin{bmatrix} 0 \\ 1 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =5.993[0.11]
Hypothesis 5	$A=\begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix}$, LR-test $\chi^2(4)$ =16.132[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =44.427[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix}$, LR-test $\chi^2(3)$ =9.261[0.02]*
Hypothesis 6	$A=\begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix}$, LR-test $\chi^2(4)$ =10.982[0.02]*	$A=\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =26.785[0.00]**	$A=\begin{bmatrix} 1 \\ 0 \\ 1 \\ 0 \end{bmatrix}$, LR-test $\chi^2(3)$ =7.054[0.07]
Num of Obs	111	222	259
Sample	1986 (10) to 1995 (12)	1977 (7) to 1995 (12)	1974 (6) to 1995 (12)
Num of Lag	5	2	5
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.21: The Result of Weak Exogeniety of Trade and Financial Variables:Japan vs Asian-6 (pre-crisis sample)

JAPAN vs ASIAN-6 (pre-crisis sample)			
	SINGAPORE vs JAPAN	THAILAND vs JAPAN	PHILIPPINES vs JAPAN
(x_1, x_2)FINANCE	{REAL_SJ, [$SG/Yen]}	{REAL_TJ, [Baht/Yen]}	{REAL_PJ, [Peso/Yen]}
(x_3, x_4)TRADE	{DT_SGJP, IDT_SGJP}	{DT_THJP, IDT_THJP}	{DT_PPJP, IDT_PPJP}
Rank (r)	2	1	1
H_0	$H_o{:}\alpha_{r=2}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =188.56[0.00]**	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =42.812[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =48.758[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =3.1834[0.52]	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =4.1418[0.38]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =14.108[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =36.779[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =27.853[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =50.981[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =36.271[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =25.298[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =5.5969[0.13]
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =156.86[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =19.673[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =30.975[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =156.19[0.00]**	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =18.261[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =[0.03]*8.594
Num of Obs	227	226	170
Sample	1977 (5) to 1995 (12)	1977 (3) to 1995 (12)	1982 (4) to 1995 (12)
Num of Lag	1	2	1
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.22: The Result of Weak Exogeniety of Trade and Financial Variables:Japan vs Asian-6 (pre-crisis sample)

USA vs ASIAN-6 (pre-crisis sample)			
	INDONESIA vs USA	MALAYSIA vs USA	KOREA vs USA
(x_1, x_2)FINANCE	{REAL_IU, [Rp/$US]}	{REAL_MU, [Ringgit/$US]}	{REAL_KU, [Won/$US]}
(x_3, x_4)TRADE	{DT_IDUS, IDT_IDUS}	{DT_MYUS, IDT_MYUS}	{DT_KRUS, IDT_KRUS}
Rank (r)	2	1	1
H_0	$H_o : \alpha_{r=2} = A\psi$	$H_o : \alpha_{r=1} = A\psi$	$H_o : \alpha_{r=1} = A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =32.592 [0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =44.592[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =12.469[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =4.5076[0.34]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =25.730[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =19.777[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =14.003[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =1.4454[0.69]	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =18.245[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =17.263[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =6.935[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =17.234[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =20.360[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =28.874[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =16.763[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =23.017[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =39.135[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =17.507[0.00]**
Num of Obs	187	190	187
Sample	1980 (6) to 1995 (12)	1980 (3) to 1995 (12)	1980 (8) to 1995 (12)
Num of Lag	5	2	5
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.23: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian-6 (pre-crisis sample)

USA vs ASIAN-6 (pre-crisis sample)			
	SINGAPORE vs USA	THAILAND vs USA	PHILIPPINES vs USA
(x_1, x_2)FINANCE	{REAL_SU, [$SG/$US]}	{REAL_TU, [Ringgit/$US]}	{REAL_PU, [Peso/$US]}
(x_3, x_4)TRADE	{DT_SGUS, IDT_SGUS}	{DT_THUS, IDT_THUS}	{DT_PPUS, IDT_PPUS}
Rank (r)	2	1	1
H_0	$H_o{:}\alpha_{r=2}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$	$H_o{:}\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =114.41[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =26.874[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =26.874[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =5.086[0.27]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =24.196[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =24.196[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =53.432[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =14.104[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =14.104[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =49.299[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =16.241[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =16.241[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =85.003[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =28.900[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =28.900[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =83.044[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =28.897[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =28.897[0.00]**
Num of Obs	187	169	169
Sample	1980 (11) to 1995 (12)	1981 (12) to 1995 (12)	1981 (12) to 1995(2)
Num of Lag	1	2	2
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.24: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian-6 (pre-crisis sample)

JAPAN vs ASIAN-6 (crisis sample)			
	INDONESIA vs JAPAN	MALAYSIA vs JAPAN	KOREA vs JAPAN
(x_1, x_2)FINANCE	{REAL_IJ, [Rp/Yen]}	{REAL_MJ, [Ringgit/Yen]}	{REAL_KJ, [Won/Yen]}
(x_3, x_4)TRADE	{DT_IDJP, IDT_IDJP}	{DT_MYJP, IDT_MYJP}	{DT_KRJP, IDT_KRJP}
Rank (r)	2	1	1
H_0	$H_o : \alpha_{r=2}=A\psi$	$H_o : \alpha_{r=1}=A\psi$	$H_o : \alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =25.55[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =22.69[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =20.90[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =11.86[0.01]*	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =25.82[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =16.78[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =15.90[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =8.163[0.04]*	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =14.79[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =9.397[0.05]	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =8.410[0.03]*	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =15.41[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =24.07[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =24.49[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =6.64[0.08]
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =28.89[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =24.09[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =5.74[0.12]
Num of Obs	25	25	25
Sample	1996 (1) to 1998 (2)	1996 (1) to 1998 (2)	1996 (1) to 1998 (2)
Num of Lag	1	1	1
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.25: The Result of Weak Exogeniety of Trade and Financial Variables: Japan vs Asian-6 (crisis sample)

JAPAN vs ASIAN-6(crisis sample)			
	SINGAPORE vs JAPAN	THAILAND vs JAPAN	PHILIPPINES vs JAPAN
(x_1, x_2)FINANCE	{REAL_SJ, [$SG/Yen]}	{REAL_TJ, [Baht/Yen]}	{REAL_PJ, [Peso/Yen]}
(x_3, x_4)TRADE	{DT_SGJP, IDT_SGJP}	{DT_THJP, IDT_THJP}	{DT_PPJP, IDT_PPJP}
Rank (r)	2	1	1
H_0	$H_o:\alpha_{r=2}=A\psi$	$H_o:\alpha_{r=1}=A\psi$	$H_o:\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =28.67[0.00]**	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =39.02[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =14.41[0.00]**
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =7.162[0.12]	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =20.69[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =21.68[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =12.63[0.01]*	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =45.49[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =14.14[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =14.92[0.00]**	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =49.69[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =18.79[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =24.47[0.00]**	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(3)$ =4.545[0.33]	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =17.82[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =20.66[0.00]**	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(3)$ =8.296[0.08]	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =24.18[0.00]**
Num of Obs	25	25	25
Sample	1996 (1) to 1998 (2)	1996 (1) to 1998 (2)	1996 (1) to 1998 (2)
Num of Lag	1	1	1
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.26: The Result of Weak Exogeniety of Trade and Financial Variables: Japan vs Asian-6 (crisis sample)

USA vs ASIAN-6 (crisis sample)			
	INDONESIA vs USA	MALAYSIA vs USA	KOREA vs KOREA
(x_1, x_2)FINANCE	$\{$REAL_IU, [Rp/$US]$\}$	$\{$REAL_MU, [Ringgit/$US]$\}$	$\{$REAL_KU, [Won/$US]$\}$
(x_3, x_4)TRADE	$\{$DT_IDUS, IDT_IDUS$\}$	$\{$DT_MYUS, IDT_MYUS$\}$	$\{$DT_KRUS, IDT_KRUS$\}$
Rank (r)	2	1	1
H_0	$H_o: \alpha_{r=2} = A\psi$	$H_o : \alpha_{r=1} = A\psi$	$H_o : \alpha_{r=1} = A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =21.145[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =7.012[0.07]	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =7.399[0.06]
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =7.509[0.11]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =20.839[0.00]**	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =13.231[0.00]**
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =17.165[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =9.525[0.02]*	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =10.296[0.01]*
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =22.059[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =9.152[0.02]*	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =11.101[0.01]*
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =9.539[0.04]*	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =13.242[0.00]**	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =37.916[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =13.785[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =17.821[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =38.486[0.00]**
Num of Obs	25	25	25
Sample	1996 (2) to 1998 (2)	1996 (2) to 1998 (2)	1996 (2) to 1998 (2)
Num of Lag	1	1	1
**,* denotes rejection of the null hypothesis of weak exogeniety at 1% and 5% level of significance			

Table 4.27: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian-6 (cisis-sample)

USA vs ASIAN-6(crisis sample)			
	SINGAPORE vs USA	THAILAND vs USA	PHILIPPINES vs USA
(x_1, x_2)FINANCE	{REAL_SU, [\$SG/\$US]}	{REAL_TU, [Ringgit/\$US]}	{REAL_PU, [Peso/\$US]}
(x_3, x_4)TRADE	{DT_SGUS, IDT_SGUS}	{DT_THUS, IDT_THUS}	{DT_PPUS, IDT_PPUS}
Rank (r)	2	1	1
H_0	H_o:$\alpha_{r=2}=A\psi$	H_o:$\alpha_{r=1}=A\psi$	H_o:$\alpha_{r=1}=A\psi$
Hypothesis 1	$A=\begin{bmatrix}0&0\\0&0\\1&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =21.145[0.00]**	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =7.358[0.06]	$A=\begin{bmatrix}0\\0\\1\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =2.4184[0.49]
Hypothesis 2	$A=\begin{bmatrix}1&0\\0&1\\0&0\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =7.509[0.11]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =4.1975[0.24]	$A=\begin{bmatrix}1\\1\\0\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =10.481[0.01]*
Hypothesis 3	$A=\begin{bmatrix}0&0\\1&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =17.165[0.00]**	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =8.291[0.04]*	$A=\begin{bmatrix}0\\1\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =16.366[0.00]**
Hypothesis 4	$A=\begin{bmatrix}0&0\\1&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =22.059[0.00]**	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =8.2914[0.04]*	$A=\begin{bmatrix}0\\1\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =16.215[0.00]**
Hypothesis 5	$A=\begin{bmatrix}1&0\\0&0\\0&0\\0&1\end{bmatrix}$, LR-test $\chi^2(4)$ =9.539[0.04]*	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =4.9492[0.17]	$A=\begin{bmatrix}1\\0\\0\\1\end{bmatrix}$, LR-test $\chi^2(3)$ =12.936[0.00]**
Hypothesis 6	$A=\begin{bmatrix}1&0\\0&0\\0&1\\0&0\end{bmatrix}$, LR-test $\chi^2(4)$ =13.785[0.00]**	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =5.2467[0.15]	$A=\begin{bmatrix}1\\0\\1\\0\end{bmatrix}$, LR-test $\chi^2(3)$ =12.890[0.09]**
Num of Obs	25	25	25
Sample	1996(2) to 1998(2)	1996(2) to 1998(2)	1996(2) to 1998(2)
Num of Lag	1	1	1
**,* denotes rejection of the null hypothesis of weak exogeneity at 1% and 5% level of significance			

Table 4.28: The Test Results of the Weak Exogeniety of Trade and Financial Variables:USA vs Asian-6 (crisis sample)

Country	k	d[max]	Granger Causality		Causality Direction
			First Hypothesis	Second Hypothesis	
Indonesia -Japan	2	1	$\chi^2(3)$=9.091[0.02]*	$\chi^2(3)$=0.938[0.81]	T $\longrightarrow$ F
Singapore-Japan	1	1	$\chi^2(3)$=6.930[0.07]	$\chi^2(3)$=9.700[0.02]*	F $\longrightarrow$ T
Thailand-Japan	1	1	$\chi^2(3)$=6.411[0.09]	$\chi^2(3)$=4.070[0.25]	unknown
Malaysia-Japan	2	1	$\chi^2(3)$=10.122[0.01]*	$\chi^2(3)$=8.139[0.04]*	F $\leftrightarrows$ T
Philippines-Japan	2	1	$\chi^2(3)$=2.630[0.45]	$\chi^2(3)$=8.706[0.03]*	F $\longrightarrow$ T
Korea-Japan	2	1	$\chi^2(3)$=4.302[0.23]	$\chi^2(3)$=2.300[0.51]	unkown
Indonesia-USA	2	1	$\chi^2(3)$=5.220[0.15]	$\chi^2(3)$=3.036[0.38]	unknown
Singapore-USA	3	1	$\chi^2(8)$=14.600[0.06]	$\chi^2(8)$=3.500[0.89]	unkown
Thailand-USA	1	1	$\chi^2(2)$=2.619[0.26]	$\chi^2(2)$=0.828[0.66]	unknown
Malaysia-USA	4	1	$\chi^2(12)$=25.022[0.01]*	$\chi^2(12)$=25.369[0.01]*	F $\leftrightarrows$ T
Philippines-USA	2	1	$\chi^2(3)$=2.981[0.39]	$\chi^2(3)$=2.984[0.39]	unknown
Korea-USA	2	1	$\chi^2(3)$=0.184[0.98]	$\chi^2(3)$=11.654[0.00]**	F $\longrightarrow$ T

* denotes rejection of the null hypothesis of non causality 5% level of significance

Table 4.29: The Test Results of Granger non-causality of Trade and Financial Variables

Country	Country's Partner	Granger Causality: Firts Hypothesis	Second Hypothesis	Causality Direction
Indonesia	Singapore	...	...	...
	Thailand	χ^2(4)=5.381[0.24]	χ^2(4)=3.346[0.50]	unknown
	Malaysia	χ^2(6)=16.391[0.01]*	χ^2(6)=3.083[0.54]	T $\longrightarrow$ F
	Philippines	χ^2(7)=9.245[0.23]	χ^2(7)=5.763[0.56]	unknown
	Korea	χ^2(7)=20.112[0.00]**	χ^2(7)=6.545[0.47]	T $\longrightarrow$ F
Thailand	Indonesia	χ^2(7)=7.449[0.38]	χ^2(7)=10.457[0.16]	unknown
	Singapore	χ^2(7)=19.346[0.00]**	χ^2(7)=21.760[0.00]**	F $\longleftrightarrow$ T
	Malaysia	χ^2(7)=10.636[0.15]	χ^2(7)=14.038[0.05]	unknown
	Phillipines	χ^2(7)=12.544[0.08]	χ^2(7)=6.379[0.49]	unknown
	Korea	χ^2(7)=22.109[0.00]**	χ^2(7)=12.900[0.07]	T $\longrightarrow$ F
Singapore	Indonesia	...	...	...
	Thailand	χ^2(7)=9.920[0.19]	χ^2(7)=12.084[0.09]	unkown
	Malaysia	χ^2(7)=15.750[0.02]*	χ^2(7)=10.608[0.15]	T $\longrightarrow$ F
	Phillipines	χ^2(7)=9.554[0.21]	χ^2(7)=15.228[0.03]*	F $\longrightarrow$ T
	Korea	χ^2(7)=29.215[0.00]**	χ^2(7)=7.879[0.34]	T $\longrightarrow$ F
Malaysia	Indonesia	χ^2(7)=11.174[0.13]	χ^2(7)=22.252[0.00]**	F $\longrightarrow$ T
	Thailand	χ^2(7)=9.3011[0.23]	χ^2(7)=12.991[0.07]	unknown
	Singapore	χ^2(7)=6.8554[0.44]	χ^2(7)=8.6302[0.28]	unknown
	Phillipines	χ^2(7)=7.3708[0.39]	χ^2(7)=8.9973[0.25]	unknown
	Korea	χ^2(7)=4.410[0.73]	χ^2(7)=14.785[0.03]*	F $\longrightarrow$ T
Philippines	Indonesia	χ^2(7)=21.421[0.00]**	χ^2(7)=33.033[0.00]**	F $\longleftrightarrow$ T
	Thailand	χ^2(7)=19.353[0.00]**	χ^2(7)=25.720[0.00]**	F $\longleftrightarrow$ T
	Singapore	χ^2(7)=12.573[0.08]	χ^2(7)=13.594[0.05]	unknown
	Malaysia	χ^2(7)=34.476[0.00]**	χ^2(7)=11.047[0.13]	T $\longrightarrow$ F
	Korea	χ^2(7)=23.956[0.00]**	χ^2(7)=15.930[0.02]*	F $\longleftrightarrow$ T
* denotes rejection of the null hypothesis of non causality 5% level of significance				

Table 4.30: Granger Causality Test Results between Finance and Trade

Country	Country's Partner	Variable's acronym		Granger Causality		Causality Direction
		Export	Exc.Rate	ER $\nrightarrow$ EX	ER $\nrightarrow$ EX	
Indonesia	Singapore	X2S	$\frac{Rp}{\$US}$	$\chi^2(1)=0.2914[0.58]$	$\chi^2(1)=2.261[0.13]$	unknown
	Thailand	X2T	$\frac{Rp}{\$US}$	$\chi^2(1)=0.372[0.54]$	$\chi^2(1)=0.644[0.42]$	unknown
	Malaysia	X2M	$\frac{Rp}{\$US}$	$\chi^2(1)=0.372[0.54]$	$\chi^2(1)=0.6449[0.42]$	unknown
	Philippines	X2P	$\frac{Rp}{\$US}$	$\chi^2(1)=0.295[0.58]$	$\chi^2(1)=0.233[0.62]$	unknown
	Korea	X2K	$\frac{Rp}{\$US}$	$\chi^2(1)=0.039[0.84]$	$\chi^2(1)=1.272[0.25]$	unknown
Thailand	Indonesia	X2I	$\frac{Baht}{\$US}$	$\chi^2(1)=0.636[0.42]$	$\chi^2(1)=0.028[0.86]$	unknown
	Singapore	X2S	$\frac{Baht}{\$US}$	$\chi^2(1)=0.606[0.43]$	$\chi^2(1)=0.057[0.81]$	unknown
	Malaysia	X2M	$\frac{Baht}{\$US}$	$\chi^2(1)=0.0226[0.88]$	$\chi^2(1)=0.0005[0.98]$	unknown
	Phillipines	X2P	$\frac{Baht}{\$US}$	$\chi^2(1)=0.194[0.65]$	$\chi^2(1)=0.209[0.64]$	unknown
	Korea	X2K	$\frac{Baht}{\$US}$	$\chi^2(1)=0.0190[0.89]$	$\chi^2(1)=4.22[0.03]$*	ER $\longrightarrow$ EX
Singapore	Indonesia	X2I	$\frac{\$SG}{\$US}$	$\chi^2(1)=4.29[0.03]$*	$\chi^2(1)=0.310[0.57]$	ER $\longleftarrow$ EX
	Thailand	X2T	$\frac{\$SG}{\$US}$	$\chi^2(1)=0.005[0.94]$	$\chi^2(1)=1.406[0.23]$	unknown
	Malaysia	X2M	$\frac{\$SG}{\$US}$	$\chi^2(1)=0.261[0.60]$	$\chi^2(1)=1.084[0.29]$	unknown
	Phillipines	X2P	$\frac{\$SG}{\$US}$	$\chi^2(1)=5.674[0.01]$*	$\chi^2(1)=9.380[0.00]$**	ER $\longrightarrow$ EX
	Korea	X2K	$\frac{\$SG}{\$US}$	$\chi^2(1)=0.3854[0.53]$	$\chi^2(1)=0.4321[0.51]$	unknown
Malaysia	Indonesia	X2I	$\frac{RG}{\$US}$	$\chi^2(1)=2.528[0.11]$	$\chi^2(1)=5.521[0.01]$*	ER $\longrightarrow$ EX
	Thailand	X2T	$\frac{RG}{\$US}$	$\chi^2(1)=1.144[0.28]$	$\chi^2(1)=1.472[0.22]$	unknown
	Singapore	X2S	$\frac{RG}{\$US}$	$\chi^2(1)=1.612[0.20]$	$\chi^2(1)=0.805[0.36]$	unknown
	Phillipines	X2P	$\frac{RG}{\$US}$	$\chi^2(1)=0.0331[0.85]$	$\chi^2(1)=1.188[0.27]$	unknown
	Korea	X2K	$\frac{RG}{\$US}$	$\chi^2(1)=6.072[0.01]$*	$\chi^2(1)=0.870[0.35]$	ER $\longrightarrow$ EX
Philippines	Indonesia	X2I	$\frac{Peso}{\$US}$	$\chi^2(1)=0.7666[0.38]$	$\chi^2(1)=2.279[0.13]$	unknown
	Thailand	X2T	$\frac{Peso}{\$US}$	$\chi^2(1)=0.0794[0.77]$	$\chi^2(1)=12.274[0.00]$**	ER $\longrightarrow$ EX
	Singapore	X2S	$\frac{Peso}{\$US}$	$\chi^2(1)=3.102[0.07]$	$\chi^2(1)=3.038[0.08]$	unknown
	Malaysia	X2M	$\frac{Peso}{\$US}$	$\chi^2=16.800[.00]$**	$\chi^2=.19194[.66]$	ER $\longrightarrow$ EX
	Korea	X2K	$\frac{Peso}{\$US}$	$\chi^2(1)=0.150[0.69]$	$\chi^2(1)=0.182[0.66]$	unknown
* denotes rejection of the null hypothesis of no-causality at 5% level of significance						

Table 4.31: Granger Causality Test Results between Bilateral Exports and Exchange Rate

Chapter 5

Conclusion

The three main chapters within this thesis form an empirical investigation on contagion and its transmission channels in the Asian crises 1997-98. Since the last decade, the analysis of such crises has attracted a wide attention among academics, analysts, and policy makers. In the economic literature, contagion refers to the presence of a crisis contingent transmission mechanism that would not exist in tranquil periods. However, investigating empirically the presence of contagion is difficult: first, there is no single approach as to how we should conduct an empirical test for the presence of contagion. Second, every suggested approach has limitations.

In a popular and simple approach, the presence of contagion (i.e. a crisis-contingent transmission mechanism) in stock markets is detected by comparing cross country conditional correlations calculated from different sub-samples. A significant increase in correlation during crisis periods is interpreted as evidence of the presence of contagion. Many researchers who investigated the presence of contagion using this approach reported that contagion was present.

Recently, many studies have shown that the conditional correlation test suffers from a serious methodological deficiency, particularly in a market exhibiting heteroskedasticity. With heteroskedasticity, there will be a bias toward a higher correlation during a period of turmoil. A small number of studies provide an alternative solution to correct for this bias. A first approach is to construct a heteroskedasticity robust parameter stability test. In an application to the data on stock market returns for emerging markets including East Asian countries, the results of the test show very little evidence of the presence of contagion in episodes of financial crisis. However, it has been argued that where a sample has been arbitrarily split into crisis/non crisis period, the heteroskedasticity test appears to have a low power of rejection. Furthermore, the method requires identification assumptions that can sometimes be quite strong.

A second alternative solution is to use the full sample but to split the sample into its crisis and non-crisis windows endogenously. Contrary to the heteroskedasticity test, the application of these tests for the presence of contagion in stock markets using Asian data shows that contagion was present. This solution offers a number of clear advantages over the previous one.

We argued in Chapter 2 that since the method uses a structural model of interdependence which consists of two markets, it may not fully capture all the characteristics of the crisis. The test used in the Chapter 2, therefore, uses the full sample but does not require the sample to be split into crisis and non-crisis periods. The model also allows us to include all markets under investigation which is suitable in the situation where financial crises spread to other countries at almost the same time.

The adopted model is extended by using daily nominal interest rate and stock market returns data. The first step in implementing this procedure is to estimate a VAR model representation of the return process in all markets under examination. Then, outliers are identified and the residuals are whitened by introducing dummies into the model. Based on a-priori economic knowledge, each outlier is earmarked as originating in one particular country or as a common shock. If the dummies that are associated with idiosyncratic shocks are also significant in markets other than the one they originated in, this is interpreted as the presence of contagion.

Using data on stock market prices and daily nominal interest rates from Indonesia, Malaysia, Thailand, Singapore, Korea, and Philippines, the results presented in Chapter 2 indicate that some empirical evidence to support the proposition that contagion was present in both interest rate and stock market data.

In the adopted model used in Chapter 2, the transmission mechanism of international shocks is measured by a set of dummy variables. Since such measurement has been the subject of criticism, we used this as a point of departure to extend the test.

In the Chapter 3 in the thesis, we therefore, develop a new approach to test contagion where the transmission channel is measured by an error correction. The approach is based on the properties of a cointegrated VAR. As shown analitically in this Chapter that in a cointegrated system, the presence of cointegration determines the economy's response to transitory shocks.

A two stage approach was followed where in the first stage, all possible pairs of the series are examined in order to exploit the possibility of structural linkages between markets. The presence or absence of cointegration obtained from this stage, therefore, is an indication of whether there is a structural linkage between markets. The test is a conventional test for cointegration. The results obtained from the first step show that there is mixed evidence of pair-wise cointegration between markets over most of the period.

In the second stage of the analysis, in each pair of countries (markets) found to be cointegrated from this first stage, two indicators, which are measures of the transmission mechanism (a recursive maximum eigenvalue or Λ) and an impulse response to transitory shocks (α_1/α_2) are estimated. Under this framework, the recursive maximum eigenvalue is a measure of market comovement that can change over time due to either changes in the volatility of underlying shocks (Σ^{-1}) or to changes in (α_1/α_2), which may be interpreted as changes in the transmission mechanism, showing that contagion was present.

Using data from stock market, daily nominal interest rate, deposit rate and money markets interest rates, the results presented in Chapter 3 show considerable instability in the period shortly before and during the Asian crisis. This is interpreted as evidence of the presence of contagion. Overall, the results presented in Chapters 2 and 3 suggest that contagion was present during the Asian crisis 1997-98.

While the present contagion is clearly found in these studies, it is still unclear what underlying factors drives its presence. Chapter 4 aims at addressing this issue particularly exploring whether trade or finance variables are the main transmission channels that are responsible for spreading a shock across countries.

Theoretically, a shock occurring in one country can be spread to another country mainly through two mechanisms : *a competitive devaluation* or *financial links*. However, the validity of the competitive devaluation view has recently been questioned since bilateral trade linkages between Indonesia, Malaysia, Thailand, Korea, and the Philippines are not very striking.

We argued in the Chapter 4 that a group of crisis countries in the South East Asia (Indonesia, Malaysia, Thailand, Korea, and the Philippines) have historical relationships in trading and/or financial markets with the USA and Japan. In this case, the validity of competitive devaluation theory, particularly the argument that one country's devaluation may have indirect effects on export sales from other countries that compete in the same market may still be valid. In terms of the channels through which shocks are transmitted internationally, it is very likely that both trade and finance channels are important in transmitting international disturbances. Chapter 4 therefore, set out to test the validity of this argument.

In the literature, there are a number of empirical studies examining the validity of the theory. These studies generally concentrate on using cross-sectional data and defining contagion in terms of probability. In order to identify the variables responsible for the international transmission of the shocks, the first step is to construct indicators measuring the trade links (i.e. direct bilateral-trade trade and or competition in the third market, cross-market hedging), and financial links (i.e an indicator that measures the role of common creditor). The trade and financial indicators are treated as independent variables. The second step is to use a probit/panel probit regression where the dependent variable takes on two values (1 and 0). This value reflects the probability that a country will suffer crisis given that another country (ground zero) experiences a crisis. Under this approach, the relative importance of the transmission channels of international shocks can be seen by looking at the significance of the coefficients of financial and trade indicators in the probit/panel probit regression. In general, the results of these studies suggest that there is mixed evidence. However, in the situation where both trade and financial variables are highly correlated, the relative importance of the the role of the transmission channels is difficult to distinguish.

Chapter 4 concentrates on investigating the international transmission of shocks between a group of countries in the East Asian region (Indonesia, Malaysia, Thailand, Korea, and the Philippines, and Singapore) and the USA and Japan.

The model outlined in Chapter 4 takes a different approach from the existing literature in detecting the relative importance of transmission channels and is based on time series data. In this case four variables, namely, direct bilateral trade, indirect trade, interest rates and exchange rates are analysed within a cointegrated VAR framework. The first two variables are a measure of trade links, while others measure financial links. The empirical analysis is conducted using the Johansen method of cointegration. The relative importance of the transmission channels is detected by looking at which of these variables responds to the disequilibrium (weak exogeneity condition in the cointegrated system). The rejection of the null hypothesis that trade variables are weakly exogenous in the cointegrated system suggests that trade variables are important in channelling shocks.

The results presented in Chapter 4 indicate that there is mixed evidence of which transmission channel is more dominant in spreading international shocks. While the dominance of financial variables in influencing trade variables in the Asian market is clearly apparent in case of Singapore-Japan, Phillipines-Japan and Korea-US, causality in two directions is also found in the pairs of observations between the USA and Thailand and the USA and Malaysia, and the direction of causality in a number of cases remains unclear. The difficulty in detecting this direction of causality is very likely due to the limited amount of bilateral trade among countries within the Asian country and/or due to the fact that the institutional structure in Asian emerging markets is still limited in term of market size and liquidity.

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